MONTGOMERY COUNTY PUBLIC SCHOOLS
Department of Planning and Construction
45 W. Gude Drive, Suite 4000
ROCKVILLE, MARYLAND 20850

REQUEST FOR PROPOSALS
ARCHITECTURAL DESIGN SERVICES
DAMASCUS HIGH SCHOOL MAJOR CAPITAL PROJECT

SCOPE OF WORK:	Architectural Design Services
PROJECT DESCRIPTION:	Replacement of Damascus High School
REQUEST FOR PROPOSAL ISSUED:	June 12, 2026
PRE-PROPOSAL SITE WALK:	June 18, 2026, at 1:00 PM (Not Mandatory)
RFI DUE DATE:	June 24, 2026, at 2:00 PM
PROPOSAL DUE DATE / TIME:	July 8, 2026, at 2:00 PM
BOE APPROVAL / NTP:	August 20, 2026

Montgomery County Public Schools (MCPS) is seeking proposals from architectural firms to provide professional design and construction administration services for the Damascus High School Major Capital Project, located at 25921 Ridge Road, Damascus, MD.

The project involves designing a new high school building with a capacity of 2,250 students (2,700 student core). The existing school building will remain operational during construction and will be **demolished after the new facility is completed on the same site**. The selected Architectural firm shall provide comprehensive planning, design, permitting, bidding, construction administration, and close-out services.

The Proposal submissions package must include one (1) hardcopy of the proposal and one (1) electronic copy of the proposal on a USB drive in .pdf format, and a fixed design fee proposal must be included as part of the submission in a separate sealed envelope, shall be hand delivered to Montgomery County Public Schools, 45 W. Gude Drive, Main Lobby Bid Dropbox, Rockville, Maryland 20850, attention to Patrick Schmidt (Patrick_M_Schmidt@mcpsmd.org) no later than **July 8, 2026, 2:00 pm**.

All Requests for Information (RFI) shall be submitted to Patrick_M_Schmidt@mcpsmd.org, with a copy to Construction@mcpsmd.org by **June 24, 2026, 2:00 pm.** Contact shall be by email only**.** Responses to RFI questions and clarifications will be issued through a formal Addendum.

MCPS reserves the sole right, without incurring any liability, to change any aspect of the proposed procurement described above, including the right not to proceed with the procurement and/or the right to proceed in a different manner or on a different timeline than as described above.

MCPS reserves the right to waive any informality in any or all proposals, and to reject or accept any proposal or portion thereof. It is the intent of MCPS to identify the firm that can best meet the demands of the project while providing the best value and ensuring success. The dates listed in the RFP are target dates established by MCPS. MCPS reserves the right to modify the dates as it deems necessary.

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Attachment H – AIA Document B101 Standard Form of Agreement Between Owner and Architect with MCPS Modifications (DRAFT)

PART 1 - OBJECTIVES

1. The objective of this Request for Proposals (RFP) is for the Board of Education of Montgomery County, herein referred to as Montgomery County Public Schools (MCPS), to independently evaluate, qualify, and select an architectural firm to provide design and construction administration for the replacement of Damascus High School located at 25921 Ridge Road, Damascus, Maryland. All planned construction is contingent on the Montgomery County Council's approval of funding for this project.

2. Consideration will only be given to firms with the relevant quantitative experience, requisite skills, and successful history of similar commercial and industrial projects necessary to provide the required professional services. Companies are invited to submit their technical proposals in accordance with the requirements set forth herein.

3. Minority business enterprises (MBE) are encouraged to respond to this notice. MCPS is committed to the success of its minority business program. Architectural firms responding to this notice agree that they will make a good-faith effort to have not less than ten percent of the value of work under this RFP performed by minority or women-owned business firms, licensed in the respective discipline for the work performed, unless a formal waiver is requested and is granted.

4. It is imperative that the instructions in this technical proposal be followed. Incomplete submissions will be rejected.

5. Selection of an architectural firm to provide professional design services is not final until approved by the Montgomery County Board of Education.

6. The selected architectural firm will be expected to provide all work necessary in the pursuit of all regulatory approvals required to obtain proper building permits for the construction of the project.

7. Unsuccessful Offerors will be notified and provided the opportunity to request a debriefing. Requests for debriefing shall be submitted in writing to Montgomery County Public Schools, Department of Planning and Construction, 45 W. Gude Drive, Suite 4000, Rockville, MD 20850. A debriefing will be scheduled at the earliest practicable time following receipt of the written request. The debriefing shall be limited to a discussion of the unsuccessful Offeror’s technical proposal and will identify areas in which the proposal was determined to be weak or deficient.

PART 2 – SUBMISSION OF QUALIFICATIONS

1. Offerors shall submit qualification information in accordance with the requirements identified herein. The MCPS Procurement Officer or their representative may, at their discretion, contact one or more Offerors during the evaluation process to clarify any entries submitted and may request additional information. Such additional information must be submitted to MCPS no later than five (5) days after the request.

2. The selection of an Offeror shall be based primarily on the information submitted as part of the Technical Proposal. MCPS accepts no responsibility for any expenses incurred in the proposal preparation requirements.

PART 3 - RIGHT TO WAIVE INFORMALITIES

The Board of Education reserves the right to waive any informalities or immaterial deviations in the Request for Proposals.

PART 4 - MISREPRESENTATION

If any Offeror knowingly makes a misrepresentation in submitting information to MCPS, or fails to provide all required information, such misrepresentation or omission will be sufficient grounds for rejection of its submission.

PART 5 – PROPOSAL WITHDRAWAL

A proposal may not be withdrawn after it is submitted to MCPS unless the offeror makes a written request to MCPS before the time set for receipt of proposals, or the offeror provides clear and convincing evidence that a mistake in the proposal has been made, and only then with the approval of the MCPS Procurement Office.

PART 6 – SCHEDULE OF EVENTS

The anticipated schedule of events related to this Request for Proposal is as follows:

Request for Proposal Issued:	June 12, 2026
Pre-Proposal Site Visit:	June 18, 2026, at 1:00 pm
RFI Due:	June 24, 2026 at 2:00 pm
RFI Responses:	July 2, 2026
Proposals Due:	July 8, 2026, at 2:00 pm
Notify Short Listed Firms:	July 20, 2026
Interviews:	August 5, 2026
BOE Approval / NTP:	August 20, 2026
Design Phase Dates:	
School Staff Meeting:	October 8, 2026, at 2:50 pm
Community Engagement Meeting #1:	October 8, 2026, at 6:00 pm
Community Engagement Meeting #2:	October 22, 2026, at 6:00 pm
Community Engagement Meeting #3	November 10, 2026 at 5:00 pm
Schematic Design (SD) Deliverable to MCPS:	November 17, 2026
Submit Schematic Design (SD) to BOE:	December 4, 2026
Present Schematic Design (SD) BOE:	January 14, 2027
Approval of Schematic Design (SD) by BOE:	January 28, 2027
Submit Schematic Design (SD) to IAC:	January 29, 2027
All Required Permits Shall be Obtained No Later Than:	May 31, 2028
Start Construction:	June 1, 2028
Substantial Completion of New School Building:	June 2, 2031
Complete Demolition of Existing School and Site Work:	July 2, 2032

(The dates listed above are target dates and subject to change at the discretion of MCPS.)

PART 7 – CONSTRUCTION BUDGET

The construction budget for the project is $255 million and is based on the prevailing wage scale for construction. The Architect/Engineers (A/E) shall adhere to and work within the construction budget and shall accomplish the design services required to permit the award of a contract and/ or agreement on a Guaranteed Maximum Price (GMP) using MCPS procedures for the construction of the facility designed at a price that does not exceed the construction budget as set forth. When the GMP received exceeds the estimated price, the Architect/Engineers shall perform such redesign and other services as are necessary to permit contract award within the funding limitation. These additional services shall be performed at no additional fee increase to MCPS.

PART 8 – SCOPE OF SERVICES

The work requested of the architectural and engineering (A/E) firm in executing this "Scope of Services" is to be performed under the direction of a licensed architect and professional engineer registered in the State of Maryland. The architecture firm shall provide a licensed professional architect on the project throughout all phases of the project. The scope of services will be set forth in the AIA Document B101 Standard Form of Agreement between Owner and Architect with MCPS modifications.

The A/E is to provide a design concept and documentation consistent with good architectural and engineering practices and in compliance with all applicable codes and standards. The A/E is fully responsible for the design, selection, and application of all materials, systems, components, processes, and methods documented in the final contract documents. The A/E will ensure that the final product is adequate for, but not in excess of, what is required to perform the intended function. It should be clearly understood that A/E design consultation extends through construction and beneficial building occupancy to final acceptance by the Board of Education.

The selected firm will be responsible for all phases of design, from schematic design to construction documents, cost estimates for each design phase, permitting, bid assistance, construction administration, on-site construction observation, and post-construction close-out, along with specified sustainability and regulatory requirements. Essential services include, but are not limited to, the following:

A. **Pre-Design:** Review the approved educational specifications and implement them into the design.
B. **Planning and Engineering –** The Project will require the services of licensed professionals knowledgeable of State of Maryland and Montgomery County regulations and requirements concerning environmental remediation, development review, permitting, public improvements and infrastructure, fees, etc. The architect will be responsible for preparing all required plans and securing all necessary approvals to obtain all permits associated with the project.
C. **Preliminary Plan Presentation:** Prepare a preliminary plan brochure that summarizes the results of the Schematic Design phase, energy analysis, site analysis, cost summary, schedule, etc., utilizing the MCPS standard format for presentation to the members of the Board of Education.
D. **Design Phases:** Provide Schematic Design (SD), Design Development (DD), and Construction Documents (CD). Collaborate with CMR throughout all phases of design, value engineering, bid assistance, and construction through project close-out. Submit design plans, specifications, and cost estimates to MCPS and MSDE – IAC at each design phase for approval before moving into the next design phase. The design shall meet the requirements set forth in the Educational Specifications.

E. **Permitting:** Prepare all required plans and secure all necessary approvals required to obtain all permits associated with the project. Coordinate with the Montgomery County Dept. of Permitting Services, Maryland-National Capital Park and Planning Commission (M-NCPPC) for Mandatory Referral and other regulatory agencies.
F. **Construction Administration:** Process submittals and change orders, site observations, RFI responses, approve application for payments, project close-out documents, and issuance of Substantial Completion Certificate.
G. **Design Schedule:** Develop and submit a Project Schedule in Gantt chart format with time/event relationship between each major activity and milestone, that includes the design phases, Mandatory Referral (MR), IAC submissions, AHJ approvals, permitting, etc., for the Owner's review and acceptance at the start of the Project.
H. **Cost Estimates**: Provide detailed cost estimates for each of the following design phases: Schematic Design, Design Development, and Construction Document.
I. **Community Engagement Meetings**: Conduct a minimum of four (4) community engagement meetings, including two (2) staff meetings, during the Schematic Design phase to receive feedback and gather inputs from the community, staff, and stakeholders on the proposed design options.
J. **Phased Demolition:** The new school must be constructed while the existing school remains operational. Once the new building is occupied, the scope includes the complete demolition of the existing school structure and final site work.
K. **Sustainability:** The design shall incorporate ground-source geothermal systems and be solar-ready to support the achievement of a net-zero energy building. The project shall also be designed to achieve Green Globes with a minimum of 2 globes, but striving for 3.
L. **Commissioning Services:** The architect/engineer shall collaborate with the Commissioning Services Agent hired by MCPS for performance and functional testing of the building systems and assemblies.
M. **MCPS Consultants**: The Architect/Engineer (A/E) design team shall coordinate and collaborate with MCPS-hired consultants to integrate the required building systems and components into the design, including, but not limited to, door hardware, intrusion detection systems, security cameras, card access readers, and data infrastructure.
N. **Geotechnical Investigation**: The architect shall retain the services of a Geotechnical Engineer to perform an investigation of the site soils and determine the required design criteria and foundation designs.
O. **Existing Conditions Survey**: The survey shall include the existing facility, structures, property boundary, topography survey, subsurface materials and conditions, and underground utilities type, locations, size, and material. Provide a final survey report to MCPS.
P. **Value Engineering**: In the effort to ensure the designs align with the project budget, the architect shall clearly indicate a series of design elements on the drawings that can be considered as add or deductive alternates for evaluating the cost impact of these items and how they can or cannot be accommodated by the project budget.
Q. **Constructability Reviews:** The Architect shall be fully responsible for the constructability of the proposed site features and structures. The Architect shall coordinate the preliminary design of all mechanical, electrical, and plumbing (MEP) work to avoid conflicts among the respective MEP systems and to confirm that they will all fit within the allotted space

PART 9 – TECHNICAL PROPOSAL SUBMISSION REQUIREMENTS

A. Each Offeror shall submit a technical proposal and a separate, sealed fee proposal, both fully responsive to the RFP. The fee proposal shall identify in detail all costs associated with the listing of services. Use the Offer's Fee Proposal Form in Attachment A.

B. Submitted proposals shall have the following formatting requirements:

1. Minimum Font Size: 11 point
2. Section Dividers: Include clearly labeled tabs or dividers corresponding to each section identified in Technical Proposal Submission – Part 1.
3. Maximum Page Limit: Technical proposals shall not exceed 75 pages. Cover pages, section tabs/dividers, and table of contents pages will not be counted toward the page limit.

C. Procurement Process—MCPS will appoint an "Evaluation Committee" to evaluate the proposals provided in response to the RFP. The Evaluation Committee will evaluate each Proposal based on the evaluation factors. Interviews will also be conducted and scored. Based on the interviews and presentations, the Evaluation Committee will select the Offeror it considers the best fit for the Project.

D. The Offeror's experience must include the completed design and construction of educational projects including a minimum of 2 high schools and 1 elementary school projects in the past 10 years. If an Offeror does not meet the minimum projects completed requirements, its proposal may be deemed non-responsive and disqualified from further consideration.

E. The architectural firm and its consultants are to demonstrate that they have the skills, competence, responsibility, licensing, professional staff, financial capabilities, and other resources to satisfactorily perform the nature and magnitude of work necessary to complete the project.

F. The offeror is to submit a letter on company letterhead signed by an authorized person verifying compliance with the following mandatory requirements, with corresponding attachments in the proposal:

1. Firms must be licensed as required by the State of Maryland (Business Regulation Article, Annotated Code of Maryland) and shall submit proof of current business with their submission.

2. Firms must provide a "Good Standing Certificate" from the General Accounting Division, Comptroller of Maryland, and hold a current registration with the State Department of Assessments and Taxation.

G. Technical Proposal Submission – Part 1

The proposal must include the Offeror's understanding of the scope of work and a fully detailed, developed approach to be undertaken by the Offeror to accomplish the Scope of Work for the Project. The approach should clearly articulate the Offeror's prior experience with projects of similar size, type, and scope, and how the firm and key personnel will leverage and apply that experience on these projects. The written approach should document how the team will meet the Project's requirements by describing the processes, procedures, and strategies used. This approach shall outline the philosophy and methodology for:

1. Relevant Experience [30 PTS]

a. **Project Experience:** The project team demonstrates completion of multiple K-12 educational projects comparable in size, scope, and complexity. Each discipline

demonstrates deep expertise in similar project types and integration across disciplines. Describes design and coordination processes/procedures successfully applied to projects.

b. **Key Personnel Experience:** Identifies all required roles (i.e., Principal, Project Manager, Project Architect, Engineers of Record, etc.). Demonstrates minimum qualifications and relevant project experience of key personnel. Provides clear roles, responsibilities, and level of involvement of each key team member throughout the project. Ensures that all disciplines are led by experienced professionals capable of addressing complex design challenges.

c. **Capacity and Availability:** Demonstrate sufficient staffing capacity and resource availability to ensure project success. Demonstrate ability to take on the project given the current workload.

d. **Minority Business Enterprises:** Make a good-faith effort to have participation of not less than ten percent of the value of work performed by minority or women-owned business firms.

2. Project Approach [40 PTS]

a. **Project Management and Coordination Strategy:** Provide a clear project management structure, team organization, communication protocols, and coordination methods. Include the proposed approach to advancing schematic design through construction documents and project close-out.

b. **Approach to Project Delivery:** Provide detailed project plans, site utilization strategies, and QA/QC processes. Demonstrate coordination strategies and proactive problem-solving approaches to successfully design a highly functional facility.

c. **Communication and engagement stakeholders:** Provide outlines of a clear communication plan for MCPS, Construction Manager, and outside agencies. Describe the proposed methodology and prior experience in conducting community meetings. Include strategies for engaging school leadership, staff, and students.

d. **Schedule:** Provide a realistic and logical design schedule that sequences activities for the successful achievement of required milestones that includes all phases of design, community engagement, permitting activities, state design approvals, mandatory referral by Planning Commission, etc.

3. Design Ideas, Creativity, and Sustainability [30 PTS]:

a. **Design Ideas:** Demonstrate up to 2-3 viable conceptual plans that account for an occupied construction site, including phasing consideration to maintain necessary school operations, and maintain the proposed schedule and within budget. Concepts also consider all site constraints and opportunities, as well as the neighboring context.

b. **Creativity & Innovation:** Introduces innovative strategies that enhance the educational environment and flexible learning spaces.

c. **High-Performance Design and Sustainability Goals:** Concepts to consider high-performance design and achieve sustainability goals of net-zero energy.

H. Technical Proposal Submission – Part 2

1. The Offeror shall submit a Cost Proposal in a separate, sealed envelope clearly labeled: *"Cost Proposal – Technical Proposal Submission Part 2."* The Offeror shall use the Offer's Fee Proposal Form in Attachment A. The Cost Proposal shall include the following:

    a. A lump sum Fixed Design Fee.
    b. A detailed fee breakdown by each design phase.
    c. A detailed fee breakdown by discipline and all consultants on a separate sheet.
    d. Hourly billing rates for all proposed key personnel on a separate sheet.

    Failure to provide the required cost information in the prescribed format may result in disqualification.

2. Following the evaluation of Technical Proposal Submission – Part 1, the Owner will shortlist a minimum of three (3) highest-ranked Offerors for interviews. Only shortlisted Offerors will be invited to participate in the interview phase.

3. Shortlisted Offerors shall comply with the following interview requirements and format:

    a. A maximum of seven (7) presenters is permitted. The presentation team shall include key personnel of the design team, including, but not limited to, the Architect and representatives from the Civil, Structural, and MEP disciplines, as appropriate to support the presentation and respond to questions.

    b. Each Offeror will be allotted five (5) minutes for introduction and thirty (30) minutes for the oral presentation.

    c. A question and answer session of fifteen (15) minutes will follow the presentation.

PART 10 – EVALUATION CRITERIA AND AWARD

A. A committee of MCPS staff will independently review and evaluate each technical proposal based on a combination of qualifications and cost factors.

B. MCPS reserves the right to clarify information submitted in the Technical and Fee proposals. Firms shall furnish MCPS with all such information and data necessary to determine if the proposal is responsible and responsive to MCPS requirements as stated herein.

C. MCPS intends to award the contracts to the firm that, based upon the criteria for evaluation, is the most responsive and responsible and most qualified to accomplish the scope of services/work in the time frame required, within the budget, and is in the best interest of MCPS.

D. Incomplete or missing responses, or responses that do not follow the required format, will negatively affect the evaluation of a firm.

E. The Technical Proposal submission consists of the following sections and possible points per section:

Part 1: Technical Proposal Submission

● Relevant Experience	30 Points
● Project Approach	40 Points
● Design Ideas, Creativity, and Sustainability	30 Points

Part 2: Interview and Fee Proposal

Shortlisted Offerors will be evaluated during the interview based on the following criteria:

● Team organization and professional experience of the key project team members	20 points
● Demonstrate a plan for QA/QC strategies, community engagement and communication protocols, coordination methods for success in design services.	20 points
● Demonstrate a plan to employ innovative design solutions and Project approach resulting in the successful design of a highly functional facility	20 points
● Team participation and professionalism during presentation	20 points
Fee Proposal	20 points

F. Upon completion of the evaluation process, the Evaluation Committee shall recommend the selected Architectural/Engineering Team to the Superintendent, who shall submit the recommendation to the Board of Education (BOE) for approval.

Attachment A –

Offeror's Fee Proposal Form

Firm Name: _____

The Offeror's fixed Professional Design Services Fee Proposal is as follows:

1. Professional Design Services Fee is: $_____

    a. Provide a breakdown of the Design Services Fee by following tasks:

        Schematic Design $_____

        Design Development $_____

        Construction Documents $_____

        Bidding Negotiation $_____

        Construction Administration $_____

        Post Construction / Close-Out $_____

    b. Provide a breakdown of the Design Services Fee by each design discipline and consultants on a separate sheet.

    c. Provide Hourly billing rates for all proposed key personnel on a separate sheet.

2. The Offeror acknowledges and understands that the fixed Design Services Fee is firm and will not be subject to further adjustment once agreed upon in the Agreement.

Attachment B –

Educational Specifications and Space Summary

Damascus High School

PSC#L15F090

Site Specific Educational Specifications

Major Capital Project

Date: May 29, 2026

Montgomery County Public Schools
Rockville, Maryland 20850

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Space Summary

Damascus High School
Major Capital Project
Space Summary

When this project is complete, the following spaces are to be provided:
The capacity will be 2250 with a core of 2700. Updated 4/10/2026

FACILITY	#	SQ. FT./ FACILITY	TOTAL NET SQ. FT.	TOTAL DEPT. SQ. FT.
Standard Spaces				51,545
Standard Classroom	**47**	840	39,480	
Drama Classroom	**1**	1,200	1,200	
Developmental Reading	**1**	840	840	
Project/Collaboration Rooms	4	550	2,200	
Workrooms	3	225	675	
Large Staff Office	4	1,000	4,000	
Small Staff Office	2	500	1,000	
Composition Aid Work Area	1	200	200	
Textbook Storage	1	550	550	
Textbook Storage	2	450	900	
Textbook Storage	2	250	500	
Special Education				17,055
SCB Classrooms	**5**	840	4,200	
LFI Classrooms	**5**	840	4,200	
Personal Care Rooms	8	100	800	
Adaptive PE	1	950	950	
Life Skills Resource Room	1	800	800	
Equipment Parking	1	200	200	
Resource Room	**2**	840	1,680	
Speech & Language	2	250	500	
OT/PT Room	1	250	250	
Transition Office	2	125	250	
Conference Room	1	300	300	
Itinerant Staff Office	2	125	250	
Support Staff Office	1	125	125	
Accommodation Rooms	4	300	1,200	
Large Staff Office	1	1,100	1,100	
Textbook Storage	1	250	250	

FACILITY	#	SQ. FT./ FACILITY	TOTAL NET SQ. FT.	TOTAL DEPT. SQ. FT.
ELD				2,820
Classrooms	**3**	840	2,520	
Student Support Office	1	300	300	
Science				25,025
Science Laboratories (Island layout)	**6**	1,500	9,000	
Science Laboratories (Perimeter layout)	**8**	1,500	12,000	
Preparation Rooms	4	300	1,200	
Chemistry Preparation Room	3	300	900	
Chemical Storage	1	125	125	
Storage Rooms	5	300	1,500	
Textbook Storage	1	300	300	
Art Department				7,300
Ceramic/Sculpture Room	**1**	1,500	1,500	
Kiln/Glaze/Prep Room	1	300	300	
Ceramic Pug Room	1	100	100	
Studio Art Room	**1**	1,300	1,300	
Photography Room	**1**	1,300	1,300	
Dark Room	1	250	250	
Digital Art Room	**1**	950	950	
Department Office	1	300	300	
Storage Rooms	4	250	1,000	
Gallery Space	1	300	300	
Music Department				6,250
Instrumental Room	**1**	1,950	1,950	
Instrumental Storage Roon	1	450	450	
Percussion Storage Room	1	150	150	
Choral Room	**1**	1,800	1,800	
Office/Library	1	400	400	
Practice Room	4	75	300	
Robe/Uniform Storage	1	300	300	
Small Ensemble/Keyboard Laboratory	**1**	900	900	

FACILITY	#	SQ. FT./ FACILITY	TOTAL NET SQ. FT.	TOTAL DEPT. SQ. FT.
Music (Regional Arts Program)				2,640
Collaboration Studio/Practice Rooms	**1**	1,400	1,400	
Small Practice/Lesson Rooms	4	60	240	
Ensemble/Sectional Room	1	400	400	
Instrument Storage	1	250	250	
Percussion Storage Room	1	150	150	
Audio Tech Support-Mixing Studio	2	100	200	
Technology Education				3,900
Foundations of Technology Lab	**2**	1,500	3,000	
Student Storage Space	2	200	400	
Material Storage Space	2	140	280	
Office	1	220	220	
Programming				2,520
Computer Laboratory	**2**	1,100	2,200	
Office	1	220	220	
Storage	2	50	100	
Multipurpose Laboratory				1,550
Laboratory	**1**	1,350	1,350	
Storage	1	200	200	
Child Development				2,300
Laboratory	**1**	1,000	1,000	
Observation Room/Classroom	1	800	800	
Office/Storage	1	150	150	
Indoor Storage	1	200	200	
Outdoor Storage	1	150	150	

FACILITY	#	SQ. FT./ FACILITY	TOTAL NET SQ. FT.	TOTAL DEPT. SQ. FT.
Culinary Arts				4,415
Food Preparation Area	**1**	1600	1600	
Dry Food Storage Area	1	200	200	
Cooler/Freezer	2	150	300	
Restaurant	1	900	900	
Dressing Rooms	2	100	200	
Classroom/Computer Laboratory	**1**	900	900	
Washer/Dryer Area	1	75	75	
Toilet Room	1	60	60	
Non-food Storage Area	1	80	80	
Office	1	100	100	
Cybersecurity				4,950
Laboratory	**3**	1,500	4,500	
Lab Storage Room (2 may be combined accessible from 2 labs)	3	150	450	
Horticulture				2,800
Classroom	**1**	840	840	
Office	1	160	160	
Headhouse	1	400	400	
Headhouse Storage	1	300	300	
Equipment Maintenance Area	1	300	300	
Greenhouse	1	800	800	
Automotive Technology				6,950
Auto Technology Laboratory	**1**	5000	5,000	
Storage/Tool Room	4	200	800	
Teacher Planning Area	1	100	100	
Instructional Classroom	1	750	750	
Teacher Planning Area	1	100	100	
Locker/Changing Area	1	200	200	

FACILITY	#	SQ. FT./ FACILITY	TOTAL NET SQ. FT.	TOTAL DEPT. SQ. FT.
Physical Education				31,010
Main Gymnasium	**1**	10,000	10,000	
Ticket Booth	1	100	100	
Indoor Concessions Area	1	400	400	
Second Gymnasium	**1**	6,000	6,000	
Dance Studio	**1**	1,850	1,850	
Storage Closet	1	100	100	
Fitness/Cardio-Pulmonary (Weight) Room	**1**	2,400	2,400	
Storage Closet	1	100	100	
Wrestling Room	**1**	1,850	1,850	
Storage Closet	1	60	60	
Health Classroom	**2**	950	1,900	
Locker Rooms	2	1,650	3,300	
Inclusive Locker Room	1	250	250	
Shower/Drying Area	2	150	300	
Toilet Room	2	200	400	
Staff Office	2	600	1,200	
Common Planning Room	1	200	200	
Resource Teacher Office	1	100	100	
Outside Storage	1	500	500	
Athletics				8,080
Team Rooms	5	475	2,375	
Team Rooms	2	950	1,900	
Athletic Director Office	1	200	200	
Athletics Dept. Storage	1	125	125	
Coaches Office	2	125	250	
Coaches Closet	2	40	80	
Referee Office	1	125	125	
Football Equip./Uniform Drying	1	500	500	
Training Room	1	300	300	
Laundry Room	1	125	125	
General Storage	1	1,500	1,500	
Chair and Table Storage	1	400	400	
Storage	2	100	200	

FACILITY	#	SQ. FT./ FACILITY	TOTAL NET SQ. FT.	TOTAL DEPT. SQ. FT.
Library Media Center				9,355
Circulation Area	1	750	750	
Main Learning Environment	1	5,000	5,000	
Collaboration rooms	2	300	600	
Work and Production Area	1	900	900	
Television Studio	1	1,250	1,250	
Editing Rooms	3	75	225	
Editing Room	1	140	140	
Media Services Technician Office	1	140	140	
Storage (general)	1	200	200	
Storage (equipment)	1	150	150	
Auditorium				17,875
House Area	1	9,500	9,500	
Ticket booth	1	100	100	
Concession Booth	1	200	200	
Stage	1	4,000	4,000	
Orchestra Pit	1	500	500	
Orchestra Pit Storage	1	300	300	
Scenery Construction/storage	1	1,130	1,130	
Stage Office	2	100	200	
Make-up Room	1	200	200	
Dressing Rooms	3	250	750	
Costume Storage	1	225	225	
Projection Room	1	225	225	
Lighting Equipment Storage	1	100	100	
Costume Construction	1	225	225	
Musical Equipment/Piano Storage	1	70	70	
Riser Storage	1	150	150	
Student Activities Facilities				1,700
Student Council Suite	1	350	350	
School Store	1	150	150	
School Store Storage	1	150	150	
Journalism Staff Room	1	350	350	
Yearbook Staff Room	1	350	350	
Literary Magazine Staff Room	1	350	350	

Staff Offices				1,480
Signature Coordinator Office	1	140	140	
Staff Development Office	1	200	200	
School Psychologist Office	1	140	140	
Internship Coordinator	1	125	125	
IT Systems Specialist Office	1	125	125	
Staff Support Offices	6	125	750	
Administration Suite				5,775
General Office	1	1,200	1,200	
Principal's Office	1	250	250	
Assistant Principal's Office	4	140	560	
Administrative Support Office	1	140	140	
Principal's Secretary Office	1	125	125	
Business Administrator Office	1	140	140	
Financial Specialist Office	1	125	125	
Business Administrator Waiting Area	1	100	100	
Privacy Room	2	75	150	
Conference Room	1	300	300	
Large Team/Testing Room	1	1,300	1,300	
Storage	1	125	125	
Paper Storage	1	60	60	
Testing Room	1	175	175	
PTA Storage Room	1	100	100	
Attendance Office	1	125	125	
Office Workroom/Storage/Toilet Area	1	400	400	
Photocopy Room	1	200	200	
Fire Command Center	1	200	200	
Counseling Suite				3,775
Resource Counselor Office	1	175	175	
Counselors' Office	11	125	1,375	
School Psychologist Office	1	125	125	
Social Worker Office	1	125	125	
Waiting Room	1	300	300	
Conference Room	1	300	300	
Records Room	1	250	250	
Registrar's Office	1	125	125	
Workroom	1	200	200	
Career Information Center	1	800	800	

FACILITY	#	SQ. FT./ FACILITY	TOTAL NET SQ. FT.	TOTAL DEPT. SQ. FT.
Health Suite				860
Waiting Room	1	150	150	
Treatment/Medication Room	1	140	140	
Office/Health Assessment Room	1	100	100	
Health Assessment/Isolation Room	1	100	100	
Rest Areas	2	100	200	
Storage	1	50	50	
Toilet Rooms	2	60	120	
Security Suite				1,075
School Security Office	1	450	450	
Restorative Justice Room	1	500	500	
Remote Security Office	1	125	125	
Staff Facilities				1,600
Staff Room	2	500	1,000	
Staff Dining	1	600	600	
Food Services Facilities				15,845
Student Dining	1	12,000	12,000	
Serving Area	1	1,300	1,300	
Food Preparation	1	1,200	1,200	
Dry Food Storage	1	400	400	
Ref.& Frozen Food Storage.	1	420	420	
Office	1	100	100	
Locker/Toilet Room	1	100	100	
Loading & Receiving Platform	1	125	125	
Remote Food Service/Vending Machine/cyber café	1	200	200	

FACILITY	#	SQ. FT./ FACILITY	TOTAL NET SQ. FT.	TOTAL DEPT. SQ. FT.
Building Services Facilities				3,340
Building Services Office	1	140	140	
Locker/Shower Area	1	300	300	
Compactor/Trash Room	1	300	300	
General Storage and Receiving Area	1	1,000	1,000	
General Storage	5	250	1,250	
Building Services Outdoor Storage	1	350	350	
Mechanical Spaces				750
Telecom Equipment Closet (TEC)	1	400	400	
Telecommunication Closets	7	50	350	
Subtotal–School	**108**		**244,540**	**244,540**
Net to Gross (*1.5)				**367,110**
The following spaces should be designed and bid as an add-alternate:				
Bridge to Wellness				905
Administrative Area				
General Office/Reception Area	1	150	150	
Storage Closets	1	30	30	
Mental Health/Social Services/Youth Development Suite				
Therapy Room	1	175	175	
Care Manager Office	1	150	150	
Youth Development/PYD Office	1	150	150	
Conference Room	1	250	250	
Subtotal–Wellness Center			**905**	**905**
Total Project			**245,445**	**245,445**
Net to Gross (*1.5)				**368,468**

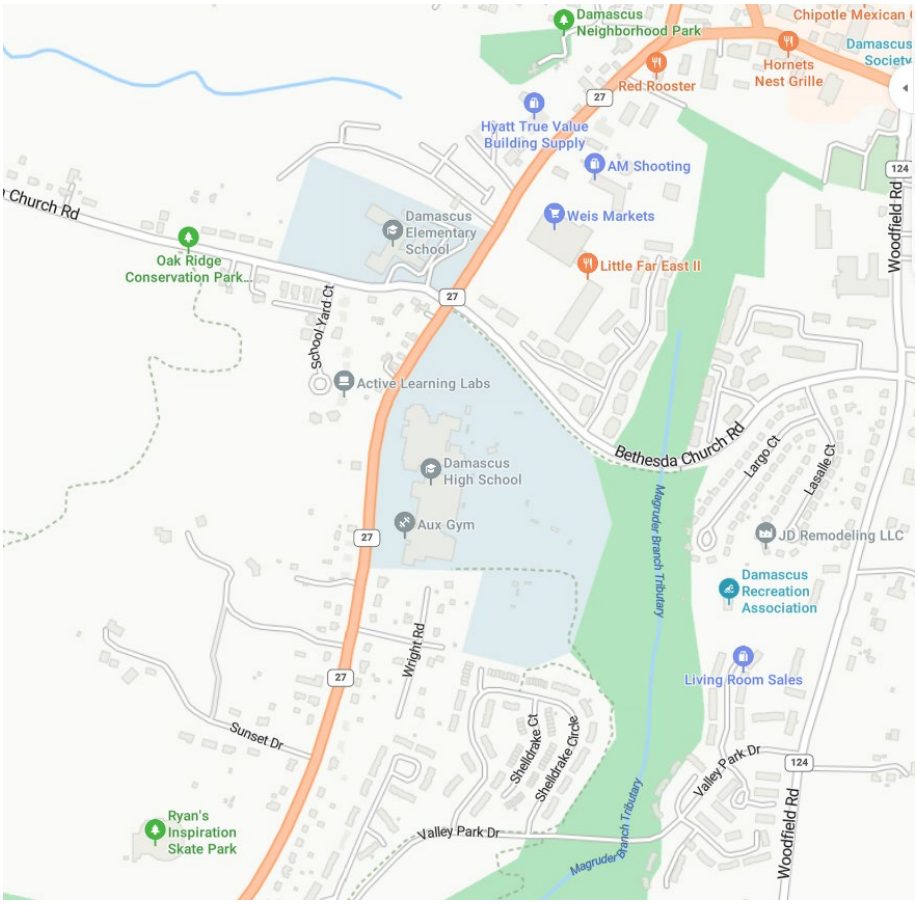
The following spaces should be designed as a master planned addition:				
Master Planned Addition				**19,445**
Standard Classroom	**18**	840	15,120	
Science Laboratories (Perimeter layout)	**2**	1,500	3,000	
Preparation Rooms	1	300	300	
Workrooms	1	225	225	
Small Staff Office	1	500	500	
Textbook Storage	1	250	250	
Telecommunication Closets	1	50	50	

Introduction

☐ In this document, facilities are described for the Damascus High School Major Capital Project educational program. The descriptions provide the architect with useful guidelines and staff representatives use them when reviewing drawings and specifications for the facility improvements.

☐ This school will be designed with a capacity of 2,250 students, a core capacity of 2,700 students, and is to have a 20-classroom addition master planned to bring it to its core capacity. The architect should show the location for the future classroom addition.

☐ The school is located at 25921 Ridge Road, Damascus, MD 20872. There are townhouses to the northeast, as well as a shopping center. Damascus Elementary School is due north, there are single family detached units to the west and south, and there is a forested park to the east. Access to the site is from Ridge Road as well as Bethesda Church Road.



☐ This project needs to meet the educational guidelines for a Grades 9–12 program. The project is scheduled to open in August 2031. The site work will be completed by August 2032.

☐ The educational specifications are divided into three sections.

- The first section, the space summary, lists the type of spaces and square footage required when the project is complete.

- The second section describes the general design, location, and specific requirements for each type of space in accordance with Montgomery County Public Schools (MCPS) guidelines.
- The third section identifies additional program requirements for the school.

☐ The architect will provide a space summary comparison between the programmed space requirements and the proposed work after each phase of the project including but not limited to the feasibility study, schematic design, design development, and final design phase.

☐ The architect should show the location for relocatable classrooms, should they be required in the future. These units should be sited in a location where it will not cause conflict with the constructability of a future addition. The necessary utility connections, i.e. electrical power, fire alarm, public address, and data should be provided near the future location of relocatable classrooms.

☐ The design of the school should promote a collaborative approach for both teaching and learning. Flexibility of design should be provided to accommodate changing educational programs and pedagogy.

☐ The project will be designed to meet current local and state sustainability guidelines.

General Planning Considerations

In the general planning of this building and development of the site, special consideration is to be given to the following comments and instructions.

Code and Guidelines

☐ The architect is expected to become thoroughly familiar with all national, state and local fire safety, life safety, and health code regulations and to follow applicable rules of the State Interagency Committee on School Construction.

☐ The building is to be accessible to the disabled within the meaning of the latest edition of the Americans with Disabilities Act and to conform to all the latest requirements of the *Americans with Disabilities Act Standards for Accessible Design* (ADA Standards). (The regulation can be found at https://www.ada.gov/2010ADAstandards_index.htm)

☐ In addition to the ADA Standards, the *Maryland Accessibility Code* (COMAR.09.12.53) also is required for public schools. (The regulation can be found at *https://www.dllr.state.md.us/labor/build/buildaccess.shtml*).

☐ Per COMAR 23.03.02: Regulation .29, all high school projects that include replacing or upgrading the electrical system should be designed and constructed so that a designated public shelter area can be fully powered in the event of an emergency.

☐ The architect should refer to the MCPS Facility Guideline Specifications when noted. The Document can be found at:
http://www.montgomeryschoolsmd.org/departments/construction/publications/guidelines.shtm
Note: this link is down temporarily, but will be refreshed upon completion of an update to the specifications.

☐ Special consideration should be given to energy conservation including total life-cycle costs. The current Department of General Service (DGS) requirements shall be applied as design criteria. Life-cycle cost accounting in accordance with DGS criteria is required. A statement on energy conservation must be a part of the preliminary plans submission. Additional details on energy conservation will be provided under separate cover.

☐ The architect should refer to MSDE 2006 *Classroom Acoustic Guidelines* to address the acoustical qualities for classrooms. Core learning spaces should include sound-absorptive finishes for compliance with reverberation time requirements as specified in ANSI*, Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools* (ANSI S12.60-2002.)

☐ High quality materials are to be used in the construction. The architect should refer to the MCPS Facility Design Guidelines.

Educational Considerations

☐ The school should be designed to support flexible and collaborative learning environments. When possible, the architect should identify collaborative work spaces throughout the building. These

spaces can be located near the instructional spaces as well as informal areas such as the library, hallways, etc.

☐ All spaces should be designed in such a way that can be adapted to changes in pedagogical changes in the future.

☐ The classrooms should be designed to accommodate various size groups. Each classroom should be readily adaptable for group work, various presentation formats, and should have maximum connectivity to outside resources.

☐ The shape of the classroom and the design of built-in features and storage areas should provide optimum net usable floor area. Elongated rooms and features that protrude into floor area, limiting flexibility, are to be discouraged. Rectangular shaped classrooms are preferred.

☐ For maximum instructional flexibility, large special instruction areas such as those provided for general music and multipurpose laboratories should be designed to allow easy conversion of space for other kinds of instruction in the future.

☐ Every teaching station, support space, and core area must be wired for computer and VOIP telephone, along with adequate electrical supply in compliance with Maryland Sate design guidelines for Technology in Schools and the MCPS Office of Technology and Innovation (OTI) guidelines. Facilities must be adaptable to accommodate rapid development in high technology and its equipment since educational program and organization in this field are dynamic. Space and power supply must be flexible to meet these changing needs.

Facility Considerations

☐ The architect is to design the spaces within 5 percent (plus/minus) of the net square foot guidelines provided in this document unless otherwise noted.

☐ The first impression of a building is important. The main entrance to the school should have a clear and inviting identity, and the architect should emphasize the entrance area through its design and landscape.

☐ The Gym entrance should be easily identifiable, and also be inviting though design and landscape, as should Linkages to Learning if it is part of the program.

☐ The facility is to reflect an appealing visual, acoustic, and thermal environment and is to be properly furnished and equipped. Thoughtful colors and textures should be used.

☐ The design of the main lobby area needs to convey a feeling of warmth and welcome. The inclusion of a lighted showcase in which student work can be displayed is recommended.

☐ The main lobby should have a large overhead-animated electronic display board for messages and videos.

☐ Lighting must meet current guidelines and provide adequate levels.

- ☐ Carpeting should be limited to the principal's office, assistant principal's office and conference room in the administration suite, the offices in the guidance suite, and the main reading room of the library media center (LMC).

- ☐ The inclusion of lighted showcases to display student work should be provided in the corridors of the main entrance, art classrooms, technology education, gymnasium, and in each grade level area. They should be recessed into the wall with access from within a room and have an electric outlet. Lighting should be switched on or off from within the display case. Each display case shall have its own lighting switch.

- ☐ Staff work areas should be arranged to encourage interdisciplinary interaction.

- ☐ Noise and distracting sounds are to be minimized. In areas such as the cafeteria, auditorium and classrooms, which may be used for meetings and a variety of other purposes, the sound of operating fans for ventilation should not interfere with instruction.

- ☐ An MCPS-designed alarm system will provide security for this facility. The architect will provide for this system in consultation with the Division of Planning and Construction (DPC) staff.

- ☐ Coordination must occur with MCPS DPC and any contractors for door security, camara locations (interior and exterior), intrusion, latch detection, remote dogging at main entrance and bus loop entrance, ACS, electronic hardward functions, card reader locations and design intent for all systems including sign operations.

- ☐ Some windows must be operable in each learning environment within the building. Transmission of light through windows into various portions of the plant is to be considered in relation to heating and ventilating and in relation to planning the building for air conditioning. All instructional spaces should have exterior windows. If the design does not permit exterior windows, windows onto corridors for borrowed light should be provided.

- ☐ The specification for the window coverings will be provided by DPC. Screens on operable windows should be installed in all food related areas. Shades on side lights next to door openings or half lights are required.

- ☐ Careful placement of glass is required to avoid excess heat gain in occupied areas.

- ☐ The entire school is to be air-conditioned.

- ☐ Zoning the plant for heating and air-conditioning should be related to after-hours use of various areas such as offices, gymnasium, cafeteria, and library media center (LMC). Appropriate location of parking, cross-corridor doors, and toilet rooms are necessary for after-hours use. Some classrooms near the cafeteria should be zoned for after-hour use as well.

- ☐ Core spaces such as the cafeteria, gymnasiums, and LMC should be easily accessible for community use and secure from the rest of the building after school hours.

- ☐ Special attention should be given to security measures within the building including location of security barriers in corridors and lockable doors to secure various sections of the building for after-hour use.
- ☐ Spaces that serve no real educational function, such as corridors, should be limited while at the same time assuring an easy to supervise and smooth flow of pupil traffic to and from the LMC, cafeteria, gymnasium, auditorium, specialized centers, and support rooms.
- ☐ For security purposes, all doors into classrooms, conference rooms, offices, etc. must be designed with a sidelight window with shades. If a sidelight is not possible, then the door requires a vision panel. Doors should only have one vision panel on top half if needed. Limit lower vision panels.
- ☐ Some toilet rooms should be located so that they may be used during after-hours for student use and adult use.
- ☐ Bathrooms for staff and students should be located throughout the building. Some student and adult bathrooms must be located near the cafeteria and gymnasiums (available for after-hour use as well).
- ☐ To the extent feasible, at least one single user restroom should be provided on each floor and in high traffic areas for student use. These toilets should be designed with a non-locking door, and one individual stall in each toilet room.
- ☐ Group single user restrooms with full-height walls, and standard doors rather than bathroom stall partitions, should be provided near the cafeteria, gymnasium, and auditorium, and be designed open to the corridor for greatest supervision. One ADA restroom per group of single user restrooms shall be included or more if required by code.
- ☐ Electric water coolers should be strategically located throughout the building and close to the restrooms. At least eight of the water coolers should have water bottle filling stations and should be located near high volume areas such as the cafeteria, gymnasium, auditorium, and on each floor.
- ☐ Corridors where lockers are installed must be a minimum of 10' in width.
- ☐ The number of lockers in the corridor should be equal to 20 percent of the student body.
- ☐ The location of the elevator(s) must consider use by the student population, LMC staff, and after-hours users. Card readers are required for elevator use on all floors.
- ☐ A public address system is required in the facility. The architect and engineers should refer to the MCPS Facility Guideline Specifications for additional information.
- ☐ A building services call system is required.
- ☐ A room numbering system which is logical and understandable and which lends itself to electronic scheduling of room assignments for students is required. Permanent room numbers should be provided on all drawings at bid time.

☐ Identify storage room for spare materials/attic stock such as acoustic ceiling tile, paint, carpet tile, and ceramic tile. Include 12" metal shelving in the storage room.

Site Considerations

☐ A covered walkway from the bus loading area to the front door is desirable.

☐ The design of the building and grounds must provide for a secure environment for students and staff. Isolated areas should be minimized, and natural surveillance encourage by eliminating visual barriers.

☐ Exterior lighting is to be shaded from neighboring properties and is to be operable as appropriate from both time and key switches. For major entrances, a doorbell should be installed. The kitchen delivery area is to include peep site viewer for service area door entrance, and MPR entrance should also include a peep site viewer for after school activities.

☐ Walkways from remote parking areas to have lighting along an accessible path.

☐ Separate controls on a time clock for illumination of walkways and parking lots, including parking areas for the stadium area are required.

☐ Landscaping and provision for outdoor watering are to be included. Planting is to include screen planting and those that may be needed for erosion control. Other landscaping to support energy conservation and to relate the building to the site with aesthetic appeal must be included.

☐ Rough ins for electric charging stations are necessary to both a standard and ADA parking spot.

☐ Rough ins for underground conduits and sprinkler systems (as required by code) for future relocatable classroom locations.

☐ Bike racks, trash and recycle bin locations require concrete pads.

☐ Bike racks should be provided near the building. U shaped bolted down with trim ring to cover bolts is the MCPS standard.

☐ Vehicle barriers should be considered at any entrance near a drive aisle.

☐ Sidewalk ADA ramps, curb cuts should be considered at all parking lot crossings.

☐ PV array on structured canopies in the parking lot may be used to meet Net Zero requirements.

Technology Framework

The latest technology should be integrated into every aspect of building. The architect should consult with the Division of Technology Services (DTS) and the Department of Planning and Construction (DPC) for the latest technology requirements. The architect must at a minimum plan for the following elements.

- ☐ Through the use of wireless access, local area and wide area computer and video networks, students should have access to each other, to schools throughout the county with similar capabilities, and to universities and government institutions throughout the world.
- ☐ Each classroom is to have one dedicated 20 amp electrical circuit for a charging mobile laptop cart.
- ☐ Each classroom will have an interactive teaching board at the teaching wall and computer network outlet (CNO) for the teacher's computer.
- ☐ Additional outlets to allow for charging of personal student devices should be provided in the classrooms and throughout the building.
- ☐ CNOs consisting of a flush mounted standard electrical box with 1 1/2" conduit to the ceiling space overhead should be located in all classrooms, offices, and other work locations according to the following general rules:
  - ☐ one CNO per office, staff office, planning room, etc. adjacent to telephone outlet
  - ☐ One CNO for VOIP system in the classroom
  - ☐ Two CNOs for student use located 3' apart along the back or side wall in each classroom.
  - ☐ Multiple CNOs in media center at circulation desk, reference areas, etc.
  - ☐ One CNO at each science lab workstation
  - ☐ All other areas such as the stage, bookstore, dining room, etc., where computers might be used.
- ☐ The number and location of telecommunication closets required to support the building-wide computer network is dependent on the size and geometry of the building. The layout of the telecommunication closets will be determined during the design phase of the project.
- ☐ Outdoor wireless access points need to be provided at the schools.
- ☐ Wireless access point needs to be provided at the main entrance of the school for a message board.
- ☐ CNOs for security cameras are required. The number and location will be determined during the design process.

Description of Facilities

Please refer to the summary of spaces for the actual number and size for each space described below. Some deviations will be allowed to provide the best program and design solutions consistent with capital considerations.

Standard Classroom

- ☐ Standard classrooms will be distributed throughout the school and must provide for a combination of large and small group activities.

- ☐ Each classroom should be designed to support flexible furniture arrangements that will support a variety of teaching and learning models.

- ☐ A 36”W x 24”D x 84” lockable teacher's closet is to be provided for general supply storage, personal storage, and wardrobe. There should be a duplex electrical outlet, a mirror with a pin tray, file cabinet, closet rod, a finger door latch, and adjustable shelves inside the wardrobe. The location should be near the teacher’s desk if possible.

- ☐ The building information and communications distribution system and other aspects of the building design must comply with the latest edition of MSDE *Maryland Public School Standards for Telecommunications Distribution System*.

- ☐ Book storage should be located along the window wall with half of the cabinets equipped with hinged, lockable doors. A minimum of 60 linear feet should be provided for mobile book storage.

- ☐ The main teaching wall layout needs to be in accordance with MCPS Facility Guideline Specifications. The main teaching wall will be designed to accommodate a portable interactive teaching board.

- ☐ Whiteboards should be installed on all the available walls of each classroom.

- ☐ 6” map rails and tack rails are to be placed above all whiteboards. One flag holder attachment is to be placed on all map rails with four to six map holders. Snap trim is the MCPS standard for all display boards, and H trim is required for all split board assemblies.

- ☐ Classrooms must have access to computer networks, the school's administrative database, LMC information systems, telecommunications options, and PA system. Computer/technology wiring must be in accordance with DDC, MSDE, and OTI guidelines.

- ☐ Each classroom should be equipped with window coverings for all windows and on the door. All exterior windows on the ground floor, sidelight by the door, vision panel in the door, and windows facing the corridor are to receive an opaque shade. Exterior windows on upper floors to receive 5% openness shade. The specifications for the window coverings will be provided by DPC.

- ☐ Battery-operated clocks will be installed by MCPS.
- ☐ The teacher's desk should be located by the teaching wall and have clear view of the door. The call button should be located near the teacher's desk.
- ☐ Floor Finish: VCT, Ceiling Finish: 2'x4' ACT, Wall Finish: Painted, Base: 4" rubber, Lighting: 2x4 LED

Drama Classroom

- ☐ This classrooms should be designed with the same as elements as a standard classroom.
- ☐ Consideration should be this room to paint the walls black.
- ☐ Space should be identified in this room for a portable stage.
- ☐ A 150 sf storage closet should be provided for costumes and props accessible to this classroom.

Developmental Reading Classroom

- ☐ The developmental reading room should be centrally located.
- ☐ Sufficient power and data to support 15 student computers plus 2 for the teacher and mobile interactive white board.
- ☐ A standard teaching wall should be provided per MCPS Facility Guideline Specifications.
- ☐ Tables for 20-25 students should be provided in this classroom.
- ☐ Mobile bookshelves should be located on the window wall.

Project/Collaboration Room

- ☐ Project/Collaboration rooms should be located adjacent to classrooms with interior glass and a door into each classroom (not opposite each other) as well as a door to the corridor.
- ☐ Teachers should be able to easily supervise this space from the adjacent classrooms.
- ☐ A standard teaching wall should be provided in this room with additional magnetic whiteboards along other walls in the room.
- ☐ Some of these spaces areas can be designed off the corridors to create collaborative learning environments throughout the building.

Workroom

- ☐ The workroom should be centrally located and convenient to each floor where there are general academic classrooms.
- ☐ Cabinetry appropriate for storing a variety of office and school supplies should be designed along one wall of the workroom.
- ☐ A portion of countertop is to be more than 30 inches wide to accommodate a large paper cutter.
- ☐ Space adequate for a large copying machine with necessary electric service, data drop, and ventilation should be designed, if the school or program requires an additional copying machine.

Staff Office

- ☐ The staff office may serve as the department office at many high schools and should include a 100 sq. ft. office for the Resource Teacher for private meetings.
- ☐ The staff offices also may be designed as collaborative spaces in varying sizes with storage units in the staff offices rather than teacher's wardrobes in each classroom.
- ☐ Space for teacher desks, storage cabinets if needed, bookshelves, and filing cabinets for commonly used department or staff supplies and instructional materials should be identified.
- ☐ A work counter with sink and electric outlets is required.
- ☐ Space should be provided for a refrigerator.
- ☐ One 4'x6' magnetic whiteboard is required.
- ☐ Secure storage and electric and data outlets to accommodate computer equipment.

Composition Aid Work Area

- ☐ This area should be located near one of the large staff offices to support the English Department.
- ☐ Space for three or four teacher desks should be provided in this area.
- ☐ Each work area needs electrical and data outlets for computer workstations.
- ☐ One four-foot magnetic whiteboard should be provided in this room.

Textbook Storage

- ☐ Textbook storage should be conveniently located to the staff offices and is to be equipped with steel shelving for books.
- ☐ ATC ceilings are to be provided in these spaces.
- ☐ If the storage room is 100 sf or greater, add data and a call switch.
- ☐ A storage cabinet unit with locking doors is needed for storage of large-size posters and construction paper, and charts so that these items may lie flat.

Special Education

Spatial needs
Classroom
Resource Room
Speech and Language Room
Occupational Therapy/Physical Therapy (OT/PT) Room
Transition Office
Conference Room
Itinerant Staff Office
Support Staff Office
Accommodation Rooms
Large Staff Office
Textbook Storage

- ☐ Special education classrooms should be located with similar departments in the building so that integration with regular students occurs naturally.
- ☐ The specific requirements for the classrooms are the same as the requirements for standard classroom requirements. Please refer to the preceding section for these requirements.
- ☐ Please see the last section of this document for additional special education program requirements specific to this school.

Resource Room

- ☐ This space should accommodate 15-20 students and should be centrally located in the academic classroom areas.
- ☐ The room should be designed with a standard teaching wall per MCPS Facility Guideline Specifications.
- ☐ The resource room should have open shelving, counter space, and closed storage within the room.
- ☐ A teacher's wardrobe should be provided.

Speech Language Room

- ☐ This room requires a magnetic whiteboard, open and closed lockable storage, open shelving, and a lockable teacher wardrobe.
- ☐ Room for a teacher's desk, lockable file cabinet, and table to work with small groups of students is required.
- ☐ The speech/language room should be wired for access to one computer workstation each.

- ☐ The speech room must be located on the first floor, near the OT/PT room, and have appropriate acoustic treatment.
- ☐ The speech room needs a 4’ x 4’ mirror mounted to the wall.

Occupational Therapy/Physical Therapy (OT/PT) Room

- ☐ Each room must have whiteboard that is mounted two feet off the floor.
- ☐ A tack board, open and closed lockable storage, open shelving, and a lockable teacher wardrobe are required.
- ☐ A sink with counter space is required in the OT/PT room.
- ☐ Room for a teacher's desk, lockable file cabinet, and assorted-sized furniture with adjustable legs should be provided.
- ☐ The OT/PT room should be wired for access to one computer workstation.
- ☐ The OT/PT room requires a ceiling mounted hook, with a 12-foot diameter clear space for hanging swings and other suspended equipment.
- ☐ The OT/PT room requires lockable storage with sufficient area to house large gross motor equipment (minimum of 35 square feet) such as therapy balls, scooter boards, walkers, balance beams, ramps, etc.

Transition Office

- ☐ This office should be designed with two computer outlets.
- ☐ This office should have a desk and table with four chairs for small meetings.
- ☐ A 4’x6’ magnetic whiteboard should be installed on one wall.
- ☐ A telephone is needed in this room.

Conference Room

- ☐ This room should accommodate 12-15 people.
- ☐ Data and electric outlets should be provided for a monitor and computer.
- ☐ A 4’x6’ magnetic whiteboard should be installed on one wall.
- ☐ A telephone is needed in this room.

Staff Office

- ☐ This office should be designed with two computer outlets.
- ☐ A 4'x6' whiteboard should be installed on one wall.
- ☐ A telephone is needed in this room.

Accommodations Room

- ☐ Space for 10-12 student desks should be provided.
- ☐ Power and data for 2-3 computer workstations should be provided.
- ☐ Magnetic whiteboards should be provided along all the walls in this room.
- ☐ If this room is located adjacent to a classroom or resource room, a window should be provided between the two rooms.
- ☐ A teacher's desk and wardrobe should be provided.

School Community-Based (SCB) Program

Spatial Needs
SCB Classroom
Personal care Room
Life Skills Resource Room
Adaptive PE

SCB Classroom

- ☐ It is preferable that these classrooms be located on the first floor and near the front entrance.
- ☐ Equipment parking should be located conveniently to the classroom(s).
- ☐ Provide standard academic classrooms, located adjacent to each other.
- ☐ A storage closet is preferable to casework storage.
- ☐ These classrooms should be designed with two teachers' desks, a teacher's wardrobe and small lockers to store the belongings of the paraeducators.
- ☐ A shared preparation area with refrigerator and sink should be accessible from within the classrooms.

Personal Care Room

- ☐ This toilet room should include space and power for a six-foot long changing table.
- ☐ This room should be accessible from within the classrooms.
- ☐ A personal care room may be shared between a pair of classrooms, however there is high usage and ideally, each classroom should have its own personal care room.
- ☐ This room must include a shower and a wall shelf.

Life Skills Resource Room

- ☐ Two kitchenettes with accessible refrigerator, stove, and sink should be designed in this room.
- ☐ One of the kitchenettes should be designed along the hallway wall with a window to the hallway, and so students can sell coffee from this room. Electrical outlets and data drops should be provided for coffee makers and a cash register.
- ☐ An accessible washer and dryer should be provided in this room.
- ☐ Large storage cabinets should be provided in the classroom. The architect should work with school staff to identify the proper storage cabinets.
- ☐ Space should be provided for large tables in the center of the room.
- ☐ A whiteboard and tackboards should be provided along one of the walls.
- ☐ If a school has both LFI and SCB, the Life Skill Resource Room and Preparation Area can be consolidated and shared.

Adaptive PE

- ☐ This room should be located near the rest of the Physical Education spaces and will be used for adaptive physical education for students with special needs.
- ☐ The room should be designed with indoor sports flooring not requiring a depressed slab, but with an appropriate shock absorption level.
- ☐ Two adjustable height basketball hoops should be installed in this room.
- ☐ A storage closet with metal shelving should be provided for tubes, balls, steppers, and hula hoops.
- ☐ A sound system should be installed in this room.
- ☐ This room requires a ceiling mounted hook for a swing. There should be enough space within the swing's 6' radius to avoid any obstacles.

Learning for Independence Program

Spatial Needs
LFI Classroom
Personal care Room

LFI Classroom

- ☐ Provide standard academic classrooms located adjacent to each other and near grade level peers.
- ☐ Classrooms should be set up with two teacher desks and two teacher wardrobes.
- ☐ These classrooms should be located on the first floor if possible and near the school's OT/PT room.
- ☐ These classrooms should be located near SCB classrooms (if present).
- ☐ There should be white boards installed at an accessible (ADA) height on the second teaching wall in the classroom.
- ☐ If possible, provide a small alcove adjacent to or within the classroom(s) to park equipment.
- ☐ Provide 12 ADA lockers for each LFI classroom.

Personal care Room

- ☐ This toilet room should include space and power for a six-foot-long changing table.
- ☐ This room should be accessible from within the classrooms.
- ☐ A personal care room can be shared between adjacent classrooms as long as it is easily accessible to all students.
- ☐ This room must include an accessible zero entry shower with privacy curtain, and a wall shelf.

ELD Department

Spatial needs
Classroom
Small Staff Office
Storage

☐ ELD classrooms should be designed with same requirements as standard classroom. Please refer to the preceding section for these requirements.

☐ A 100 sq. ft. office for the Resource Teacher should be provided in the office area.

Science Department

Spatial needs
Science Laboratories
Preparation Room
Chemistry Preparation Room
Chemistry Storage Room
Chemicals Storage Room
Storage Rooms
Greenhouse
Greenhouse Preparation Room
Textbook Storage

Laboratories

Each room will serve as a lecture/laboratory space. The laboratories should be designed as described below.

- ☐ One master key for all the science laboratories is required.
- ☐ The laboratories should ideally be 30' x 50' or as squared as possible.
- ☐ Only 28 student workstations may be designed in each laboratory.
- ☐ All science laboratories except for the Chemistry laboratories should be designed with 2' wide perimeter workspace counters to maximize floor space for tables and chairs.
- ☐ Only the Chemistry laboratories should be designed with island workstations or peninsulas. MCPS staff will provide the layout for the Chemistry laboratories in consultation with the school and MCPS curriculum staff.
- ☐ Permanently installed wall cabinets with glass and adjustable shelving above lab work surfaces, but not above the gas outlets, are needed. About half of the casework should be lockable.
- ☐ One flat file cabinet for E-size chart storage with narrow drawers is required.
- ☐ A 3 ' x 5' demonstration table needs to be located at the front of the room. Space for a teacher's desk should be provided next to the demonstration table.
- ☐ The demonstration table should have gas and a sink with hot and cold water with an aspirator/venturi tube.
- ☐ The demonstration desk needs one 220-volt outlet and two 120-volts.
- ☐ Half of the non-chemistry labs require a rigid non-moving 300 lb. hook.

- ☐ Three 36” W x84”H storage cabinets with adjustable shelves and glass doors that are lockable should be permanently installed in each laboratory.
- ☐ A goggle cabinet is needed for goggle storage and sterilization with adequate ventilation in each laboratory. One dedicated outlet is needed for the goggle sterilization cabinet for 36 goggles.
- ☐ One installed fume hood with full utilities (water, sink, gas, and light) is needed in each laboratory that fits in a standard cabinet (24" x 36"). This fume hood should be shared with the prep room.
- ☐ A safety station is to be installed, with shower, automatic shut-off eyewash, and drain with a sloped floor, and should accommodate people with disabilities. The shower and eyewash should have a spring-loaded mechanism.
- ☐ The master cutoff for gas, water, and electricity needs to be easily accessible to the teacher and located so that students cannot access it. The emergency cut-off key should be removable in the “on” position.
- ☐ There should be a master cutoff switch for gas, water, and electric in each room. The master cutoff switch should be strategically located at the teacher’s station so that it is not overly accessible to students, and should not be located near the exit door of the classroom. The cut-offs should operate electrically (as panic buttons) with a visible light indicator for gas and electric.
- ☐ The cut-off switch should not be located near the exit door. The reset circuit for science classrooms should be readily available to science staff.
- ☐ The electrical panel box should be easily accessible by science staff.
- ☐ Electric outlets should be wall mounted or face-of-cabinet mounted.
- ☐ One wash-up stone sink, 18" x 18" x 20" deep with hot and cold water should be provided for student use.
- ☐ Student workstations should be made of moisture and chemical resistant material.
- ☐ The student workstation sinks require cold water only.
- ☐ A chemical drain trap is needed in the demonstration and wash-up sink only in all laboratories.
- ☐ Glass display cabinets in the hallway at door entrances should be installed to several of the science laboratories.
- ☐ A map railing installed up high for permanent wall charts should not be located over the whiteboard.
- ☐ Wall drying racks (pegboard) for test tubes, etc. are needed adjacent to the stone sink to accommodate a minimum of 32 test tubes.
- ☐ A 36”W x 24”D x 84” lockable teacher's closet is to be provided for general supply storage, personal storage, and wardrobe. There should be a duplex electrical outlet, a mirror with a pin tray,

file cabinet, closet rod, a finger door latch, and adjustable shelves inside the wardrobe. The location should be near the teacher's desk if possible.

☐ Two ceiling mounted electrical cord reels are required in each laboratory.

☐ The architect should be asked to visit recently revitalized high schools and use similar designs after consulting with MCPS staff. The architect should work to design for maximum use of laboratory space within each room particularly in the placement of mechanical units.

Preparation Room

☐ One lab station with water and electric and computer capabilities should be installed in each project room.

☐ Interior glass from preparation rooms to science laboratories must be installed for visual supervision of spaces.

☐ Wall cabinets and under counter cabinets are required.

☐ Counter space made of moisture and chemical resistant materials is required.

☐ These rooms should be located between every two laboratories.

☐ A wash-up sink, 18" x 18" x 20" deep with hot and cold water, with drain board and drying rack is required.

☐ Heat, chemical, and water resistant work surfaces suitable for an autoclaving/drying oven are required.

☐ Variable sized storage cabinets are needed.

☐ A residential dishwasher with a lab ware rack insert and a full-size refrigerator/freezer for flammable materials is required in each prep room.

☐ These rooms must have an exhaust fan and air conditioning in compliance with latest ASHRAE standards.

☐ An equipment repair bench with multi-strip outlets and good lighting is required.

☐ The chemistry preparation room requires a Barnstead still that with a minimum size of 3 gallons and a 4-liter-per-hour output and reservoir. Separate water and electric sources are needed for the still.

☐ All prep rooms should have an emergency cut-off switch to all utilities.

☐ A telephone is required in all the prep rooms.

Chemical Storage Room

- ☐ The chemistry storage room requires a steel flammable storage cabinet, with outside power vent, and an acid cabinet.
- ☐ This room requires an SKD keyed door.
- ☐ This room should be located adjacent to the chemistry prep room.
- ☐ This room must have a 24-hour, 365 days per year exhaust system vented directly to the outside in compliance with the latest applicable codes. Placement on the top floor, or on an exterior wall that is not near an air intake or outdoor space that is typically occupied is necessary.
- ☐ Sturdy, wood, and chemical resistant shelves with safety anti-roll lips on each shelf to prevent accidental roll-off.
- ☐ A safety center with shower and eye wash should be provided in the chemical storage room. If the chemical storage room is located adjacent to the prep room the safety center should located close to the chemical storage room.

Storage Rooms

- ☐ The storage rooms should be located adjacent or grouped with the preparation rooms.
- ☐ A storage room is required between every two laboratories.
- ☐ Adjustable steel shelving is required and should be anchored to the wall.

Greenhouse

- ☐ The greenhouse should be easily accessible to a science laboratory and preferably should have a southern exposure, if not it should be eastern exposure or western exposure. The greenhouse must not have a northern exposure.
- ☐ The entrance to the greenhouse should be through the greenhouse preparation area. If the school has an agricultural CTE program then the greenhouse should have direct access to the laboratory as well.
- ☐ The greenhouse also requires a window for supervision from the science laboratory.
- ☐ It must have its own heat source with a thermostat, and overhead lighting separate from the rest of the school (preferably gas heat), and adequate ventilation.
- ☐ A drain is required in this space.
- ☐ One duplex electrical outlet per wall at bench height is required.
- ☐ A climate control system is required and should include a 50% shade screen and a swamp cooler or misting system to maintain a temperature range between 45 to 95 degrees.

- ☐ Growing benches are required. The architect is to provide the layout for the growing benches within the greenhouse
- ☐ Careful attention to keeping spills contained in the greenhouse is required.
- ☐ The greenhouse requires a hose bib.

Greenhouse Preparation Room

- ☐ A sink is required in the greenhouse prep room.
- ☐ Careful attention to spills and floods is required in this room.
- ☐ A deep prep sink with cold water is required.
- ☐ Lockable storage cabinets under the counter are required.
- ☐ Lockable wall mounted cabinets are required.
- ☐ A 6-foot counter with sink is needed for student work. Counter material must be moisture and chemical resistant.

Art Department

Spatial needs
Ceramic/Sculpture Room
Kiln/Glaze/Clay Prep Room
Ceramic Pug Room
Studio Art Room
Digital Art Room
Department Office
Storage Rooms

- ☐ Each art room should have adequate and appropriate north natural lighting in addition to a visual reference to the outdoors for the purpose of study.
- ☐ Direct or easy access to the outdoors for bringing in large supplies and materials from each room is desirable. Electric outlets and water should be available in the outdoor space.
- ☐ Entrance doors must clear 36 inches.
- ☐ All sinks are to have moveable faucet lever controlled hot and cold water.
- ☐ Six extension outlets should be provided in the ceiling of all art rooms over the tables.
- ☐ One sink in each art classroom should have an eyewash with automatic shut-off mechanism.
- ☐ Storage is to be provided for both two- and three- dimensional art projects, for student books, and for reference books and magazines.
- ☐ Blackout shades are to be included in each classroom on all windows.
- ☐ Extensive electric outlets, approximately 4’ apart, are to be provided in each room.
- ☐ All available walls are to have tack boards with picture molding at the top. Verify sizes with MCPS.
- ☐ Ceiling track lights are to be provided, and six to ten spotlights are needed per room.
- ☐ One lighted display case lockable from within one of the art rooms, with viewing from the corridor side, is to be provided near the art suite and another near the main entrance to the building.
- ☐ Lighting should be sufficient for all parts of the classroom.
- ☐ All installed cabinets should be lockable.
- ☐ Classroom supply and project storage should be keyed to the same key.
- ☐ Individual student storage units for flat and 3-D work should have the capacity to lock.

- ☐ Proper air ventilation for clay, chalk dust, with an additional switch control is required in each room.
- ☐ At least five computer outlets with electrical outlets should be provided along one wall.

Ceramics/Sculpture Room

- ☐ Four (28" x 16" x 12" deep) single basin stainless steel sinks with plaster traps are to be provided. One ADA sink is required.
- ☐ The ceramic/sculpture room should have an area for 10 to 12 pottery wheels with electrical drop down and storage for 15 pottery wheels.
- ☐ This space should have a slight slope towards a floor drain and away from the rest of the room, located near an extra deep sink with plaster trap.
- ☐ Lockable 3-D and flat storage for students work, for class projects of various sizes, clay storage, and class supplies is needed.
- ☐ Open shelves for 3-D works in progress (approximately 12" x 12" space per student for 240 students).
- ☐ Space should be provided for a 4' long plaster topped wedging table, and a 4' long slab roller.
- ☐ An exhaust fan for clay dust is needed.

Kiln/Glaze/Clay Room

- ☐ Access to this room must only be through the ceramics/sculpture room.
- ☐ Space and electrical outlets are needed for 4 kilns, a 3' wide spray booth, a jigsaw, and a buffer/grinder.
- ☐ Well-ventilated open green ware storage is required.
- ☐ This room requires sufficient vision panels from the classroom to allow for supervision of the room.
- ☐ The walls must be washable.
- ☐ Countertops should be a light color made of durable material capable of being wet with clay and glaze for long periods of time.
- ☐ A floor drain on the down grade is needed.
- ☐ The sprinkler systems need to be adjusted to go off at higher temperature in the kiln room.
- ☐ Exhaust ventilation above the kilns for ducts to outside is required.

- ☐ A spray booth is to be provided with a ducted exhaust system. Verify size with MCPS DPC staff.
- ☐ The room needs 3-phase, 250-volt, 60-cycle electricity provided in the ceramic area for three 50-amp ceramic kilns under an exhaust hood.
- ☐ An extra deep sink with a drain board is needed for buckets and glazes.
- ☐ Lockable storage for glaze chemicals, prepared glazes, equipment and projects is required.
- ☐ Space or cart to hold kiln furniture or open shelves near the kiln for kiln furniture is required.

Ceramic Pug Room

- ☐ Access to this room must only be through the ceramics/sculpture room.
- ☐ Space for a pug mill (15" x 24" x 54", 115V, 11 Amp) is required.
- ☐ Exhaust ventilation above the pug mill with ducts to the outside is required.
- ☐ Space for two slurry buckets is required (size of large garbage can).
- ☐ Space to store boxed clay (each box is 50 lbs.), usually about 1000 lbs., is required.
- ☐ Space to store recycled clay is required.

Studio Art Room

- ☐ Three (28" x 16" x 12" deep) single basin stainless steel sinks with plaster traps are to be provided in the studio art room. One ADA sink is required.
- ☐ Shelving and/or cabinets should be provided above the counter with sinks listed above.
- ☐ A tile backsplash is required between the counter and shelving/cabinetry.
- ☐ Extensive tack boards for visuals and critiques are required.
- ☐ A vertical canvas printing storage rack is required.
- ☐ Floor outlets in the center for still life arrangements (recessed or pull-down) are required.
- ☐ Extensive outlets, approximately 4' apart, around the walls and along the countertops.
- ☐ A minimum of two data outlets need to be within proximity to the teaching wall.
- ☐ This room should be designed with flexibility to accommodate changing interior, still life, and figure model setups and frequent moving and shifting of tables.
- ☐ The furniture for this room, including tables, stools, and easels, should be modular and easy to move.

- ☐ Storage needs in the classroom include flat drawer storage, open vertical racks for wet canvases, dry canvas storage in a variety of sizes, racks for 25 easels, and open shelves for 3-D student work or still life materials.
- ☐ A separate, locking storage room is needed in the studio art room for art equipment and supplies.
- ☐ At least one countertop and cabinet should be extra deep to allow for a 36" x 36"countertop paper-cutter, rotary trimmer, or Logan mat cutting system, with cabinet shelves for 22"x28" mat board.
- ☐ Storage area for 30 easels (easel dimensions approximately 75”H x 23”W x 25”D) is required.

Digital Art Room

- ☐ Lockable cabinet storage for printing supplies, cameras, tablets, external hard drives, computer software, interactive teaching materials, etc.
- ☐ A portable interactive white board will be used and power locations and data need to allow for flexibility in placement within the classroom.
- ☐ Easy access to the studio art room is necessary.
- ☐ The room needs to accommodate up to 32 desktop computer stations and other equipment used by students such as printers and scanners.
- ☐ Track lighting for still-life work is needed along one wall.
- ☐ At least 2 large whiteboards and 2 tack boards should be provided, more if wall space permits.
- ☐ Large counter work surface for computer stations should be provided with one small sink.
- ☐ Perimeter countertop space with electrical and data drops for printers and scanners.
- ☐ This room needs some space for 4 studio tables.

Office

- ☐ The office must provide visual control of adjacent classrooms.

Storage Rooms

- ☐ Each art room needs its own storage room.
- ☐ The number of these rooms will be determined in consultation with the staff depending on the design of the suite.
- ☐ The storage rooms require steel shelving throughout with one 36" wide section that is 24" depth minimum.
- ☐ Maximize shelving in this room.

☐ Direct access is needed from the ceramics/sculpture room to the storage room.

Music Department

Spatial needs
Instrumental Music Room
Instrument Storage Room
Percussion Storage Room
Choral Room
Office/Library
Practice Rooms
Robe/Uniform Storage
Ensemble/Keyboard Laboratory

- ☐ Consistent heating, cooling and humidity control are required to maintain the instruments in these rooms. The architect is to ensure that the mechanical system is designed on a separate system to allow for 24-hour control in rooms that store instruments.
- ☐ Storage cabinet facilities such as the Wenger style with locking door for sheet music are needed.
- ☐ Dead storage—considerable space for boxes of materials, costumes, etc., which are used only occasionally, is required.
- ☐ These rooms must be acoustically treated for reverberation and isolation.
- ☐ Each room is to be acoustically isolated from the rest of the school and the general/choral and instrumental areas separated by an acoustic barrier or wall with a Sound Transmission Classification (STC) of 50 or more.
- ☐ Listening is an important skill related to music education, and thus the need for quiet ventilation. Therefore, noise criterion (NC) levels of lighting and ventilating systems must not exceed NC 25 for the large rehearsal rooms and NC 30 for the practice rooms.
- ☐ All doors must be at least 4' wide with no center post to accommodate moving a grand piano and other large instruments from within the suite and to the auditorium stage. If possible, have 3’ wide double doors without a post.
- ☐ Heavy gauge locks must be provided for each room in this suite.
- ☐ Student toilet rooms and staff toilets should be located near the suite so that they might be used as dressing rooms. Each toilet room should have one stall plus dressing space.
- ☐ Recording and audio equipment with microphones, built in from the ceiling should be designed in each of the music rooms. The technology should be designed so it can be easily upgraded in the future.
- ☐ At least four duplex electrical outlets must be provided along the front wall of each music room.
- ☐ After-hours access to the music suite is required for all the spaces.

- ☐ Multiple operable and reachable windows should be in the music rooms to accommodate increased aerosols created through music performances.
- ☐ Water filling stations should be located within the choral and instrumental music rooms.

Instrumental Music Room

- ☐ The instrumental music room must be located near the auditorium and must be on the same level as the auditorium stage if possible. It should have easy access to the back or side of the stage.
- ☐ This room needs access to the outdoors and should be close to the athletic fields.
- ☐ The floor must be level.
- ☐ Approximately 120 sq. ft. of the room should be devoted to storage of basses and cellos. These racks are to be in the rear corners of the room, side by side and not front to back.
- ☐ Acoustical treatment is needed so that the room is sound engineered for a band/orchestra with a maximum size of 100 members and a maximum 50-decibel environment, and reverberation time is to be between 1.2 and 1.6 seconds.
- ☐ A minimum ceiling height of 16' ft. is necessary to obtain the proper volume and acoustics.
- ☐ The room should be free of supporting columns, and no fabric folding doors should be designed in the room.
- ☐ A standard teaching wall per DPC guidelines should be provided. A double music staff should be on one of teaching walls' whiteboards
    - ☐ A portable interactive white board will be used, and power locations and data need to allow for flexibility in placement within the classroom.

Instrument Storage Room

- ☐ This room must be adjacent to and accessed from the instrumental music room.
- ☐ There should be two access points from the storage to assist with student flow in and out of the storage room.
- ☐ A 4' wide door with window that is acoustically treated is required.
- ☐ Cabinetry and shelving must be appropriate to store a wide variety of instruments and should all be movable to provide flexibility (Wenger type) with a set of combination padlocks on a master key needs to be included.
- ☐ Consistent heating, cooling, and humidity control are critical within this room 24 hours a day, year-round.

- ☐ This room should include a work sink for instrument cleaning. Verify size with MCPS Facilities Architect.
- ☐ The room is to be arranged so that a portion may be used as a practice room.
- ☐ Security doors with upgraded locks and an alarm system need to be provided.

Percussion Storage Room

- ☐ A percussion storage room with security doors should be located at the back of the room so that heavy equipment can be easily moved for daily rehearsals as well as drumline and/or marching band rehearsals.
- ☐ Access to this room after hours is required.
- ☐ 18” metal shelving should be provided for drums and other percussion instruments.

Choral Room

- ☐ The room should have a flat floor and a ceiling height of approximately 16' free of supporting columns. The school may choose to use portable risers.
- ☐ Heavy-duty ceiling tiles for acoustic treatment should provide a sound transmission loss of at least 50 decibels, and reverberation time should be between 1.2 and 1.6 seconds.
- ☐ Acoustic panels may also be needed on the walls.
- ☐ A standard teaching wall per DPC guidelines should be provided. A double music staff should be painted on one of teaching walls’ whiteboards.
- ☐ A teacher’s wardrobe should be provided in this space.
- ☐ A portable interactive white board will be used, and power locations and data need to allow for flexibility in placement within the classroom.
- ☐ A minimum of 8-10 feet of mirror should be provided along one wall.
- ☐ Proper ventilation for a large choral group use is required.
- ☐ A music folder cabinet, horizontally slotted, with locking doors, with at least 150 horizontal compartments (15" deep, 15" high, and 2" wide), and with facilities for numbering each compartment, is required.

Office/Library Room

- ☐ This space should be located between the instrumental and choral rooms with visual contact to each.
- ☐ Visual contact to the small ensemble/keyboard laboratory also is needed.

- ☐ A telephone is to be provided.
- ☐ There needs to be space for a Wenger style sheet music storage cabinet.
- ☐ Three teacher's wardrobes should be provided in this room.
- ☐ A sink for instrument cleaning and a **work**bench are needed for small repairs.

Robe/Uniform Storage Room

- ☐ This room needs racks and cabinets for storage of 200 uniforms and hats.
- ☐ About 200 sq. ft. of storage is necessary for robes.
- ☐ Both the uniform and instrumental storage rooms are to have vision panels and doors well located for student circulation.

Ensemble/Keyboard Laboratory

- ☐ This room needs windows to allow for supervision.
- ☐ This room needs to accommodate small ensemble rehearsals, piano laboratory, computer laboratory, music theory and composition classes, electronic music laboratory, and guitar classes.
- ☐ A standard teaching wall per DPC guidelines is to be provided. A double music staff should be painted on one of the magnetic whiteboards.
- ☐ A separate independent ventilation system is required for this room because it may have up to 32 computers in the room.
- ☐ Ample electrical outlets and power along all the walls should be provided for maximum flexibility for keyboards, guitars, and computers.
- ☐ This room should be designed to ensure that cables and cords are not running along the floor in the classroom.
- ☐ Two lockable storage cabinets for classroom music, theory textbooks, exemplar CDs, headphones, equipment, etc.
- ☐ A mobile guitar storage unit is required.

Music (Regional Arts Program)

Spatial needs:
Collaboration Studio/Practice Rooms
Small Practice/Lesson Rooms
Ensemble/Sectional Room
Instrument Storage
Percussion Storage
Audio Tech Support-Mixing Studio

- ☐ Consistent heating, cooling and humidity control are required to maintain the instruments in these rooms. The architect is to ensure that the mechanical system is designed on a separate system to allow for 24-hour control in rooms that store instruments.
- ☐ Storage cabinet facilities such as the Wenger style with locking door for sheet music are needed.
- ☐ Dead storage—considerable space for boxes of materials, costumes, etc., which are used only occasionally is required.
- ☐ These rooms must be acoustically treated for reverberation and isolation.
- ☐ Each room is to be acoustically isolated from the rest of the school and the general/choral and instrumental areas separated by an acoustic barrier or wall with a Sound Transmission Classification (STC) of 50 or more.
- ☐ Listening is an important skill related to music education, and thus the need for quiet ventilation. Therefore, noise criterion (NC) levels of lighting and ventilating systems must not exceed NC 25 for the large rehearsal rooms and NC 30 for the practice rooms.
- ☐ All doors must be at least 4' wide with no center post to accommodate the movement of a grand piano and other large instruments from within the suite and to the auditorium stage.
- ☐ Heavy gauge locks must be provided for each room in this suite.
- ☐ Recording and audio equipment with microphones, built in from the ceiling, should be designed in each of the music rooms. The technology should be designed so it can be easily upgraded in the future.
- ☐ At least four duplex electrical outlets must be provided along the front wall of each music room.
- ☐ After-hours access to the music suite is required for all the spaces.
- ☐ Multiple operable and reachable windows should be in the music rooms to accommodate increased aerosols created through music performances.
- ☐ Bottle filling stations should be located within the choral and instrumental music rooms.

Large Collaboration Studio/Practice rooms

- ☐ Located near the auditorium and must be on the same level as the auditorium stage if possible. It should have easy access to the back or side of the stage.
- ☐ The floor must be level.
- ☐ Acoustic treatment is needed so that the room is sound engineered for a band/orchestra with a maximum size of 30 members and a maximum 50-decibel environment, and reverberation time is to be between 1.2 and 1.6 seconds.
- ☐ A minimum ceiling height of 16' ft. is necessary to obtain the proper volume and acoustics.
- ☐ No supporting pillars or fabric folding doors should be designed in the room.
- ☐ A standard teaching wall per DDC guidelines should be provided. A double music staff should be painted on one of teaching wall whiteboards.
- ☐ Practice rooms to be accessed from within the studio

Instrument Storage Room

- ☐ This room must be adjacent to and accessible from within the instrumental music room only.
- ☐ A 4' wide door (necessary for timpani) with a window for supervision, that is acoustically treated is required.
- ☐ Cabinetry and shelving must be appropriate to store a wide variety of instruments and should all be movable to provide flexibility (Wenger type) with a set of combination padlocks on a master key needs to be included.
- ☐ Consistent heating, cooling, and humidity control are critical within this room 24 hours a day, year-round.
- ☐ This room should include a utility sink for instrument cleaning.
- ☐ The room is to be arranged so that a portion may be used as a practice room.
- ☐ Heavy gauge lockable doors need to be provided.

Percussion Storage Room

- ☐ A percussion storage room with security doors should be located adjacent to the back of the room so that heavy equipment can be easily rolled out for daily rehearsals as well as drumline and/or marching band rehearsals.
- ☐ Access to this room after hours is required.
- ☐ Fixed shelving and cart storage for maximum flexibility. Some shelving should be provided for drums and other mallet percussion instruments.

Small Ensemble

- ☐ This room needs windows to allow for supervision.
- ☐ This room needs to accommodate small ensemble rehearsals, piano laboratory, computer laboratory, music theory and composition classes, electronic music laboratory, and guitar classes.
- ☐ A standard teaching wall per DDC guidelines is to be provided. A double music staff should be painted on one of the magnetic whiteboards.
- ☐ Ample electrical outlets and power along the walls should be provided for maximum flexibility for keyboards, guitars, and computers.
- ☐ This room should be designed to ensure that cables and cords are not running along the floor in the classroom.
- ☐ Two smaller lockable storage cabinets for classroom music, microphones, and audio equipment, textbooks (classroom set), headphones, equipment, etc.
- ☐ Practice rooms to be accessed from within the studio for supervision.
- ☐ Cable passthrough into large ensemble room for recording purposes as well as the small ensemble room.

Practice Rooms

- ☐ These rooms need to be acoustically treated for isolation and reverberation.
- ☐ Rubber seals for sound proofing and thick solid doors to reduce sound transmission should be used.
- ☐ The doors need windows to allow for supervision.
- ☐ These rooms should be located with easy access to both the instrumental and choral rooms.
- ☐ These rooms to be keyed by the supplier.

Audio Tech Support/Mixing Studio

- ☐ This room needs windows to allow for supervision.
- ☐ Counter for sound mixing equipment.
- ☐ Acoustic treatment for sound separation.
- ☐ Appropriate electrical outlets for sound equipment.

- ☐ Data.
- ☐ Recording from large ensemble room as well as the small ensemble room and practice rooms.

Technology Education

Spatial needs
Technology Laboratory
Student Storage
Materials Storage
Applied Engineering Laboratory
Student Storage Space
Material Storage Space
Computer Laboratory
Material Storage Space
Fabrication Laboratory
Office

☐ These labs should be located on the ground level or near an elevator to easily transport equipment and materials and where the creation of loud noises and occasional vibrations will not affect the instruction going on elsewhere in the building.

☐ Sufficient lighting to have work surfaces without shadows is needed.

☐ Acoustic treatment to walls ceiling and floors is needed. Ceilings should be drop/suspended to cover all structural and air-handling devices.

☐ The main teaching wall layout needs to be designed in accordance with MCPS Facility Guideline Specifications.

- ☐ A portable interactive white board will be used, and power locations and data need to allow for flexibility in placement within the classroom.

☐ Ample electrical service and receptacles to accommodate computers and portable electric tools are needed.

☐ Sufficient service shall be provided to accommodate flexibility within the lab with tabletop machinery.

☐ Extensive electric outlets, approximately 4’ apart, are to be provided in each room.

☐ All floor receptacles need to be flush and include data outlets.

☐ All doors should have windows, including entrance to the corridor, and office.

☐ Technology education laboratories and centers need to be protected by alarm with a keypad.

☐ Casework should include storage cabinets with locking doors and drawers for storage of various sized items.

- ☐ Storage is to be provided for both two- and three-dimensional engineering projects, for student books, and for reference books and magazines.
- ☐ Classroom supply and project storage should be keyed to the same key.
- ☐ Teachers should be able to easily supervise the labs from adjacent classrooms.
- ☐ Computer network outlets (CNOs) consisting of a flush-mounted standard electrical box with 1 1/2" conduit to the ceiling space overhead should be located in all classrooms, offices, and other work locations according to the following rule. The architect should consult with the OTI/DDC for the latest technology requirements.
  - ☐ One CNO should be located in the rear of each classroom
  - ☐ One CNO in the office adjacent to the telephone outlet
  - ☐ CNOs in the applied engineering lab to allow for 32 laptop/desktop computers
  - ☐ All other areas where computers might be used

Technology Laboratory

- ☐ The center/laboratory should be designed with two distinct areas. One area should be equipped with student computer workstations and instruction, while the second area should accommodate an area for fabrication.
- ☐ The instructional area should accommodate 32 students.
- ☐ The laboratory should include 2-student workbenches with 2.25 inch laminated maple polyurethane tops with no lockers below to allow for ease of flexibility to move the tables.
- ☐ The following equipment should be provided in this laboratory:
  - ☐ One bench top band saw
  - ☐ One bench top drill press
  - ☐ One mobile teacher demonstration bench
  - ☐ One storage cabinet
- ☐ The floor covering needs to be non-slip tile.
- ☐ Ample electrical service should be provided to workbenches through overhead pull-down receptacles for machines and portable electric hand tools.

- ☐ A goggle cabinet is needed for goggle storage and sterilization with adequate ventilation in each laboratory. One dedicated outlet is needed for the goggle sterilization cabinet for 36 goggles.
- ☐ Walls facing the laboratory need windows with mini-blinds beginning 36" from the floor.
- ☐ Because of the types of materials and substances handled in these labs, built-in ventilation systems shall be installed and connected that adequately maintain air quality and will not be shut down prior to the end of the school day.

Material Storage Room

- ☐ A flammable storage unit should be provided.
- ☐ Metal shelving should be provided in this room that is 24" deep.

Student Storage Room

- ☐ A dual tank air vacuum system should be provided
- ☐ Metal shelving should be provided in this room that is 24" deep.

Applied Engineering Laboratory

- ☐ The applied engineering laboratory is designed to accommodate individualized and team instruction for up to 32 students who will work together to apply engineering concepts using the tools of mathematics and science.
- ☐ The instructional area requires the standard MCPS teaching wall.
- ☐ A portable interactive white board will be used and power locations and data need to allow for flexibility in placement within the classroom.
- ☐ Sufficient power and data for 32 computers is required.
- ☐ The space should be designed so that students each have an individual computer desktop or laptop as well as workspace to work on projects. The furniture should be able to accommodate electrical wiring for tools such as drills to work on engineering and/or robotic projects.
- ☐ A counter with base and wall cabinets should be provided to store supplies in the laboratory.
- ☐ Location for a mobile charging station should be identified for future use of laptop computers.

Material Storage Room

- ☐ A lumber rack should be provided in this room if the school has a Project Lead the Way Program.

☐ Metal shelving should be provided in this room that is 24" deep.

Student Storage Room

☐ Metal shelving should be provided in this room that is 24" deep.

Computer Laboratory

☐ The computer laboratory should be zoned for independent air-conditioning during times when the rest of the building is closed.

☐ The minimum dimensions of the room should provide for an uninterrupted area of 25' x 32' so that the computer laboratory may be designed with the following requirements.

☐ Each computer laboratory should accommodate 32 student workstations.

☐ The layout should be designed with five to six collaborative groups of computers workstations that cluster around a monitor.

☐ The file server and printers are to be located near teacher's desk or in office.

☐ A teacher's wardrobe and storage cabinets should be provided.

☐ The teaching wall should be designed to accommodate an interactive teaching board. The teaching wall layout will be provided by the Department of Planning and Construction (DPC).

- ☐ A portable interactive white board will be used and power locations and data need to allow for flexibility in placement within the classroom.

☐ Marker boards should be provided in the laboratory.

☐ The architect should consult with the DTS/DPC staff for the latest technology requirements.

☐ Space and outlets should be provided for printers.

☐ The storage area is to include shelving and a work counter with electrical outlets and overhead and base cabinets.

Fabrication Laboratory

☐ This room should have a wash-up sink with eyewash with soap and paper towel dispenser.

☐ The following equipment should be provided in the laboratory:

- ☐ Wood wall bench
- ☐ Two mobile planers

- ☐ Mobile contractor saw
- ☐ Dual canister dust collector
- ☐ Mobile machine bench with vacuum system
- ☐ Bench top band saw
- ☐ Bench top scroll saw
- ☐ Bench top belt/disc sander
- ☐ Bench top drill press
- ☐ Mobile storage cabinet

☐ An emergency control switch is needed with a key to restore power.

☐ Appropriate safety zones need to be identified on the floor of fixed equipment.

Multipurpose Laboratory

Spatial needs
Laboratory
Office
Storage

- ☐ The multipurpose laboratory should be located near an exit door for easy unloading of food or other deliveries.
- ☐ If possible, the laboratory also should be located in the same area as other science labs; however, it is not imperative.
- ☐ The laboratory must be designed with perimeter counters around two or three sides of the laboratory.
- ☐ Floor space for long tables to seat 32 students in front of the demonstration desk is needed. Tables should be able to seat 2-3 students.
- ☐ The teaching wall should be designed in accordance with the MCPS Facility Guideline Specifications.
- ☐ A portable interactive white board will be used, and power locations and data need to allow for flexibility in placement within the classroom.
- ☐ A safety station is to be installed, with shower, automatic shut-off eyewash, and drain with a sloped floor, and should accommodate persons with disabilities. The shower and eyewash should have a spring-loaded mechanism.
- ☐ Keyed master cutoff for gas and electricity to the demonstration science station is needed.
- ☐ Electric outlets should be wall-mounted, or face-of-cabinet mounted.
- ☐ The fire emergency cut-off switches for kitchen units should be wall mounted high enough not to be accidentally activated.
- ☐ Re-set circuit should be readily available to the teaching staff.
- ☐ The laboratory should have access to all technology in the building so that computers can be moved around the laboratory.

Kitchen Units

- ☐ Three or four kitchen units are needed along the perimeter counters.

- ☐ The units should include a sink and wall oven. No range or stovetops are required. One of the student kitchen units should be designed with a garbage disposal.
- ☐ Wall oven; hood may be required over oven with exhaust duct;
- ☐ Ample electrical outlets along the counter to be used for small appliances and induction type stoves;
- ☐ Outlets over counters should have dedicated circuits to prevent breaker tripping.
- ☐ Electric outlets should be located above the counter tops.
- ☐ Base and wall cabinets that are lockable should be designed along the perimeter workstations
- ☐ Two residential refrigerators should be provided in the kitchen area.

Storage

- ☐ Lockable door with access to the teaching station;
- ☐ A vision panel or window into the storage room is required for supervision.
- ☐ The room is to be equipped with 18” metal shelving secured to the perimeter walls;
- ☐ Space and electrical and plumbing requirements should be designed for a commercial grade washer and wall-vented dryer that meets ADA requirements;
- ☐ Perimeter counters should be adjacent to the washer/dryer and be a minimum of 24” deep;
- ☐ Space for one residential refrigerator and one residential freezer; and
- ☐ Space for a table for folding laundry.
- ☐ A sink.
- ☐ The sink and appliances must be ADA compliant.

Office

- ☐ The office must have access to the teaching station.
- ☐ Doors and walls will have windows, 42" from the floor for visibility into the teaching station.
- ☐ Computer and telephone service with telecommunication capabilities should be provided.

☐ The space should be designed for conventional office furniture, wardrobe, file cabinet, and books and instructional materials storage.

Child Development

Spatial needs
Laboratory
Observation Room/Classroom
Office
Storage
Site Requirements
Outdoor Physical Activity Area
Outdoor Storage Shed

- ☐ The child development laboratory needs to accommodate 10–15 students and 18 preschool students.
- ☐ The location of this classroom should have convenient access to a fenced play area with equipment rated for 2-5 year-olds, parking lot, and a drop-off area.
- ☐ Standard and handicapped-accessible parking spaces and a drop-off area should be provided adjacent to the main outside entrance of the facility.
- ☐ Site lighting needs to be provided at the parking and drop-off area and above the main entrance and other areas as required for security. The lighting shall be controlled by photocell or time clock.
- ☐ Access road to the laboratory must permit passage by emergency vehicles during childcare hours.

Child Development Laboratory

- ☐ The floor must be tiled.
- ☐ 6 ' of pegboard, tackboard and whiteboard should be installed 24" from the floor for preschool child use.
- ☐ 9 sq. ft. of tackboard should be mounted 36" from the floor at indoor hallway entrance door to the room. Another 9 sq. ft. of tackboard should be mounted 36" from floor at the door leading to the outdoor playground.
- ☐ A 12" wide shelf is needed just under the bottom of the tackboard running the width of the tackboard.
- ☐ Teacher whiteboard space needs to be provided.
- ☐ Storage is to be provided for cots or mats.

- ☐ A kitchen area needs the following:
  - ☐ cabinets
  - ☐ countertops that are washable and made from stain and crack resistant material
  - ☐ lockable cabinets
  - ☐ lockable refrigerator
  - ☐ microwave mounted under the wall hung cabinets
  - ☐ sink with disposal and hot and cold water
  - ☐ a dishwasher
- ☐ A child-height water fountain that is separate from the sink fixtures should be included.
- ☐ A bathroom area should be designed with the following:
  - ☐ an alcove without a closing door
  - ☐ two preschool child-size toilets with partitions between and around the toilets, and free of closing doors
  - ☐ hot and cold running water with water temperature adjusted not to exceed 120º F
  - ☐ two preschool child size sinks with locking cabinets below, mirrors above, and soap, toilet paper, and towel dispensers installed at preschool child height are needed
- ☐ An art area should have washable, stain and crack resistant flooring with a child size sink and countertop area.
- ☐ Storage should be provided for student notebook/backpacks near the entrance door.
- ☐ Two open shelves, 30" high and 18" deep should be installed around the wall base.
- ☐ 18 preschool storage lockers ("cubbyholes") with hooks for coats should be located inside the door leading to the playground entrance. Storage above and below the coat hook area should be provided. Storage lockers should remain detached from wall.
- ☐ Electrical outlets should be childproof and wall-mounted at 8-ft intervals throughout the room and at 4-ft intervals along the kitchen counter back splash. Outlets are to be provided on all walls, and exceed the number required by applicable code(s). Wiring should be sufficient to handle operations of many appliances simultaneously.
- ☐ No outlets should be provided in the children's bathroom.

- ☐ Technology should include computer and telephone outlets. The architect should consult the DTS for current guidelines.
- ☐ Security of the facility should be integrated into the school's security system.
- ☐ The area in the room designated for napping must have a smoke detector directly above, even if the building has a sprinkler system

Observation Room/Classroom

- ☐ This room should accommodate 30 students and be designed with the standard classroom requirements.
- ☐ Three book storage shelves, one tackboard, and one whiteboard are needed at adult height.
- ☐ A cabinet along one wall should be 5' long, 24" deep and 3' high with 3 shelves inside and locking cabinet doors.
- ☐ A large window should be installed from ceiling to half wall height to allow for viewing into the child development laboratory.
- ☐ A writing countertop 29" from floor and 18" deep should be installed under the glass so high school students have a surface for writing. Nothing should be installed under the countertop, such as cabinets, that would prohibit students from sitting at the countertop in order to observe and evaluate children.
- ☐ An effective audio system is needed to hear into the child development laboratory.

Office/Storage

- ☐ This room should have space for a desk with a telephone and computer and teacher wardrobe/storage/file drawer space.
- ☐ A vision window is needed into the child development laboratory to allow for observation by the staff.
- ☐ The room needs to be secured from within the child development laboratory.
- ☐ Commercial style metal shelving should be installed around the perimeter of the room.
- ☐ Overhead light, with a wall switch, and room ventilation is needed.

Outdoor Physical Activity Area

- ☐ This area should be a total of 2,800 sf designed with a soft play area of approximately 1,100 sf and hard play area of approximately 1,700 sf. MCPS staff will work with the architects to design this space.
- ☐ The outdoor area should have direct access to the child development laboratory area, with a clear window view of the area.
- ☐ The space must be enclosed with a 36" vinyl-coated chain-link fencing with protective piping covering the top of linking.
- ☐ A boxed and soft play area should be provided for playground equipment such as Physical Education Pre-K Bid Items #11272, 11282, or 11292.
- ☐ A bench should be provided in the area.
- ☐ Landscaping plans should include low maintenance, non-poisonous plants that do not have berries or thorns.
- ☐ A grassy area and shade tree should be provided.

Outdoor Storage

- ☐ A brick shed, if economically feasible, with burglarproof doors should be built inside the chain link fencing.
- ☐ storage system installed on the inside walls for play vehicles.
- ☐ Two 24" shelves along one wall are needed for portable playground equipment storage.
- ☐ Lighting and ventilation should be included.
- ☐ A capped, childproof, approved outdoors electric outlet on one side wall of the brick shed is needed.

Culinary Arts

Spatial needs
Food Preparation Area
Dry Storage Area
Cooler/Freezer
Restaurant
Dressing Rooms
Classroom
Washer/Dryer Area
Toilet Room
Non-food Storage Area

The culinary arts program provides students with the opportunity to explore the variety of careers in the food service industry. Students develop skills based on industry standards. The program includes food preparation and service experience in commercial and institutional operations related to restaurants, catering, and banquets. Students learn food science and food safety principles, professional food-handling techniques, and quantity preparation through the use of commercial equipment. Training also includes nutrition, menu planning, food costing, cost control, customer and employee-employer relations, safety and personal hygiene.

Food Preparation Area

- ☐ The kitchen has five distinct areas for food preparation, serving, and cleaning. These areas include: hot food area, cold food area, baking area, expediting area, and dishwashing area.
- ☐ A wardrobe closet is required to hang uniforms, jackets, and hats.
- ☐ A job board should be provided in this area.
- ☐ Areas should be designated throughout the food preparation area for storing rolling racks.
- ☐ One ice machine should be provided in the food preparation area.
- ☐ One blast chiller should be provided in the food preparation area.
- ☐ An eyewash is required in this area.
- ☐ Easy access to an entrance for unloading groceries is required.

Hot Food Area

- ☐ Two commercial-grade stoves with four burners and an oven below are required.
- ☐ A 4’ griddle area is required.
- ☐ Two salamanders should be provided.
- ☐ Two commercial grade microwave ovens.
- ☐ One convection oven and one combi oven/steamer are required.
- ☐ One tilt skillet should be provided.
- ☐ Two deep fryers are required.
- ☐ A steam jacket kettle is required.

Cold Food Preparation Area

- ☐ Eight to ten 6’ stainless steel worktables for student use are required for this area.
- ☐ A vegetable sink and hand sink should be located in the cold food preparation area.
- ☐ One ice bath sink is required.

Baking Area

- ☐ Two 8’ worktables with stainless steel tops are required in the baking area.
- ☐ Storage is required for the variety of baking pans.
- ☐ A vegetable sink and hand sink should be located in the baking area.

Expeditor Area

- ☐ This area is required for keeping completed food warm or cool until ready to be served.
- ☐ An 8-foot expediter counter with heat lamps is required for the hot food.
- ☐ A four-foot counter is required for the cold food area.
- ☐ A chef counter for hot and cold food with heat lamp, soup and heated bread drawer is required.

Dishwashing Area

- ☐ A high heat dishwashing system is preferred to a chemical system.

- ☐ Three basin sink is required for the dishwashing area.
- ☐ Some space for rolling racks is desired in the dishwashing area so that clean items may immediately be placed on the racks for storage.

Dry Food Storage

- ☐ This area is needed to store non-perishable food items, equipment, dishes, and paper goods.
- ☐ The dry food storage area must be adjacent to the cold prep area and receiving area.
- ☐ Door opening must be a minimum of 3' 8".
- ☐ It must be air conditioned at all times.
- ☐ This area requires mobile shelving and dunnage, key lock for security, and must be free of roof access ladders or electrical panels.
- ☐ The shelving must be ventilated.
- ☐ Some storage should be provided for rolling racks.
- ☐ A lockable storage cabinet is required to store scales, burners, knives, and other expensive equipment.

Cooler/Freezer Area

- ☐ The cooler/freezer storage area should be provided with the freezer located inside the cooler and should be located adjacent to the prep and receiving areas.
- ☐ Insulated slab and thickset quarry tile floor is preferred with a minimum of 20 ft candle lighting.
- ☐ Roof mount compressors, stainless steel mobile shelving and dunnage, and sound alarm for temperature monitoring should all be included.

Dressing Area/Vestibule

- ☐ Two banks of stacked lockers (24 total) on either side of the vestibule area are required.
- ☐ Windows are required from the vestibule into the cooking area as well as from the corridor into the vestibule for supervision. Uniforms will be stored in a wardrobe closet in the food preparation area.

Toilet Room

- ☐ A toilet room is required accessible from within the food preparation area.

Classroom

- ☐ A 10’ long demonstration table is required with a variety of cabinets and drawers beneath for storage of utensils and cooking supplies.
  - ☐ A small reach-in refrigerator should be provided at the demonstration table.
  - ☐ A mirror should be provided over the demonstration area to allow students to view the area.
  - ☐ The demonstration table requires a stainless-steel top and a two burner gas stove.
- ☐ The classroom should be designed as a standard classroom.
- ☐ An area for a teacher’s desk and file cabinet is required.
- ☐ The teaching wall should be designed per DOC standards.
- ☐ The classroom should be located adjacent to the food preparation area with access from the hallway and the food preparation area.
- ☐ A large window should be provided between the food preparation area and the classroom to allow for supervision of the area.
- ☐ 60’linear feet of mobile bookshelves should be provided for storing cookbooks.

Washer/Dryer Area

- ☐ A commercial washer and dryer are required.
- ☐ A small storage room is needed for chemical storage. This area needs to be separated from any food storage area.

Restaurant

- ☐ The restaurant should accommodate approximately 40 customers in a variety of seating arrangements.
- ☐ The décor and layout of the restaurant will be developed with school staff and students.
- ☐ The restaurant should be in a prominent location in the facility with easy access for customers.

Automotive Technology

Spatial needs
Auto Technology Laboratory
Auto Technology Classroom
Auto Technology Classroom Storage
Auto Technology Storage Room
Auto Technology Tool Room
Auto Technology Teacher Planning Area
Auto Technology Locker/Changing Area

This space should be designed in consultation with school staff

This instructional program prepares individuals to service and maintain all types of automobiles. The program includes instruction in the following: diagnosis of malfunctions and the repair of engines; fuel, electrical, cooling, and brake systems; and drive train and suspension systems. Also, instruction is given in the adjustment and repair of individual components and systems such as radiators transmissions, and carburetors.

☐ The minimum clearance height is 20’ is standard for automotive shops to allow for LED light fixtures which should be flush or recessed.

☐ Parking lot area for "demo" cars and customer car parking is required.

☐ One single 14’x14’ overhead door to center aisle, flanked by 10’ x 10’ overhead doors to correspond with service bay aisles is required.

☐ One Hybrid/Electric Vehicle Maintenance Lift Bay

- The Hybrid/Electric Vehicle maintenance bay shall be equipped to handle Hybrid/Electric Vehicles. The bay width, length, and height requirements shall be similar to the parent program requirements. The bay shall have vehicle charging points conveniently accessible without long extensions. The lifts shall comply with manufacturers’ current safety practices, documentation, and training associated with high voltage/electric vehicle lockout/tag-out and service procedures. A lift design shall have low enough clearance to reach the lifting points on most HEVs without contacting the battery pack.

☐ 2 EV Charging stations located outside, within the fenced-in dedicated AutoTech parking lot, with the ability to expand to more as needed (pull more lines).

☐ The Hybrid/Electric Vehicle Maintenance lift bay has emergency power shut off near major equipment and each electric outlet for tools is protected by GFI. The lift shall have access to electricity and data. Two outdoor charging stations are recommended for HEV charging.

☐ The Hybrid/Electric Vehicle Maintenance Shop has access to controlled natural light paired with

artificial light which simulates daylight.

- ☐ For safety and security within the Hybrid/Electric Vehicle Maintenance Shop, fire and soundproofing attenuations are provided. The shop has direct access to the classroom, tool room, storage room, and outside storage area. Dust producing areas such as raw material processing are physically separated from any program area that may produce ignitions such as welding or metal grinding. Overhead doors that access the exterior are able to be closed with one button in the event of an emergency. Adequate bench space for instruction and component repair on vehicles or large assemblies is located within the shop area. All equipment meets the safety requirements of the Environmental Protection Agency (EPA) and Occupational Safety and Health Act (OSHA) with signs that identify hazardous areas.
- ☐ Access to driveway for parts delivery from an outside door is required.
- ☐ Access to large secure holding area for vehicles from shop door is required.
- ☐ Direct access from classroom and teacher planning area to shop.
- ☐ All areas of the lab should be visible from the classroom and planning area.
- ☐ Windows should be located 8' above floor.
- ☐ A display case near the auto technology and body labs is desired.
- ☐ The shop should have light gray walls, 5 feet high, with white paint up to the ceiling.
- ☐ Hard surface concrete floors are required in the shop, painted with a gray water-based epoxy, chemical resistant, no-slip, professional looking paint. The equipment and safe areas must be designated with a different paint color.
- ☐ Service desk needed in a central area with a computer and overhead projector viewer.
- ☐ A small instructional area is needed with a whiteboard that seats up to 25 students. This floor of this area should be painted a different color.
- ☐ Parking area for 4-5 training cars.
- ☐ All electricity should be ground fault breakers.
- ☐ 110-volt outlets are required throughout entire area per electrical code (walls).
- ☐ 220V lifts (staff will verify) and parts washing cabinet is required.
- ☐ There should be 220V outlets on several walls for welding in several areas.
- ☐ One duplex 110V receptacle should be fitted to stationary column of each lift.
- ☐ An eyewash station and emergency shower fixture is required in the shop.
- ☐ A wash-up area is required in the shop area with a commercial grade stainless steel trough sink.

- ☐ Two water outlets (one on each side of shop) should be provided. Two additional frost proof hose bibs should be located near an overhead door for outside car washing when weather permits.
- ☐ Reasonable access to both male and female restrooms should be provided. Rest rooms should not be located within the lab or class area.
- ☐ Screw air compressor (large enough capacity to service auto tech /auto body/and foundations) centrally located and adequately soundproofed so the noise is not intrusive in the classrooms/ offices. A back up compressor is requested.
- ☐ Air compressor should have a drier system located in compressor room.
- ☐ Emergency electric power shut-off switch; ground fault circuit breakers
- ☐ The following equipment is required in the shop (this list will need to be confirmed by the school staff)
  - ☐ Ten two post asymmetrical lifts with shop lights over each lift
  - ☐ One alignment lift with a shop light over the lift
  - ☐ One stock truck
  - ☐ One air conditioning service unit
  - ☐ Four battery chargers
  - ☐ One bench grinder with stand
  - ☐ One brake bleeder
  - ☐ One chain hoist
  - ☐ One drill press
  - ☐ Six engine stands
  - ☐ Two fire extinguishers located at opposite ends of the laboratory per codes and regulations
  - ☐ Six floor jacks
  - ☐ Eight pairs jack stands and storage shelf
  - ☐ Four oil drain unit—portable 5 gallon
  - ☐ One tire changer in addition to two relocated from current shop
  - ☐ Two transmission jacks
  - ☐ One parts washer w/side tray

- ☐ One computerized wheel balancer—road force
- ☐ Ten work benches with vices (one per lift station)
- ☐ One glass bead parts cleaner
- ☐ One hoist hydraulic
- ☐ Two brake lathes in separate areas with brake disc/drum storage shelf
- ☐ Two used oil storage tanks—100 gallon each (Located outside)
- ☐ One used antifreeze storage tank – 100 gallon (Located outside)
- ☐ Two overhead exhaust venting systems —one hose at each bay/lift
- ☐ Air hose reel for each student workstation
- ☐ One headlight aimer
- ☐ One oil filter crusher
- ☐ Fluid dispenser and area for four 55 gallon drums—new fluid
- ☐ Four high type safety stand
- ☐ One commercial washer and dryer
- ☐ A sanitizing goggle cabinet located next to the office
- ☐ Emergency safety center including eyewash.
- ☐ Rack for eight push brooms
- ☐ Rack for eight squeegees
- ☐ Rack for eight dust pans
- ☐ A dedicated outlet for a mobile laptop computer cart.

Classroom

- ☐ The teaching wall should be designed per DOC Facility Guideline Specifications.
- ☐ An electrical outlet for a mobile laptop cart is required.
- ☐ A location for a printer is required.

- ☐ Four metal shop benches for classroom demonstration and instruction are desired.
- ☐ A storage room that is accessible from the classroom is required.
- ☐ Classroom should be accessible from the corridor as well as the lab for scheduling flexibility and should have access to daylight.

Storage Room

- ☐ Two flammable storage cabinets are required.
- ☐ Storage for approximately eight engines, eight transmissions, floor jacks, engine hoists, and engine stands is required.
- ☐ Open metal shelving should be provided with a depth of 18” and 24”. To maximize space, wall shelving units that are above the work area should be used as lofts that do utilize lower floor space.

Tool Room

- ☐ Six lockable storage cabinets are required.
- ☐ Shelving for 100 two-drawer tool boxes is required.
- ☐ Open metal shelving should be provided with a depth of 18" and 24". To maximize space, wall shelving units that are above the work area should be used as lofts that do utilize lower floor space.

Outside Vehicle Storage Area

- ☐ Fenced parking/storage for approximately 25 vehicles (including EV vehicles) is required.
- ☐ Two Level 3 charging stations (DC Fast Charging)

Locker/Changing Area (s)

- ☐ The locker area should accommodate 40 double tier lockers (total of 80 lockers).
- ☐ The locker area should open to the laboratory area for easy supervision.
- ☐ A single user toilet should be provided in this area for student use.

Physical Education

Spatial needs
Main Gymnasium
Ticket Booth
Indoor Concessions Area
Second Gymnasium
Dance Studio
Dance Studio Storage Room
Fitness/Cardio-Pulmonary (Weight) Room
Fitness Storage Room
Wrestling Room
Wrestling Room Storage Room
Health Classroom
Locker Room
Inclusive Locker Room
Shower/Drying Room
Towel Storage Room
Toilet Room
Staff Office
Common Planning Area
Resource Teacher Office
Outdoor Storage
Storage

☐ The physical education facilities must conform to all national, state, and local safety regulations. The Architect is to refer to the "Mid-Level/High School Physical Education and Athletic Facilities Construction" Checklist, available from the DDC.

☐ There must be audible and visual signals for emergency egress.

☐ Six keys should be tooled for the physical education/athletics area. These keys include:

- ☐ Key #1 should open all indoor physical education offices, closets, and storage areas.
- ☐ Key #2 should open the gymnasiums, wrestling, weight, and dance rooms, locker rooms, and storage areas inside of these areas.
- ☐ Key #3 should open indoor athletic directors and coaches' offices, team rooms, and athletic storage areas.
- ☐ Key #4 should open all school outside doors related to physical education and athletics.
- ☐ Key #5 should open all outside storage areas and the press box/concession complex.

- ☐ Key #6 should open all the CUPF storage closets.

☐ All outside doors related to the physical education/athletic program areas should be keyed for reentry.

☐ The major entrance doors to the gymnasiums and lockers should be double doors with no center post. Non-glazed doors are preferred. If design allows, electronically controlled operable windows should be provided.

☐ All clocks, exit signs, and emergency signs should be caged for protection from sporting events.

☐ An alarm pad should be installed and zoned for the physical education/athletic area.

Main Gymnasium

☐ The Main Gymnasium is to have a hardwood sport floor. The ceiling should be 27' high clear.

☐ One of two configurations should be used for the main gymnasium regarding its relationship with the second gymnasium.

- ☐ First, and most preferable, if possible, the main gymnasium and second gymnasium should be adjacent and separated by a motorized dividing wall with walk through doors, so that when the dividing wall is open, there is an open space of 16,000 sq. ft. (10,000 sq. ft. from main gymnasium and 6,000 sq ft. from second gymnasium). The main gymnasium and second gymnasium should be combined, if feasible. Drop curtains should be provided in both gymnasiums so that when the dividing door between the gyms is closed, the curtains could further divide each of the two gymnasiums into two separate areas.

- ☐ If the main gymnasium and second gymnasium cannot be configured as specified above, then both gyms should have motorized dividing curtains to divide each gymnasium into two separate teaching stations.

☐ The controls are to be located over to the side and at eye level.

☐ Provisions for reducing glare are required.

☐ Appropriate LED lighting, acoustic treatment and high-volume ventilation are imperative.

☐ It is particularly important that ventilation functions equally and quietly on both sides of the curtain or folding wall.

☐ Emergency lights are needed for power outage situations. Emergency lights should be at least 12' from the floor.

☐ Attention should be given to the design of lighting fixtures and sprinkler heads so that they will not be damaged by indoor ball sports.

☐ If there is access to the outdoors from the gymnasium, a concrete landing is needed.

☐ White lighting should be used.

Fixed equipment is to include:

- ☐ 14 Senoh insertion-type volleyball floor plates and 10 Senoh insertion-type badminton floor plates re required. Floor plates must be installed per manufacturer's specifications.
- ☐ 10 basketball backstops, all of which must be electrically key-operated, must be provided.
- ☐ 8 backboards are to cross-court each half of the gymnasium. The crosscourt backboards may be fan-shaped aluminum with a target square.
- ☐ 2 backboards are to serve as the main court. The two main court backboards should be short rectangular glass with safety padding and hydraulic heavy-duty rims.
- ☐ Doors should not be located under any basketball backstop.
- ☐ All baskets should have safety straps.
- ☐ Wall safety padding (6' x 16') in school colors must be mounted under each basketball backstop 4" max AFF.
- ☐ Two electrically operable combination wrestling/basketball/volleyball scoreboards with variable 10- to 60-second basketball shot clocks (one with players' names) are to be installed – 6 person side panel.
- ☐ All electrical connections and outlets should be wall mounted not floor mounted.

☐ The Main Gymnasium should have the following striping patterns:

- ☐ One regulation volleyball court lengthwise, and two regulation cross volleyball courts, one on each side of divider curtain, each with two KA 25 volleyball sleeves.
- ☐ Four regulation 20 x 44 badminton courts on each half of gym, each with two KA 45 badminton sleeves, to use with badminton uprights.
- ☐ Three cross-court gym class volleyball courts, 30 x 44, each with two KA 25 volleyball sleeves.

☐ Bleachers are to be installed with 6' scorers' tables located on both sides of the gymnasium. Plug-in service for score table controls shall be provided to both sides of the bleachers and be wall mounted

☐ Bleachers must be motorized, have self-storing end rails and end panels. Consideration must be given for seating for the physically disabled per ADA. The bottom row of bleachers should stack.

- ☐ All risers must be equal in height, wall attached, have handrails at aisles, and comply with NFPA 102.
- ☐ There should be electric clocks in wire cages located on each half of the gym.
- ☐ A high-quality public-address system and sound system must be provided, and electronic controls should be located in closet off of the gymnasium.
- ☐ Several electric outlets should be located on all four walls as well as microphone and computer outlets.
- ☐ One duplex electrical outlet should be installed at the top of each section of the bleachers, placed close to center court.
- ☐ MCPS staff will provide court diagrams and approval prior to painting.
- ☐ Painting and wall graphics selected by staff are to be provided.
- ☐ All controls, fire alarms, doors, etc. should not be located behind baskets.
- ☐ Doors should not be within 6’ to either side of a basket to allow for sufficient padding along the walls.
- ☐ Consideration should be given in the design of fixtures/graphics to allow for hanging team award banners.

Main Gymnasium Lobby Area

- ☐ The lobby should be adjacent to the main gymnasium.
- ☐ Barriers are to be provided to deny access to other parts of the building from the main gymnasium/lobby area.
- ☐ School staff should be consulted on location of the security barrier so that offices and storage areas are accessible when the barrier is closed, particularly those related to athletics.
- ☐ Public toilet facilities and recessed electric water coolers should be available within the gymnasium/lobby area for use for indoor sports activities.
- ☐ Four recessed trophy cases should be located in hallways near the gymnasium. Two should be lighted.
- ☐ The athletic director's office should be located near the main gymnasium.

Ticket Booth

- ☐ A secure ticket booth must be provided and should be located between the main entrance and the lobby/restroom areas so that a person must pass the ticket booth before entering the lobby/restroom area.

Indoor Concession Area

- ☐ The indoor concession area must be visible from the gymnasium lobby.
- ☐ The concession areas need the following items:
  - ☐ stainless steel sink with garbage disposal
  - ☐ locking cabinets
  - ☐ stainless steel table
  - ☐ counters
  - ☐ ice machine (cubed not shaved)
  - ☐ space for a freezer, microwave oven, refrigerator, and popcorn machine
  - ☐ several electrical outlets with separate dedicated circuits

Second Gymnasium

- ☐ As specified in the configuration of gymnasiums section and in the main gymnasium description, there are two possible configurations for the second gymnasium.
- ☐ The preferred configuration would be that the second gymnasium be adjacent to the main gymnasium and separated from it with an electronically controlled folding wall so that one very large space will result when the wall is open.
- ☐ If it is not adjacent to
- ☐ In either design, the second gymnasium is to have a hardwood sport floor.
- ☐ The Second Gymnasium should have the following striping patterns:
  - ☐ One regulation volleyball court lengthwise, with two KA 45 volleyball sleeves.
  - ☐ Four regulation 20 x 44 badminton courts played across, each with KA 45 badminton sleeves, for use with badminton uprights (this setup allows a high school to host a badminton tournament with 12 regulation courts at the same time).

- ☐ Three non-regulation 30 x 44 gym class volleyball cross courts, with KA 25 volleyball floor sleeves. (this setup allows for nine gym class volleyball courts at the same time).

☐ This facility is to be directly accessible to the outdoors instructional physical education facilities.

☐ There should be a concrete landing.

☐ The ceiling should be 27' high.

☐ An electric folding door (as described in main gymnasium) should be included.

☐ LED lighting, acoustic treatment, and high volume ventilation system are imperative.

☐ It is particularly important that ventilation function equally and quietly on both sides of the folding partition. Emergency lighting is needed for power outage situations.

☐ Emergency lights should be at least 12' from the floor.

☐ Attention should be given to the design of lighting fixtures and sprinkler heads so that they will not be damaged by indoor ball sports.

☐ Paint colors and wall graphic layouts are to be provided by MCPS staff.

☐ All controls, fire alarms, etc. should be located to the side and at eye level, not behind the basketball backstops.

☐ An electric clock with cage should be installed in each side of the gymnasium.

☐ Computer outlets and a communications device outlets must be provided.

Fixed equipment is to include:

- ☐ Basic electric scoreboard with 45-second clock mounted on top of the main backboard should be installed.
- ☐ Two motorized, key-operated, glass, short rectangular basketball backboards with heavy-duty hydraulic rims, safety padding and safety straps should be installed serving the main court.
- ☐ Four bi-fold fan-shaped aluminum basketball backboards with hydraulic lift and safety straps are to be included.
- ☐ Wall safety padding 6' x 16' should be installed behind all basketball backstops 4” max AFF.
- ☐ Doors should not be located under any basketball backstop.
- ☐ 10 Senoh insertion-type volleyball standards and 5 Senoh insertion-type badminton standards should be installed per manufacturer’s specifications.

- ☐ Floor plates for gymnastic equipment must be provided. The floor plates must all be compatible with main gymnasium equipment.
- ☐ Two 10' x 42 ' archery nets are to be provided.
- ☐ A batting cage net for baseball and softball with keyed electronic hoist system should be included.

Dance Studio

- ☐ The ceiling should be no less than 16' high.
- ☐ The dance should have a sprung hardwood floor.
- ☐ There should be acoustic panels from the ceiling and on the walls as appropriate.
- ☐ An electric deodorizer system and an excellent ventilation system must be provided.
- ☐ Electrical outlets should be provided around the room.
- ☐ MCPS staff will provide paint colors and graphic layouts.
- ☐ The storage room needs to secure stereo sound equipment.
- ☐ A sound system should be installed in the storage closet.
- ☐ A small whiteboard (4' x 6') and tackboard (4' x 6') should be installed.
- ☐ Safety plate glass mirrors are to be provided on two opposite walls.
- ☐ A two-inch diameter ballet barre should be installed on the mirrored walls.
- ☐ A battery-operated clock with protective cover should be installed approximately 9' high.
- ☐ Data outlets and communication devices must be provided.
- ☐ A water filling station must be located in the hallway near the room.

Fitness/Cardio-Pulmonary Room (Weight Room)

- ☐ The ceiling should be a minimum of 16' high.
- ☐ This room must have high volume ventilation system as well as an electronic deodorizing system.
- ☐ Electrical outlets should be placed on all walls.

- ☐ Confirmation with MCPS central office PE curriculum specialist regarding equipment to be provided.
- ☐ An alcove for a mirror, with the mirror installed, should be provided.
- ☐ The floor should be rubber resilient flooring appropriate for weight training. This flooring must be glued to the sub-floor.
- ☐ LED lighting and acoustic treatment must be provided.
- ☐ Light switches are to be keyed.
- ☐ A small secure closet (minimum of 100 sq. ft.) should be provided to store audio equipment, loose weights, bars, and other instructional materials. Shelving should be provided along one wall.
- ☐ MCPS staff will provide paint color and graphics layout.
- ☐ Two large commercial ceiling fans with guards should be provided.
- ☐ A small whiteboard (4' x 6') and tackboard (4' x 6') should be installed.
- ☐ One electric clock with protective cover should be installed approximately 9' high.
- ☐ Computer outlet and a communication device must be provided.

Wrestling Room

- ☐ This room must be 43' x 43'.
- ☐ The ceiling height should be a minimum of 16' high.
- ☐ The room must be able to accommodate a 42'x42' wrestling mat, after wall padding is secured to the walls. Generally, wall padding begins a few inches above the floor.
- ☐ All four walls must be padded from the floor to a height of 6'.
- ☐ Colored acoustic panels should be provided from the ceiling.
- ☐ An electric deodorizer system and an excellent ventilation system must be provided.
- ☐ Electrical outlets should be provided around the room.
- ☐ MCPS staff will provide paint colors and graphic layout.
- ☐ A small storage closet is needed to secure stereo equipment.
- ☐ A sound system with the control panel should be installed in the storage closet.

- ☐ A small whiteboard (4' x 6') and tackboard (4' x 6') should be installed.
- ☐ One electric clock with protective cover should be installed approximately 9' high.
- ☐ Computer outlet and a communication device must be provided.
- ☐ A keyed electric hoist system must be installed to move and store wrestling mats.
- ☐ A water filling station must be located in the hallway near this room.

Health Classroom

- ☐ The health classroom is to be designed as a standard academic classroom per the specifications found in the academic section.
- ☐ This classroom should be located within the physical education areas since the health and physical education teacher may be the same person and may have locker room supervision duty between class periods.

Locker Rooms

- ☐ The following are requirements for both the male and female locker rooms.
- ☐ The locker rooms should be on the same floor as the gymnasiums. Ideally, there should be direct access from the locker rooms to the gymnasiums.
- ☐ The locker rooms need an outside exit for use by physical education classes. This exit door must be keyed for re-entry by classes and after-hours maintenance issues. This is a card reader access point.
- ☐ A maze entrance should be designed to block vision from the hallway.
- ☐ The rooms are to be air-conditioned and include a deodorizing system.
- ☐ Barriers or doors are to secure the locker rooms from other areas.
- ☐ All locker room floors are to be skid-resistant VCT. The floor surface must be safe but smooth enough for thorough cleaning.
- ☐ Hose bibs are required near the shower area as well as within proximity to the restroom area.
- ☐ Appropriate drainage is needed.
- ☐ Lockers should be located to provide good visual supervision from the offices.
- ☐ An electric water cooler, clock, board, and a 4' x 8' tackboard should be supplied in each locker room. If not inside, the water coolers should be located as close to the entrances as possible.

- ☐ A programmable locking system should be installed on the locker room entrances.
- ☐ The architect should provide maximum security in the locker areas by use of cages and screens to secure the physical education lockers during after-school use of the area.
- ☐ To the extent feasible, MCPS should provide at least one inclusive changing facility into the design of new schools and school renovations, taking into account safety and confidentiality considerations in the design and location of the inclusive changing facility.

Lockers

- ☐ Each locker room is to have triple tier (3 in 1) lockers, 72"H x 12"W x 15"D with built-in combination lockers and ventilation. There should be an equal number of lockers in the male and female locker rooms.
- ☐ The lockers should accommodate student backpacks.
- ☐ ADA lockers should be provided in each locker room to accommodate a minimum of 5% or as required by code, of the program capacity of the school.
- ☐ Ten lockers with key locks should be provided.
- ☐ The locker colors should reflect the school colors.
- ☐ Locker rows are to be a minimum of 7' 6" on the center.

Benches

- ☐ Benches used for dressing purposes, including ADA benches, are to be secured to the floor with a single bench between locker rows. ADA benches should be in close proximity to ADA lockers.
- ☐ They are to be secured to the floor base with a single bench between each locker row.

Shower/Drying Area

- ☐ The shower area is to be free from hazardous projections and is to be well ventilated.
- ☐ Each shower room is to have 4 individual showers and one handicapped accessible shower, with modesty panels, a nonskid floor surface and recessed soap dishes. Marble thresholds are required at the shower to floor transitions.
- ☐ Skid grip flooring must be installed.
- ☐ All showers should have shower rods and curtain installed.

☐ The shower room should be designed adjacent to space, that if needed in the future, the shower room could be enlarged.

Toilet Rooms

☐ Male and female toilet rooms must have equal number of fixtures.

☐ 2 full-length mirrors not over sinks are to be provided.

Inclusive Locker Rooms

To the extent feasible, MCPS should provide at least one inclusive changing facility into the design of new schools and school renovations, taking into account safety and confidentiality considerations in the design and location of the inclusive changing facility.

This space should be master planned in the building with the following features:

☐ Interior double door entrances with maze to block vision into space must be designed.

☐ Some shelves should be provided near the entrance to the locker room for student books.

☐ The locker rooms should be well ventilated and include a deodorizer system.

☐ The locker room should be adjacent and located on the same floor so that the Physical Education Offices can have a connecting door to the offices to allow for supervision of the space.

☐ Fifty lockers should be provided in this space with several lockers with key-entry are needed for ADA accommodations.

☐ Small private dressing areas are to be provided in the inclusive locker area with one meeting ADA requirements.

☐ A full-length mirror is to be provided in the room with a convenient electrical outlet.

☐ The locker room should reflect school colors.

☐ Plumbing should be roughed in for a future toilet room.

☐ The floor surface must be a non-skid surface but smooth enough for thorough cleaning. VCT/rough surface tile is preferred.

Staff Office

☐ The two offices should be adjacent and centrally located for access by both male and female students.

- ☐ Each office needs to be separated from the other office by a common planning room and have access to the hallway leading to the gymnasium.
- ☐ There should be direct access to the appropriate locker room.
- ☐ Each office requires a separate shower, toilet, sink, mirror with shelf over sink that is large enough to use as changing areas for the physical education staff.
- ☐ Each office requires 6 full-length lockers.
- ☐ A full-length mirror is required.
- ☐ The office needs windows with blinds for effective supervision of the appropriate locker room.
- ☐ The windows should be placed so that staff in the common planning area cannot see through the staff office into the locker room
- ☐ The space must be air conditioned.
- ☐ The office suite needs voice, data, and video connections.
- ☐ 4 tackboards, 2" wood tack strip (5' high around the perimeter of the room) are needed.
- ☐ The floors should be covered in VCT.

Common Planning Room

- ☐ A common planning room is required and should have access from both physical education offices and the hallway.
- ☐ The space should be large enough to allow for a small conference table with 6-8 chairs.
- ☐ It should be designed with locking cabinets, counters, clock, voice, data, and video connections.
- ☐ This room needs a tackboard and a whiteboard.

Resource Teacher Office

- ☐ This office should be located as part of the staff offices and have access to the common planning room.
- ☐ This office needs voice, data, and video connections.
- ☐ A tackboard and whiteboard should be installed on one wall.

General Storage

- ☐ General indoor storage for physical education and athletics must be provided in various locations.
- ☐ Five indoor storage closets, approximately 400 sq. ft. each are to be located on the same level and near the gymnasiums.
- ☐ Two of the storage areas are exclusively for athletics and should be rectangular in shape and have wire caging from floor to ceiling along the two long walls.
- ☐ Approximately every 4-5 ', floor to ceiling partitions should be installed to divide the long area into smaller storage spaces. These smaller spaces will be used for storage by separate sport teams.
- ☐ Each small section should have a rod for hanging uniforms and shelves for storing equipment.
- ☐ Each section shall have a door that can be padlocked.
- ☐ Adequate shelving, hooks, and bins for golf clubs, baseball bats, hockey stick, lacrosse sticks, uniforms, and warm-ups are required for physical education use.
- ☐ One of the storage rooms will be used to store wrestling mats, gymnastic equipment, chairs, and tables.
- ☐ The main access to the equipment closets should not have center posts. They should be able to be held open for each of equipment movement.
- ☐ One of the small storage rooms will be used for community use (ICB) and should have straps to store the volleyball standards along one wall (about 10’ long).

Athletics Facilities

Spatial needs
Team Room
Large Team Room
Athletic Director's Office
Athletic Department Storage Room
Coaches' Office
Coaches' Closet
Referee's Office
Football Equipment/Uniform Drying Room
Training Room
Laundry Room
General Storage
Chair and Table Storage
Storage

Team Rooms

- ☐ The large team rooms need to be equipped with 75 lockers, 72" H x 16" W x 15" D, with built-in padlock locks and benches.
- ☐ The small team rooms need to be equipped with 50 lockers 72" H x 16" W x 15" D, with padlock locks and benches.
- ☐ All the lockers must have vented fronts.
- ☐ The team rooms need to be well ventilated and air-conditioned.
- ☐ Each team room needs a mirror, 4' x 6' whiteboard, electrical outlets and tackboard.
- ☐ All the team rooms should be accessible for male and female sports.
- ☐ Door locks shall be of the "keypad" variety.
- ☐ For security purposes, team rooms should be accessible without going through the main locker rooms.

Athletic Director Office and Storage

- ☐ The athletic director's office should be located near the main gymnasium.
- ☐ It must be on the gymnasium side of the security barrier.
- ☐ This office needs voice, data, and video connections.

- ☐ A tackboard and whiteboard should be installed on one wall.
- ☐ A secure closet (60 sq. ft.) and counter with overhead lockable cabinets should be provided.

Coaches Office and Closet

- ☐ Coaches' offices and small closets are to be provided near each team room.
- ☐ A dressing/locker area needs to be provided in the offices, including six full 12" W x 15" D lockers and four double tiered lockers.
- ☐ Electrical outlets as well as voice, data, and video connections are required.
- ☐ A small secure storage closet off each office is needed.
- ☐ Visual supervision of the team rooms is desired.
- ☐ A 24" work counter with locking cabinets above should be provided along one long wall.

Referee Office

- ☐ A referee's office is to be provided with easy access to the staff showers.
- ☐ A dressing/locker area needs to be provided in the offices, including two full 12" W x 15" D lockers.

Football Equipment Drying Room

- ☐ It must have maximum ventilation including an electrical deodorizing system.
- ☐ A hanging rack system shall be installed so that it can be reachable by students during the season and removable for storage near the ceiling during the off-season.

Training Room

- ☐ A co-ed athletic training room needs to be accessible from both girls' and boys' locker rooms and team rooms.
- ☐ A water supply, whirlpool, and ice machine need to be provided.
- ☐ Training tables, sink, locking cabinets, and privacy curtains are needed.

Laundry Room

- ☐ The laundry room must be accessible from each locker room.
- ☐ It needs to be well ventilated and have a floor drain.
- ☐ An industrial washer (50 lb. capacity), dryer (50 lb. capacity), and laundry tub are to be installed.

Library Media Center (LMC)

Spatial Needs
Main Learning Environment
Work and Production Area
Storage
Television Studio/Control Room/Editing Rooms
Media Services Technician Office/Storage
Storage (Near the Auditorium)

- ☐ The Library Media Center (LMC) is the information hub of the school.
- ☐ The latest version of the MSDE document, *Facilities Guidelines for Library Media Programs,* may be used as a reference for the design of the LMC.
- ☐ The LMC should be centrally located and easily accessible from the main entrance.
- ☐ There should be easy access to the elevator.
- ☐ Toilet rooms should be located nearby the LMC.
- ☐ Sight lines are an important feature in the design of the LMC. Staff should have visual supervision of the entire LMC including the entrance from the LMC circulation desk.
- ☐ Zoned lighting with the ability to darken separate areas of the main resource room without affecting other spaces.
- ☐ The LMC should not be located below or across from high noise level activities such as music, technology education, cafeteria, or physical education.
- ☐ Multiple charging outlets need to be provided throughout the LMC and can be located in the floor, walls, and counters.
- ☐ Consideration should be given to the location of the circulation desk and seating areas that may require data and power for the use of computers or staff/student work areas.
- ☐ Ideally, a countertop with outlets above the counter should be provided along one of the walls of the LMC to allow users to plug in portable devices. The counter should be located in an area that can be easily supervised and at a desk top height so that chairs can be interchanged in the library.

Main Learning Environment

This is the main area of the library that includes the stacks, instructional space (main, secondary, and collaboration rooms), and circulation area.

Stacks (the area containing bookshelves)

☐ The height of the low moveable bookshelves should accommodate three rows of books and the height should be at least 48 inches in order to accommodate fiction and nonfiction books.

☐ Must be on wheels to allow for flexibility.

☐ Lights should be designed to allow for flexible arrangement of shelving in the main reading room.

☐ Metal shelving is to be used.

☐ Soft, comfortable seating should be provided for individual and collaborative student work and power should be provided throughout this area.

☐ Consideration should be given to shelving for special types of collections such as graphic novels, and oversized books including some picture books.

☐ Wall shelving should be maximized in this area. (six feet when possible).

☐ If there is a special program focus at the school, consideration should be provided for space for a collection that supports the specific program. The design team should consult the School Library Media Program Office for more information.

☐ Shelving is to be allocated on average as follows:

	Linear Feet	Shelving Space
Non-fiction books	530	11”
Fiction Books	670	10.5”
New Book/Interest Display	36	12”
Media Center Storage (20-24” depth)	As space allows	N/A

Circulation Area

☐ The architect needs to identify a location for a circulation desk that is large enough to accommodate two computer workstations and a networked printer to access the online catalog system.

- ☐ If space permits, storage cabinets should be provided in the circulation area for miscellaneous activities such as book repairs and holds.
- ☐ The circulation desk furniture package will include the following features:
  - ☐ a storage area for book return carts;
  - ☐ a book return container to catch the books;
  - ☐ supplies drawers;
  - ☐ a writing area unit; and
  - ☐ an area for a laser printer and supplies.
- ☐ The front height of the circulation desk should have an area that does not exceed 42" in height.
- ☐ There should be two means of egress for the circulation desk.
- ☐ The work surface for the staff member should meet ADA compliance with optimal ergonomics (keyboard height).
- ☐ Electric and Ethernet need to be provided

Instructional Areas: Main and Secondary and Collaboration Rooms

Main Instructional Area

- ☐ Sight lines are an important feature in this area. Staff should have visual supervision of the entire LMC from this area.
- ☐ A teaching wall area designed for an interactive board should be included.
- ☐ This area should include table and chair seating as well as soft seating so that the combination of seating totals 32. A variety of heights in the instructional area for students including standing and sitting options should be provided.
- ☐ This area should be carpeted.
- ☐ The space should be easy to reconfigure for a variety of uses and groupings with the use of flexible furniture to support whole class, small group, and project based learning activities.
- ☐ The instructional areas need access to all forms of technology in the school including wireless access.

Secondary Instructional Areas

- ☐ Additional informal instructional areas should be identified and located within sightlines of the

circulation desk.

☐ The flooring in this area should be VCT or other hard surface material. This area may also be used during the day for lunch.

Collaboration Rooms

☐ At least two small group collaboration rooms should be provided near the secondary instructional area that allows for students to be visually supervised, but work independently.
- These rooms should be floor to ceiling glass for easy supervision.
- These rooms should be carpeted
- Consideration for sound absorbing panels/acoustics on the ceiling or walls of these rooms
- The collaboration rooms may be different sizes.

☐ Data and electrical should be provided to accommodate a collaboration technology table.

☐ These rooms should be glass enclosed.

☐ These spaces should be carpeted.

Work and Production Area

This area was formerly two distinct spaces: the library media specialist office and library media center workroom. The new combined space now supports the library media staff functions and is also used as a multipurpose space to include maker activities for student and school staff use.

☐ The work area should be delineated through the use of a different ceiling height or half wall.

☐ This room requires VCT floor material.

☐ Consideration for a counter for student use is preferable.

☐ Adequate electrical and data outlets are to be designed in consultation with the library media Specialist and central office staff members. Dedicated circuits may be required.

☐ It must contain a sink with hot and cold water, in addition to ample worktops for library media processing, student and teacher use.

☐ Space is needed for four staff workstations. This can be built-in or through furniture. This includes one desk/workstation each for the media specialist, media assistants, and media services technician.

☐ Three lockable wardrobes need to be provided. Power will be required. See media center specifications available from the MCPS Facility Guideline Specifications.

- ☐ This space needs to contain open shelving to accommodate materials for student use such as maker space supplies and hands on activities as well as closed lockable cabinets for library media center supplies.
- ☐ Space should be provided for a networked school printer and 3D printer that is accessible by teachers and students. Identify the locations on the plans as a dedicated circuit will be required.
- ☐ Electric and data should be located on all walls to provide flexibility in the use of the space.
- ☐ The work area includes space for collaborative planning and processing of library media materials.

Library Media Storage

- ☐ The library media storage room provides for storage of library media materials, equipment, seasonal materials and supplies.
- ☐ This room requires and SKD key.
- ☐ Electric and Ethernet should be provided to accommodate library media technology needs.
- ☐ A variety of shelving should be provided for instructional materials for teacher use such as DVDs, audio book resources, and equipment with some open space to accommodate computer cart storage.
- ☐ Varied depths of shelving should be provided including 6”, 12” and 24” deep.
- ☐ Shelving should be metal.
- ☐ Consideration of having a storage room large enough to use as a holding space for students/classes during a lockdown situation if the media center is not able to be secured on all sides and/or has a large amount of glass from the outside looking in.

Television Studio/Control Room/Editing Room

- ☐ The studio requires a control room to house audio recording equipment complementing the video equipment. A window from the control room to the studio is required.
- ☐ The studio requires 12' high ceilings for lighting equipment.
- ☐ The studio needs storage for related equipment and is to be easily accessible from the outside through a separate entrance so that it can be isolated from the rest of the building.
- ☐ A pipe grid should be provided for the lighting system with a professional LED and spotlight fixtures. A dimming system is also essential for flexibility and heat management.
- ☐ Utilities are to be separately metered including air conditioning, since the lights can become very hot.

- ☐ Ceiling-mounted HVAC units are needed to provided adequate ventilation and cooling to offset the heat from lighting especially.
- ☐ A light dimming control system (Such as Colortran) should be provided.
- ☐ A black ceiling at approximately 12 feet from the floor to allow for lighting clearance and minimize reflections.
- ☐ The floor should be VCT.
- ☐ No exterior windows are preferred to help control the lights in the room.
- ☐ Adequate ventilation and temperature control is to be provided in the studio.
- ☐ A full green chroma key wall shall be provided to all allow for quality virtual backgrounds.
- ☐ Heavy curtains for sound absorption on a curtain track as well as acoustical panels are needed to improve audio quality for recording.
- ☐ A teaching wall with data and power for a mobile interactive board, and marker board.
- ☐ A separate control room with a large viewing window, including built-in counters, multiple power/data outlets, and meeting ADA requirements.
- ☐ The editing rooms require outlet strips and data above built-in counters. They need to be ADA accessible.
- ☐ A connection/hole in the wall is needed at the floor level between the control room and television studio to allow cables to go between the two spaces.

Media Services Technician Storage

The media services technician (MST) should be provided a desk, like the other media staff members, in the work/production space of the media center. There should be considerations for a MST storage area where equipment can be worked on, stored and/or secured.

- ☐ The workspace for the Media Services Technician should be located in the work/production area of the media center.
- ☐ There should be a MST storage area, either within the larger media center storage area or in a smaller separate storage area that contains a work counter with cabinets above and below, and a pegboard, mounted to the wall.

Auditorium Storage (Near Auditorium)

- ☐ This room should be located adjacent to the auditorium and should be furnished with shelving and cabinetry appropriate for storage of audio and video equipment.

Auditorium

Spatial Needs
House Area
Ticket Booth
Concession Booth
Stage
Orchestra Pit
Orchestra Pit Storage
Scenery Construction/Storage
Stage Office
Make-up Room
Dressing Room
Costume Storage
Projection Room
Lighting Equipment Storage
Costume Construction
Musical Equipment/Piano Storage

☐ The auditorium will be designed with capacity for 900 seats. The ability to provide for a variety of seating capacities (400-900) should be explored. Proper lighting still needs to be provided for the different seating arrangements.

☐ The auditorium will be used by school and community personnel for performing arts, dance, and musical programs, student meetings and programs, lectures, assemblies, films, debates, and large-group instructional activities. The design of the auditorium must permit a desirable acoustic audience experience.

☐ To support different styles of theatrical performances, the auditorium requires proscenium, thrust, modified open, and arena-type stages. One of the important functions of the auditorium is to permit teaching students the aspects of theater.

☐ The electronic and electric systems of the school need to be extended into the auditorium. These include bells, fire alarm, buzzers, telephone, and public address and custodial call systems. However, the ability to turn off bells, buzzers, public address system, etc. is required.

☐ Cable system and wireless internet. Connection between auditorium and TV Studio. Wi-Fi should extend into the lobby.

☐ House lights with control and dimmer are required. Ceiling access to locally maintain the house lights should be provided.

☐ Exterior lights are needed on the auditorium.

☐ Emergency lights need to be installed in the house and backstage. Aisle lights must be provided.

- ☐ There should be an adequate lobby with public toilets (toilets should not share a wall with the auditorium), drinking fountains, and ticket booth, built in area for serving of refreshments, and storage.
- ☐ Security barriers are required to deny access to other parts of the building from the auditorium/lobby area.
- ☐ Ticket booth (box file) with access only from a secure area is required.
- ☐ A billboard and lighted display cases accessible from the rear mounted near the ticket booth.
- ☐ A building service closet with mop sink must be located near the auditorium lobby.
- ☐ Electrical and telephone backup control access doors/panels should not be located in the hallways.
- ☐ A separate area for chairs, acoustic shells, risers, dance floor, scaffolding, near the stage, should be provided.

House Area

- ☐ The auditorium should contain a total of 900 fixed cushioned seats in one main area. Tandem-mounted seats (or riser-mounted if there are risers) permit easier maintenance and cleaning
- ☐ The house may be designed with stadium-style or raked-style seating. (pitch at Watkins Mill HS and stadium seating at QO HS are ideal).
- ☐ No two seats in each row of the house should have the same number.
- ☐ Seating and aisles should be designed with circulation patterns and fire and safety codes in mind.
- ☐ An assistive listening device for the hearing-impaired should be installed in the house area.
- ☐ Wheelchair seating areas in the house area should be provided.
- ☐ Light lock doors should be included at entrances at the rear on both sides to ensure that the auditorium can be dark for shows.
- ☐ Doors to the auditorium need to be able to open and close silently. A vestibule is preferred.
- ☐ An electronically operated movie screen in front of the proscenium is required.
- ☐ Controls should be both located in the booth and the wings. No record buttons should be added to the lights that are backstage.
- ☐ Tormentor bars are needed in the house.

☐ The architect should provide for a sound table with built-in conduit at the back of the house with appropriate storage. The sound and light boards should be portable so they can be plugged in backstage, in the house, and in the booth.

☐ A left and right area designated for follow spots in the house that do not require removal of seats or obstruct sight lines is required.

Ticket Booth

☐ A secure ticket booth must be provided and should be located between the main entrance and the lobby/restroom areas so that a person must pass the ticket booth before entering the lobby/restroom area.

Concession Area

☐ The indoor concession area must be visible from the house lobby.

☐ The concession area needs the following items:

- ☐ stainless steel sink with a garbage disposal
- ☐ locking cabinets
- ☐ stainless steel table
- ☐ counters
- ☐ ice machine (cubed not shaved)
- ☐ space for a freezer, microwave oven, refrigerator, and popcorn machine
- ☐ several electrical outlets with separate dedicated circuits

Stage

☐ This area should be 40' to 50' deep and 150' wide, with a proscenium opening of approximately 48' to 54' by 17'.

☐ A stage apron of approximately 8' with steps from the house is required.

☐ Cyclorama and stage curtains are to be provided. Staff, including the arts faculty, will work with the architect to design and choose the appropriate colors.

☐ Piano storage should be stage level and lockable.

☐ Acoustics of the stage are to be carefully studied.

☐ The stage is to be equipped with good sound projection both with and without amplification.

- ☐ The stage should be equipped with a production capable sound and lighting system. Confirm with MCPS FA on equipment capabilities and required quantity of mics to be provided.
- ☐ Electric outlets should be provided on the floor of the stage.
- ☐ Electrical and microphone outlets should be provided on the front wall of the stage house. A Three outlets on dedicated circuits are required.
- ☐ Microphone outlets are to be available at the front, side, rear of the stage and pit area.
- ☐ The stage flooring should be of edge-grain tongued and grooved pine with a non-reflective black finish.
- ☐ Ramped wheelchair access to the stage must be provided. No mechanical lifts should be provided.
- ☐ Railings must minimize site line obstructions from the house to the stage.
- ☐ Drop down screens should be provided on either side of the stage for projecting during performances or other school events. See MCPS standards.

Communications

- ☐ Communications are needed to connect the stage with the backstage, lighting-control, and sound-control areas, and control room at the rear of the auditorium, to the pit, director's office, the dressing rooms and the foyer.
- ☐ Head set communication and a monitor system are needed to connect all stage areas with all technical and performance operations. (i.e. backstage, lighting-control, sound-control areas, spot-ops, control room at the rear of the auditorium, pit, director's office, dressing rooms, and foyer.)

Ventilation

- ☐ Ventilation and air movement for the stage should be separate from the auditorium.
- ☐ Great care must be exercised to avoid introduction of unwanted and otherwise undesirable sounds from ventilation or other air-handling equipment.
- ☐ The requirements for stage lighting and other supporting and related mechanical/electrical systems will be carefully reviewed with the architect as plans progress.
- ☐ A separate HVAC system is needed for control for after-hours use.

Orchestra Pit

- ☐ The orchestra pit must be large enough to accommodate 50 performers.

- ☐ Access other than through the main house area should be provided.
- ☐ Electric outlets should be provided on the floor of the pit as well as the sides and walls.
- ☐ Access to pit must be provided for persons with disabilities.
- ☐ A small amount of lockable storage space is needed off the pit for instrument storage.
- ☐ A cable jack should be located in the pit to the booth and backstage.
- ☐ A pit cover will be provided per DPC design guidelines.

Offstage Area

Scenery Construction/Storage Area

- ☐ This room should have a ceiling height of approximately 20 ft. and easy entrance to the stage area.
- ☐ The exterior entrance should be 8 ft. wide and 10 to 14 ft. high.
- ☐ There should be easy delivery to the stage and stagecraft or scenery shop.
- ☐ 240 volt outlets for larger tools like dust collectors, cabinet saws, planers, etc.
- ☐ A dust collection system to be installed preferably from the ceiling to keep hoses off the floor.
- ☐ Fume Hood/paint booth
- ☐ Lockable storage cabinet for tools.
- ☐ Lockable storage cabinet for paints/chemicals.
- ☐ There needs to be a master outlet kill switch with a locking key. This allows the instructor to not only kill the electricity in case of an emergency but also lock out the use of outlets without supervision.
- ☐ Sheet goods rack, lumber rack (horizontal), and storage space.
- ☐ A loading dock at truck level with access to the stage area is preferable.
- ☐ An industrial sink with 3” drain with a special trap to collect contaminants for washing brushes.
- ☐ Work benches
- ☐ Eye wash station with drain
- ☐ This area must be provided with separate ventilation for quickly eliminating paint, dust, and other potentially toxic fumes or materials in the air caused by set construction activities.

Stage Office

- ☐ The office is needed near the stage and workshop.
- ☐ A separate telephone line is required.
- ☐ Data drops are required in this office.
- ☐ Space for a desk, and chair.

Make-up Room

- ☐ The make-up room needs a sink with hot and cold running water.
- ☐ Provide dimming tunable white LED fixture with a range of 2700K to 5000K at 90 CRI.
- ☐ It should contain lockable storage cabinets, tabletop height work shelves along two sides with mirrors and lights (see note above), and several electrical outlets.
- ☐ The make-up room should have student lockers and 6 portable clothing racks.

Dressing Rooms

- ☐ Separate rooms are required for males and females and an inclusive room that will include the following:
  - ☐ dressing counter
  - ☐ Mirrors
  - ☐ Provide dimming tunable white LED fixture with a range of 2700K to 5000K at 90 CRI.
  - ☐ Tack board
- ☐ These rooms should be adjacent to the make-up room.

Single Use Toilet Rooms

- ☐ Two single use toilet rooms should be located near the dressing rooms.
- ☐ These rooms should each have a toilet, sink, and mirror.

Costume Storage

- ☐ The costume storage needs pipe racks. (12 portable racks)
- ☐ There is need for large double doors and good ventilation and lighting.

☐ Shelving should also be provided.

Lighting Equipment Storage

☐ Pipe racks for hanging lights are required.

☐ Appropriate storage cabinets are needed.

Costume Construction

☐ An area of 225 square ft. is required with durable floor covering that is easily maintained.

☐ This room should contain work tables, sewing machines, ironing boards, clothes racks, storage cabinets, board, and is to have adequate lighting.

☐ A small alcove is to contain equipment for washing and drying.

Projection Room

☐ Design of this must be coordinated with MCPS Fine Arts Curriculum staff.

☐ Sliding glass will be required on the house side of this booth.

☐ Adjacent to this booth, separate enclosed areas at booth level are needed for spotlights.

☐ Lighting System and Dimmer—Attention is called to established criteria for auditorium stage and house lighting. These guidelines are to be employed by the architect and engineer in close cooperation with facilities management and will be transmitted to you under separate cover.

☐ Audio Systems—Theatrical equalizers and three-speaker systems should be considered. It is important to install "limiters" as part of the sound system to prevent power surges and/or equipment misuse. Attention is called to established criteria for auditorium sound systems. These guidelines are to be employed by the architect and engineer in close cooperation with facilities management and will be transmitted under separate cover.

☐ Acoustics is an important consideration possibly requiring consultative help.

☐ Heating, Ventilating, and Air-conditioning—Shall be zoned or separate; unwanted noise must be minimized.

☐ Established criteria for stage house rigging and counterweight systems are to be followed if the budget allows for fly loft space to be built.

Musical Equipment/Piano Storage

- ☐ Locked storage for a concert grand piano should be provided with access to the stage.
- ☐ The entrance to this storage should have a flat floor without a sill.
- ☐ An additional space is needed off stage for musical equipment storage.

Amphitheatre

- ☐ If design and budget allow, an amphitheater or pit, to seat approximately 150, should be designed in a circulation area.
- ☐ The area must be easy to supervise yet designed so that classroom instruction can take place for a large group.
- ☐ This area will also serve as a gathering place before and after school as well as an eating area during lunch period. This area will not have permanently installed seating.

Student Activities Facilities

Spatial needs
Student Council Suite
School Store
School Store Storage
Journalism Staff Room
Yearbook Staff Room
Literary Magazine Staff Room

Student Council Suite

- ☐ The student council suite needs direct access to a main corridor.
- ☐ Storage cabinets should be built-in. The room should have whiteboard, tackboard, lockable storage and a window into the hallway.
- ☐ A display board for announcements should be located near the door.

School Store

- ☐ The school store should be located near the gymnasium.
- ☐ This room has a manual roll up overhead door over the counter.
- ☐ It needs a transaction counter, shelving and display areas.
- ☐ Special consideration is to be given to security and to accessibility so as not to block the corridor during heavy usage.
- ☐ A storage area should be located adjacent to the student store.
- ☐ A corridor showcase for display should be included.
- ☐ Lockable tall storage is necessary.

Yearbook, Journalism, and Literary Magazine Staff Rooms

- ☐ The yearbook, journalism, and literary magazine staff rooms may be located near standard classrooms or near a centrally located area near the cafeteria and main gathering area for students.
- ☐ If these rooms are located adjacent to standard classrooms, the rooms should have an adjoining door to a classroom and a large window between the student staff room and classroom to allow for supervision by staff.

- ☐ If these classrooms are located in a central student area, the rooms should have large windows between the rooms to allow for supervision by staff.
- ☐ These rooms require lockable storage for student work.
- ☐ These rooms should be designed for two-four computer workstations.

Staff Offices

Spatial needs
Signature Coordinator Office
Staff Development Office
School Psychologist Office
Internship Coordinator
IT Systems Specialist Office
Support Staff Offices

Staff Offices

- ☐ All staff offices should be designed with two computer outlets to allow for two staff offices.
- ☐ Each office requires a telephone line.
- ☐ The Support Staff offices furniture layout should be shown with two staff persons, all other offices should be shown with one staff person at this time.
- ☐ No built-in cabinets should be designed in these offices.
- ☐ A magnetic whiteboard should be provided in each office.

Administration Suite

Spatial needs
General Office
Principal's Office
Assistant Principal's Office
Administrative Support Office
Principal's Secretary Office
Business Manager Office
Financial Assistant's Office
Business Manager Storage Area
Waiting Area (Business Manager)
Conference Room
Large Team/Testing Room
Testing Room
PTA Storage Room
Storage
Attendance Office
Office Workroom/Storage/Toilet Area
Photocopy Workroom

General Office

☐ There must be special attention given to the flow of traffic, seating, lighting, and fenestration as well as wall color and arrangement of employees' work areas.

☐ Staff mailboxes are to be easily accessible without going through the public waiting area. There are to be a minimum of 150 boxes at least 10 inches wide plus five additional boxes that are somewhat larger, with space provided for expansion to 200 boxes.

☐ Voice, data, and video connections are needed for all staff in the administrative suite.

☐ The general office area must include a coat closet for administration and visitor use and a small lockable closet (about 2 ft. by 4 ft.) with double doors for PTSA storage.

☐ The attendance secretary should have a window to the corridor.

☐ The general office is to have easy access to toilet rooms, privacy room, and coat closet.

☐ Carpet shall be used in the individual offices and conference room within the suite.

☐ VCT is to be used in the all the other spaces.

Principal's Office

- ☐ This office requires an outside window, a public entrance connected to the main office, and a private entrance.
- ☐ The principal's secretary is to be located adjacent to the principal's office and have a private office.
- ☐ These areas are to relate effectively with each other as well as to the general office.
- ☐ A toilet room should be provided in the principal's office. MCPS standard is ceramic tile flooring.
- ☐ The office should be adjacent to the conference room, as well as have direct access if possible.

Principal Secretary's Office

- ☐ The principal secretary's office should be located near the principal's office and close to the general office.
- ☐ The office should be designed with a window to the general office to allow for supervision of the space by the administrative secretary.

Assistant Principal's Office

- ☐ A student waiting area close to the assistant principals' offices should be provided.

Conference Room

- ☐ The conference room should be located close to the principal's and assistant principals' offices and be directly accessible to the corridor.
- ☐ Data outlet for a presentation board should be provided.
- ☐ A telephone is needed in this room.

Large Team/Testing Room

- ☐ This room requires two dedicated 20 amp electrical circuits for a charging mobile laptop carts.
- ☐ This room requires an interactive teaching board along one wall and a CNO for the computer.
- ☐ A work counter with sink and electric outlets is required. Dedicated circuits are required for each outlet to accommodate microwaves or similar appliances in this space.

- ☐ Wall and base cabinets with a sink should be designed along one wall of the room.
- ☐ Magnetic whiteboards should be provided in this room.

Testing Room

- ☐ School and/or central office staff test individual students or small groups of students. Typical testing includes psychological, diagnostic, vision/hearing, gifted, and makeup testing for required standardized tests. This room also will be used to accommodate post-test conferences with teachers and/or parents.
- ☐ This room should be designed as a secure room for testing materials and should have a counter with lockable cabinets above and below.
- ☐ This is an SKD keyed room.
- ☐ This room needs acoustical treatment as well as video, voice, and data outlets.

Attendance Office

- ☐ The attendance office should be accessible to a corridor and is needed for keeping attendance records.
- ☐ A window counter to the corridor is needed.
- ☐ This should be located near the front entrance.

Offices, Workroom, Storage, and Toilet Rooms

- ☐ These areas should be located to serve the general office employees.
- ☐ A work counter with sink and electric outlets is required. Dedicated circuits are required for each outlet to accommodate microwaves or similar appliances in this space.
- ☐ The storage room is to be adjacent to and relate well with the workroom and should not be directly accessible to the corridor. Casework for general office employees is to be provided.
- ☐ A sink cabinet and space for full size refrigerator are to be located in this room.
- ☐ Staff mailboxes are to be readily accessible but not visible from the main entrance and are to contain 150 boxes at least 12 inches wide plus five additional boxes that are somewhat larger.
- ☐ The workroom is to have space and appropriate outlet for a copier machine. Verify size and power requirements with MCPS.
- ☐ Offices, workroom, storage, and toilet rooms are to serve the general office employees.

- ☐ Toilet rooms are to have large occupied and unoccupied door indicators.
- ☐ The storage room is to relate well with the workroom and need not be directly accessible to the corridor
- ☐ A coat closet, privacy room and staff toilet rooms for administrative office staff and visitors should be included.

Workroom

- ☐ The photocopy workroom should be convenient for teacher use.
- ☐ It should not be located in the media center.
- ☐ This room requires storage cabinets, shelving, and lockable cabinets for paper, ink, and other supplies.
- ☐ Proper ventilation is required in this room.

Business Manager and Financial Assistant's Office

- ☐ These offices should be located adjacent to each other and can be designed as a separate suite with an entrance off the corridor and a door into the main office.
- ☐ A storage area should be located adjacent to these offices.
- ☐ The financial assistant's office should have a cashier's window onto the corridor.
- ☐ A storage closet on an SKD key is necessary to store the school safe/funds.
- ☐ A small waiting area should be provided.

Counseling Suite

Spatial needs
Counselor's Office
Waiting Room
Conference Room
Records Room
Registrar's Office
Workroom
Career Information Center

- ☐ The Counseling Suite is to be separated but may be adjacent to the administrative areas.
- ☐ These offices require voice, data, and video connections.
- ☐ The Records Room is to be a secure room accessed from the registrar's office.
- ☐ The Records Room is to be 1-hour rated, have no windows, and be SKD keyed.
- ☐ The Records Room is to have no windows.
- ☐ The Registrar's Office should be adjacent to the Records Room and have hallway access.
- ☐ The Workroom should have secure storage for computer equipment, good ventilation, and adequate wiring for copy machine, refrigerator, word processing equipment, etc.
- ☐ The waiting area is to have space for two secretarial desks with hookups for telephone and computer, and seating for 10-12 visitors.
- ☐ Carpet shall be used in all offices and the conference room within the suite. Corridor is to be VCT.

Career Information Center

- ☐ The career information center should be designed for use by classes of up to 30 students.
- ☐ It should be located near the guidance suite and have direct access to a hallway.
- ☐ It should provide for the collection of print and non-print materials and for individual viewing and listening.
- ☐ The career information center should be bright and inviting with plenty of interior glass into well-traveled corridor spaces.
- ☐ Power and data appropriate for ten computers workstations is required.
- ☐ An office of approximately 150 sq. ft. should be designed adjacent to the center.

Health Suite

Spatial needs
Waiting Room
Treatment/Medication Room
Office/Health Assessment
Health Assessment/Isolation Room
Rest Area
Storage
Toilet Rooms

- ☐ A designated school health services professional from the Montgomery County Department of Health and Human Services (DHHS) must be involved in the planning of the health services suite.
- ☐ The health suite should be located near the administrative area.
- ☐ Student traffic is to be kept close to the door and cross traffic is to be minimized.
- ☐ Good supervision of the room from within as well as from the general office is required.
- ☐ A separate switch to control the ventilation system in the health suite must be provided.
- ☐ Direct access to a main corridor is needed for emergency access and egress.
- ☐ Two doors to the suite will facilitate the movement of students through waiting and treatment areas during a mass procedure.
- ☐ A washable vinyl tack board is to be installed just outside the door to the health suite.
- ☐ MCPS standard flooring is VCT.

Waiting Area

- ☐ The waiting area should accommodate ten chairs, a pamphlet rack, and a 24" x 48" table.
- ☐ Its placement in relationship to the treatment area and to the nurse's office should facilitate triage, enable its supervision, and promote confidentiality in the treatment area.
- ☐ A 4’x4’ washable vinyl tackboard should be provided in this area.

Treatment/Medication Area

- ☐ The treatment area should be accessible to the waiting area and toilet rooms.

- ☐ Its design should promote confidentiality.
- ☐ The treatment area is to contain the following:
  - ☐ a kitchen-type sink and cabinet unit with locking cabinets above and below
  - ☐ a clear area of at least 36 inches on the countertop
  - ☐ a full-size refrigerator with ice-making capabilities
  - ☐ a mirror
  - ☐ an area for a hazardous materials trash receptacle
  - ☐ Space for a scale, a floor lamp, a step-on covered waste can, an l-shaped desk and chair with space for a computer and printer, a telephone, and three 4-drawer lateral locked file cabinets.
  - ☐ Two 4'x4' washable vinyl tack boards should be provided in this area.
- ☐ The location of the desk, chair, phone, and file cabinets should be placed so that it enables supervision of both the waiting area and the resting areas.

Office/Health Assessment Room

- ☐ The office should accommodate a double-pedestal desk and chair, a telephone, one lockable file cabinet, a round table to accommodate eight, and eight chairs.
- ☐ The room is to be enclosed in such a manner as to prevent the passage of voices into or out of the room. A transparent opening in the wall is to be provided to permit supervision of the waiting and treatment areas. Blinds are to be provided for privacy. Two doors should be provided, with one designated for access/egress to the health suite and one designated for access/egress into the administrative area. (An outside window would be appreciated.)

Isolation Room

- ☐ This room needs to have access and have a door to the corridor.
- ☐ A window is needed in this room to provide supervision from the treatment area and office. The design of the window also needs to ensure that only staff can see into the room.
- ☐ This room should accommodate space for a cot and a single pedestal desk and chair, telephone and computer.
- ☐ This room requires a sink and counter with lockable cabinet.
- ☐ This area requires supplementary power ventilation capable of 20 changes per hour with control by means of a separate switch within the health suite.

☐ One 4’x4’ washable vinyl tack board should be provided.

Resting Areas

☐ This area should not fully contained room but rather an area that can provide privacy for each cot with a draw curtain on a ceiling track.

☐ The rest area needs space four cots with individual light switches for wall sconces, electrical outlets 16” from the finished floor, and bedside cabinets for each rest area.

☐ These areas should be designed to enable supervision from the treatment area.

☐ In the rest area and privacy room, supplementary power ventilation capable of 20 changes per hour is to be provided.

☐ One 4’x4’ tack board should be provided in this area.

Storage Area

☐ The storage area should accommodate cots, two folding wheelchairs, and adjustable shelving for forms and supplies.

☐ The storage area is to be secured and should not be smaller than 40 sq. ft.

Toilet Rooms

☐ Two separate ADA toilets should be provided with large occupied and unoccupied door indicators.

Security

Spatial needs
School Security Office
Restorative Practices Instructional Room

School Security Office

- ☐ This office should accommodate up to 8 staff persons.
- ☐ Space is needed for a table and chairs to meet with students.
- ☐ This office must have lockers and secure storage.
- ☐ This office suite must accommodate the cameras and accompanying communication equipment for a visual monitoring system.

Restorative Practices Instructional Room

- ☐ This room should be designed as a small classroom to accommodate student desks and soft seating.
- ☐ Space should be provided for a teacher's desk, and space for a table and chairs in order to meet with students.
- ☐ The room should be designed with a teaching wall per DPC guidelines.

Command Center

- ☐ An interior room in the school needs to be designated as the command center for shelter in place/lock down emergencies. In many schools, the workroom in the administration suite may serve this purpose. The room cannot be on an outside wall.
- ☐ The room designated as the command center must have all data and communication equipment including computer outlet, telephone, and public address (PA) system.
- ☐ The PA console should be located in the room that is designated as the command center.
- ☐ Window coverings/shades must be provided for all windows and doors to the command center.
- ☐ In secondary schools, the security camera monitors should be located in this area.
- ☐ The space designated as the Command Center must be large enough to accommodate up to six staff person storage space is needed for the shelter in place/lock down emergency kit.

Staff Facilities

Spatial needs
Staff Room
Wellness Room
Staff Dining Room

Staff Room

- ☐ Two staff rooms should be provided to allow staff a place to rest, plan, study, and think together and be located near classrooms.
- ☐ Two staff toilet rooms should be located near but not within each of the staff rooms.
- ☐ The staff rooms should contain a compact built-in kitchen with six linear feet of counter space for a microwave and sink and a space for a refrigerator (NIC).
- ☐ A clock should be provided.
- ☐ An operable window in the staff room is preferred.
- ☐ An area should be designated for a computer outlet and telephone.
- ☐ Space in this area is needed for vending machines.

Privacy Room

- ☐ A small, enclosed room with countertop and space for one chair is needed.
- ☐ An electrical outlet should be provided above and below the counter and the counter should be tall enough to accommodate a small refrigerator.
- ☐ A small sink is needed for washing hands and personal items.
- ☐ A mirror should be provided above the counter.
- ☐ This space needs to be accessible to staff with disabilities.
- ☐ Occupied / Unoccupied indicator on the door.
- ☐ Keyed for emergency entry.

Staff Dining Room

- ☐ The staff dining room should be easily accessible from the kitchen area.

☐ The staff dining room should contain a compact built-in kitchen with six linear feet of counter space for a microwave and sink and a space for a refrigerator (NIC).

Food Services Facilities

Spatial needs
Student Dining Area
Serving Area
Food Preparation
Dry Food Storage
Refrigerated and Frozen Food Storage
Office
Locker/Toilet Room
Loading/Receiving Platform

Student Dining Area

☐ The dining should resemble a "Food Court". Booths and "stand-up" tables may be used.

☐ The dining area needs to seat approximately one-third of the building's student capacity.

☐ Acoustics, ventilation, and color are important considerations in the cafeteria.

☐ A public address system should be built-in.

☐ Wall power for digital display boards should be included in the dining area.

☐ Display boards and power should be located at a height to avoid student accessibility and damage.

☐ A washable vinyl tackboard is to be placed near the entrance.

☐ Care is to be exercised in the location of windows in relationship to the location of tables and chairs.

☐ Trash from the dining area must not flow through the kitchen.

☐ Student toilet rooms must be located near the cafeteria and have good sound absorption.

☐ Outside access from the cafeteria to a paved area should be considered in the design of the student dining area.

☐ There must be a water bottle filling station in the cafeteria.

☐ A listening assistance device for the hearing impaired should be included in the cafeteria.

- ☐ Security doors are needed to control access to other parts of the building from the cafeteria/stage/lobby areas.
- ☐ An outside entrance to the cafeteria for easy access in the evening and an outside eating area with permanent trash cans (preferably a courtyard) are desirable.
- ☐ Consideration should be given to the use of electronic menu boards HT AFF to minimize student accessibility and damage.
- ☐ It should be designed with flexibility to accommodate several activities.
- ☐ Several distinctive seating areas should be provided. Areas should have different kinds of seating arrangements (small tables, booths, and corner tiers), colors, and lighting.
- ☐ One of the eating areas should be located in the courtyard/patio.
- ☐ Three teaching/lecture areas for 30-50 students each should be provided. These lecture areas require the following:
  - ☐ pull-down screen
  - ☐ voice, data, and video connections
  - ☐ whiteboard
  - ☐ sound proof dividing wall
  - ☐ zoned lighting
- ☐ Attractive decor and an open kiosk activity center should be provided to promote student and social activities.
- ☐ Supervision is an important consideration. Unobstructed sight lines are necessary for one staff member to effectively supervise all of the students.
- ☐ An outside entrance to the cafeteria for easy access in the evening and an outside eating area with permanent trash cans (preferably a courtyard) are desirable.

Kitchen

- ☐ The kitchen needs to be directly accessible from the loading dock.
- ☐ A walk-in freezer of 240 sq. ft. and walk-in refrigerator of 180 sq. ft. are required.
- ☐ Walls and ceilings should be painted in light color, smooth, impervious to moisture, easy to wash, and easy to keep in good repair. An easy to mop floor such as, slip resistant quarry tile floor or polyurethane cement flooring system is required. If quarry tile is used then the color of grout should be the same or darker than the color of the floor.

- ☐ The kitchen to be linked to the security monitoring system and school intercom.
- ☐ A wall clock at the serving line that is linked to master control should be provided.
- ☐ When designing the kitchen and related spaces, special consideration should be made to temperature and humidity control and traffic.
- ☐ All current health and sanitation codes must be met.
- ☐ Special consideration should be given to the location of floor drains.

Serving Area

- ☐ Control of serving lines should be designed to facilitate rapid serving of food.
- ☐ The serving area should consist of 5 food serving sections
  - ☐ soup, salad, and deli
  - ☐ pizza, burgers, fries
  - ☐ hot lunch of the day
  - ☐ ethnic foods
  - ☐ snacks
- ☐ These stations may be portable and should be dispersed through the dining area to reduce congestion.
- ☐ Stations should be secured when not in use.
- ☐ A dedicated circuit for cash registers is required with under floor conduit for intercommunication link.
- ☐ Control railings may be portable.

Preparation Area

- ☐ The preparation area should include areas for the cook, the baker, and beverage/salad/sandwich prep areas.
- ☐ Trough-type drains at steamers and kettle locations are required.
- ☐ Hand sinks in each prep area with soap and towel dispensers and automatic wash filtered hood are required.
- ☐ Consider of the utility distribution system must be taken into account.

Dry Food Storage

- ☐ The dry food storage area must be adjacent to the prep area and receiving area.
- ☐ This requires an SKD keyed door.
- ☐ Door opening must be a minimum of 3' 8".
- ☐ It must be air conditioned at all times.
- ☐ This area requires mobile shelving and dunnage, key lock for security, and must be free of roof access ladders or electrical panels.
- ☐ The shelving must be ventilated.

Building Service Closet

- ☐ This has an SKD keyed door.
- ☐ 12” Metal shelving

Refrigerated and Frozen Food Storage

- ☐ The cooler/freezer storage area should be provided with a common wall and should be located adjacent to the prep and receiving areas.
- ☐ Insulated slab and thickset quarry tile floor is preferred with a minimum of 20 ft. candle lighting.
- ☐ Roof mount compressors, stainless steel mobile shelving and dunnage, and sound alarm for temperature monitoring should all be included.

Office

- ☐ The office should be located to provide visibility to receiving and preparation areas.
- ☐ Adequate lighting is required.
- ☐ Voice, data, and video connections are required.

Toilet/Locker Room

- ☐ This room should include a coat rack and purse lockers/
- ☐ The toilet room requires hot and cold water mixing faucets, with soap and towel dispensers and sanitary napkin disposal unit.
- ☐ An automatic door closure and approved ventilation system is required.

Loading/Receiving Area

- ☐ The loading/receiving area must be totally separate from other school receiving or trash disposal.
- ☐ Dock height of 4 ft. with 22 ft. minimum width slightly recessed roof with minimum 13 ft. header clearance, with protective bumpers, an entry door minimum of 3'8" for pallet loads.
- ☐ A doorbell with screened foyer must be provided.
- ☐ The receiving area should be enclosed, floor to ceiling, with a chain link fence. The gate should have a standard cylinder for keying with the rest of the building.
- ☐ Flexible shelving is required but should not occupy more than one third of the area.
- ☐ This area must be secure.
- ☐ Good lighting and easy access to materials being stored are required.
- ☐ Electrical outlets, appropriate lighting and ventilation must be provided in this area.

Building Service Facilities

Spatial needs
Building Service Office
Locker/Shower area
Preventative Maintenance Technician Office
Compactor/Trash Room
General Storage & Receiving Area
General Storage
Building Service Outdoor Storage
Building Service Closets

Building Service Office

☐ The entire building services area should be located adjacent to the general receiving area.

☐ The office should be designed as a general office that can accommodate two staff members with two desks and appropriate wiring for computers, phones, etc.

☐ If possible, the office should have a window or a sight line to the outside to monitor weather conditions.

Locker/Shower Area

☐ A locker area must be located near the receiving area.

☐ 20-25 full-size lockers should be provided in the locker area.

☐ The locker area should be designed with an enclosed toilet room and shower room for building service staff use.

Preventative Maintenance Technician Office

☐ This office needs to be adjacent to the boiler room.

☐ The office needs to accommodate a desk and appropriate power and data for computer and phone.

Compactor/Can Wash/Trash Room

☐ This room needs to be completely separate from the kitchen spaces with no common walls.

☐ Trash trucks must have access to this room.

- ☐ The room should be heated and have adequate interior lighting, floor drainage, and easily cleanable surfaces.
- ☐ Hot and cold water should be available for flushing and cleaning.
- ☐ The room should be designed to be pest-free and well ventilated.
- ☐ Floors should be sloped so that wash down stays within the room and goes down the drain.
- ☐ The compactors need to be installed with enough clearance away from the wall to permit staff to access the equipment from all sides.
- ☐ A roll-up door for trash transfer to trucks, steam cleaning equipment, and trash collection containers are needed.
- ☐ The room should be designed with a ramp to allow trashcans to be rolled to the dock.

General Storage

- ☐ Flexible shelving to accommodate books, teaching aids, large size (24" x 36") paper, and other instructional supplies is required.
- ☐ Adequate lighting and easy access to materials being stored are required.
- ☐ Electrical outlets, upgraded lighting and ventilation must be provided in all large storage rooms for future flexibility (use as occupied space).

Building Service Outdoor Storage Room

- ☐ Outdoor storage is to be near the service area and is to be suitable for heavy mowing, snow removal, and other outdoor equipment.
- ☐ This is an SKD keyed room.
- ☐ The dimensions of the outdoor storage area must be able to accommodate a tractor (7.5’ long by 5.5’ wide).
- ☐ A rolling garage style door and a regular door must be provided.
- ☐ 18” metal shelving is required.
- ☐ A ramped and paved driveway is required for the tractor so that it can access the sidewalk and driveways of the school during snow removal.
- ☐ Electrical service and lighting inside must be provided. Access to the light switches must be available at both entrances.
- ☐ Proper ventilation for storage of gasoline is required.

Building Service Closets

- ☐ At a minimum, there should be a building service closet for each 19,000 gross square of the facility. In addition, there should be a building service closet on each floor and each wing of the facility.
- ☐ The closets should be a minimum of 25 sq. ft.
- ☐ The building service closet must accommodate a minimum of one utility cart.
- ☐ The closet requires shelving for cleaning supplies.
- ☐ The closet requires a floor mop sink with hot and cold running water and a floor drain.
- ☐ A mop/broom holder is required.

Site Requirements

The items listed below are for a school that meets the minimum useable site size of 35 acres that is capable of fitting the instructional program, including site requirements. At schools with smaller sites, the architect is to work with MCPS staff, including the Physical Education Curriculum Coordinator, Safety Director, and school staff to determine layout of the play areas.

- ☐ All designs must be accordance with MCPS Facility Guideline Specifications.
- ☐ The site must conform to all applicable federal, state, and local regulations and laws.
- ☐ The entire site must comply with the most current ADA or COMAR regulations, whichever is more stringent.
- ☐ Protective fencing may need to be provided near heavily wooded areas, busy streets, steep hills, parking lots, bio-retention facilities, and turnaround areas.
- ☐ One fenced play yard, 1000 sq. ft. for the child development classroom is required.
- ☐ One outdoor patio, 500 sq. ft. for the art department is required.
- ☐ Accessible parking spaces should be located near the main entrance, after hours use, and the playing fields. After-hour use parking spaces are allowed in the bus loops with blue lined striping and appropriate signage.

Driveway

- ☐ The architect/engineer should refer to the MCPS Facility Guideline Specifications for design of the driveway, bus loops, etc.
- ☐ Bus traffic should be separated from car traffic at all times, when possible.
- ☐ Bus loading zones should be able to accommodate the entire student body. The number of busses will be confirmed with the MCPS Department of Transportation.
- ☐ A covered area for students in the bus loading area must be provided.
- ☐ A separate drive for parent drop-off is required.
- ☐ Pedestrian access the school facilities should be designed to make the best use of community right of way.
- ☐ Driveway aprons should be perpendicular to the centerline of the street; and if there is an intersecting street on the opposite side from the proposed driveway, the driveway apron should line up with the intersecting street.
- ☐ Driveways should be located so as not to project headlights into adjacent homes.

Parking

- ☐ Parking for 400 cars with master planning for additional 50 spaces is required.
- ☐ The parking area should be designed to maximize safety and minimize speed.
- ☐ Adequate lighting should be provided.
- ☐ Parking area should have two exits.
- ☐ Guardrails or bollards are to be installed to protect fields and play areas.

Service Drive

- ☐ The architect/engineer should refer to the MCPS Facility Guideline Specifications for the design of the service drive.
- ☐ All driveways must be arranged so that they are not required to cross the service drive to get to the play fields.

Physical Education/Athletic Fields

- ☐ All fields must be designed in accordance with MCPS Facilities Guidelines.
- ☐ All fields to be GPS or Lazer graded.
- ☐ Pedestrian access must be provided from the surrounding neighborhoods.
- ☐ All fields should be graded and sifted to remove rock and debris.
- ☐ A 3" water line for future irrigation of playing fields should be installed.
- ☐ All fields must have ADA compliant access.

Stadium Field

- ☐ The field will be designed for artificial turf and should be properly crowned to provide adequate drainage. The location of the drains/covers must not interfere with the playing surface.
- ☐ An add alternate should be designed to provide artificial turf.
- ☐ The width and length of the field must accommodate high school sized soccer, field hockey, lacrosse, and football.
- ☐ The field should be surrounded by an eight-lane track with a 24-ft wide straightaway, backside, and curves.
- ☐ If the track is separate from the stadium, then dedicated and permanent seating to accommodate spectators should be designed.

- ☐ The straightaway must be located near the home side bleachers.
- ☐ A shot put, and 2 long jump areas are to be included.
- ☐ The discus area must have a required cage.
- ☐ The field should be situated to minimize the effect of afternoon sun glare on the players as they face diagonally, and from spectators in the main bleacher section.
- ☐ An underground water system with 9 zones, four heads each is required for natural turf fields only.
- ☐ Safe stadium seating to accommodate 2000 spectators on home side and 750 on the visitor side is required. They must comply with NFPA 102 and ADA.
- ☐ All risers must be of uniform height with handrails at aisles, all aluminum boards, wheelchair parking, paved runway from track gate to bleacher, and paved under the bleachers.
- ☐ Permanent soccer/football goals with pads should be installed.
- ☐ A scoreboard for football, soccer, field hockey, and track and field events should be included.
- ☐ Lights are to be provided to illuminate and provide security for peripheral areas of the stadium field for evening activities.
- ☐ An outdoor storage shed of approximately 23’ x 30’ should be provided.

Varsity Baseball Field

- ☐ The dimensions of the baseball field should be 325' down each foul line and 360’ for center field.
- ☐ Electrical service, water service, a stainless-steel water fountain, backstop, dugouts, bullpen, batting cage, benches with safety fencing, and trash containers are to be provided.
- ☐ Equipment and fields must be in compliance with national, state, and local rules and safety standards.
- ☐ Seating for 50 spectators on each side should be provided including a paved accessible viewing area.
- ☐ Field must be situated with a north-south orientation so that direct evening sun does not interfere directly with batter and fielders.
- ☐ The distance from the backstop to home place must at a minimum comply with NFHS rules and regulations.

Varsity Softball Field

- ☐ The softball field requires a 190' radius.
- ☐ Electrical service, water service, stainless steel water fountain, backstops, bullpen, dugouts, batting cage, safety fences and benches, and trash containers are to be provided.
- ☐ Equipment and field must be in compliance with national, state, and local rules and safety standards.
- ☐ Seating for 50 spectators on each side should be provided including a paved accessible viewing area.
- ☐ Field must be situated with a north-south orientation so that direct evening sun does not interfere directly with batter and fielders.
- ☐ The distance from the backstop to home place must at a minimum comply with NFHS rules and regulations.
- ☐ An outdoor storage shed of approximately 20’ x 20’ should be provided near the baseball/softball fields.

Play Fields

- ☐ Three play fields, a minimum of 120,000 sq. ft. with 150’ width should be provided.
- ☐ Proper drainage should be assured for all of the fields.
- ☐ Two softball non-hooded backstops are to be provided in the corners of the fields if space allows.
- ☐ Two 15’ benches with safety fences on each field should be installed.
- ☐ Permanent trash containers are to be placed by the backstops.
- ☐ Two sets of multipurpose goal posts should be included on the fields—one should be permanent and the other moveable.
- ☐ Bermuda grass is best for all fields.
- ☐ The field hockey field should be should be 60 yards x 100 yards. Bermuda grass is required for this field. This field should not be crowned.
- ☐ Benches, goals, seating for 100 spectators, and permanent trash containers are needed at the field hockey field.
- ☐ A heavy duty vandal-proof outdoor water fountain should be provided adjacent to the practice fields separate from the stadium water fountain.

Paved Areas

☐ Four benches, a stainless-steel water fountain, and permanent trash containers are to be provided beside the tennis/basketball courts.

Tennis Courts

☐ Eight full-sized tennis courts with cloth nets are required.

☐ Permanent posts and cranks are required.

☐ The baseline of the court should be perpendicular to the north-south axis.

☐ The playing surface color is green with red out-of-bounds.

☐ Appropriate tennis court markings should be provided.

☐ Courts should be marked for pickleball as well.

☐ Fencing 10’ high should surround the courts.

☐ An electrical outlet should be installed on the outside of the fence.

☐ A minimum 60' long and 10' high rebound wall should be located outside the court area.

☐ The tennis courts and wall are to be located near the outside basketball courts.

☐ The tennis court construction should meet the United States Tennis Court and Track Builders Association Guidelines.

☐ If the tennis courts are not located near the outdoor storage area, provision must be made to store maintenance supplies (squeegees), ball machines, and other tennis equipment.

Basketball Courts

☐ Four paved play areas, 80' x 100' with appropriate court markings should be provided.

☐ Each basketball court should be 46’ x 80’.

☐ 8 basketball sets (post, backboard, rim, net) is required.

☐ The posts should be curved “goose neck” with fan-shaped aluminum backboards. Heavy duty double rims with polyethylene or strap nets must be provided.

☐ The basketball courts should be located next to the tennis courts.

Outdoor Concession Stand/Press Box

- ☐ This building needs to be in the stadium area.
- ☐ Restrooms adjacent to this area should include at least four fixtures for each toilet room (male and female).
- ☐ The concession building should have adequate electrical service, drainage, stainless steel sink and tables, shelves and ice machine (cubed not shaved), freezer, garbage disposal, cabinets, plumbing, floor drain, and shelving are required.
- ☐ Permanent trash containers are required.
- ☐ Separate entrances should be provided for the press box and concession stand.
- ☐ An outdoor water fountain and one hose bib should be secured to the concession stand.
- ☐ The press box must provide space for a minimum of 10 people with complete line of sight to the field.
- ☐ The press box requires heat, sliding windows, electrical outlets, and counter space under the window for people to sit. The appropriate length for the press box is 20' however if an upper and lower configuration is used, the press box may be 10' long.
- ☐ One or two outdoor ticket-taking stations/booths should be included. The exact site will be determined after fencing and traffic patterns are established.
- ☐ A storage closet (20' x 20') with garage type door should be provided in this building.
- ☐ The location should provide adequate security and orderly entrance to events.

Outdoor Shed

- ☐ One outdoor storage shed, 20' x 20', should be attached to the school.
- ☐ This storage area should have a frost proof bib, concrete floors, and ventilation to accommodate gasoline/diesel equipment, and be secure.
- ☐ It requires a 10' x 8' rolling gate.
- ☐ An outside hose bib should be included.
- ☐ A ramp should go from ground level to the doorway for each access of heavy equipment.

Outside Storage Building

☐ An outside storage building should be approximately 20 ft. by 20 ft. and will require a rolling gate 10 ft. by 8 ft. with concrete floor and flush threshold.

Outdoor Learning Areas

☐ On MCPS school sites, Outdoor Learning areas may include native plantings, bioretention facilities, permeable pavements, raised planting beds, stormwater downspout planters, pollinator habitats, strategic tree plantings, and shaded gathering areas that allow students to explore and interact with natural systems.

- ☐ This project will develop a forest management plan to guide forest conservation efforts and advance afforestation and reforestation initiatives. In partnership with Montgomery County, MCPS has prioritized tree planting to provide critical shade, improve site comfort, and establish native habitats that support local ecosystems, enhancing the usability of outdoor spaces for instruction. This approach aligns with MCPS Sustainability Policy ECI, which promotes nature-based solutions such as increasing tree canopy and improving site ecology.

- ☐ MCPS Division of Facilities Management incorporates student engagement into the restoration of natural resources and nature-based stormwater practices. These activities include planting native species in bioretention areas, tree planting, and installing educational signage. Additionally, MCPS collaborates with government agencies and nonprofit partners to further integrate local natural resources into student learning, providing hands-on opportunities that connect environmental stewardship to the curriculum.

- ☐ MCPS also operates the Outdoor Environmental Education Program at the Lathrop E. Smith Environmental Education Center, serving thousands of students annually through curriculum-based environmental learning experiences. These programs include day programs for PreK–12 students as well as the systemwide Grade 6 program. Through these initiatives, students engage in hands-on, outdoor investigations that reinforce environmental literacy and ensure equitable access to high-quality environmental education opportunities.

Other Program Requirements

Add Alternate:

PROGRAM OF REQUIREMENTS
FOR
BRIDGE TO WELLNESS

I. Overview

The Bridge to Wellness (BTW) staff will provide behavioral health, social services, and youth development services to the students and families of the school community.

II. Project Description

A. The project provides for the construction of a comprehensive BTW space where services are delivered to members of the school community. It should incorporate these basic components: the administrative area and the mental health/care management/youth development suite.
B. It is preferred that the BTW suite be located near the main entrance for supervision and security purposes and have at least one direct access to the outside with clear identification of BTW entrance to provide access during evening and weekend hours when the school is closed.
C. One entrance from the school to the BTW suite is needed.
D. The design shall consider safety and security of the BTW staff and school uses. The facility is to be arranged so access from it to the school can be controlled when school is not in session.
E. Doors should have windows, and all windows should have blinds, including the window within the door. There should be Vinyl Composite Tile (VCT) flooring throughout the center. A doorbell should be placed at the outer entrance, with audible notification to one office and the main reception area. All rooms should have the capability to be locked.

III. Bridge to Wellness Operations

A. Hours of Operation: 7:00 a.m.-6:30 p.m. (the hours of operation could change, depending on the needs of the school community) Monday through Friday as well as some days when school is not in sessions, some evening hours during the week and on the weekend, depending on the needs of the school community
B. Staff: therapist, care manager, youth development specialist, and PYD School Outreach Network Community Service Aide
C. Months of Operation: a full component of the above-mentioned staff will be present during the school day during the school year and during the summer

IV. Site Requirements

The site chosen by MCPS for the school facility must be able to accommodate the BTW suite. Site selection considerations shall include, at a minimum, the feasibility to provide separate access to a BTW suite and safety and security considerations with the operation of a BTW suite on the property. It is preferred that the location of the BTW facility is to have convenient access to the school foyer and parking lot drop off area.

V. Mechanical and Electrical Systems

The facility is to be compatible with the systems of the school at which it is located. It should have heating and air conditioning. Because the BTW may operate while the main portion of the school is not in session, the Heating, Ventilation and Air Conditioning (HV AC) must be zoned for after-hours use. The system shall be included in the school energy management system but shall allow for zoning separation capabilities. Systems selected must be maintainable by MCPS.

Electrical outlets are to be provided on all walls and comply or exceed the number required by applicable code(s). There should be an electrical outlet and data drop in the copy machine area. There should be two data drops in every office and area that will house phones and computers, including conference room(s) and offices. On new construction only, a center data drop and plug in the floor of the conference room should also be included.

VI. IT/Telecommunications

The telecommunication network conduit and wiring infrastructure are to be provided in all spaces except the building service closets and small storage rooms under 100 square feet. Additionally, wireless access points are to be provided to enable uninterrupted wireless service to computers throughout the BTW suite.

The telephone systems shall be owned by MCPS and connected to the MCPS' telephone network (see VIII. School Facilities Needed for Support). If an individual BTW school is at full capacity in terms of phone lines, Montgomery County Government (MCG)/Department of Health and Human Services (DHHS) will pay for the costs associated with required increased phone line capacity.

The computer devices will be purchased and owned by the MCG/DHHS contractors and shall be connected to the MCPS computer network. Fiber optic service or equivalent Internet connection will be provided by MCPS. The BTW suite will utilize the fiber optic service to connect to the County Government network via the Carver Educational Services Center (CESC) county link. All equipment and software will meet County standards and provide compatibility with other BTW sites.

VII. Security

The BTW suite is to be integrated into the school security system. The system must include provisions for permitting use of the suite when school is not in session, such as a separate control panel for the suite.

The suite is to be arranged so access from the suite to the school can be controlled when school is not in session. The door to this exit should be visible so that the staff can monitor the entrance and control access. This door should have a lock and bell system. Emergency buzzers should be installed in all rooms and areas of the BTW suite.

Exterior security, including the design of access from the parking area to the entrance, a doorbell, security camera system and the provision of substantial exterior lighting is important.

VIII. School Facilities Need for Support

A mailbox to accommodate letters and packages shall be identified for the BTW suite in the school mailroom. The school public address/intercom system shall be extended to all rooms in the BTW suite. Speakers in the facility shall have volume and on/off controls, as well as call back features to the school's main office. A telephone system integrated into the school telephone system shall be provided by MCPS with voice mail capabilities.

IX. Furnishings and Equipment

Montgomery County Government (MCG) shall provide the furniture and equipment as needed to operate the BTW suite. A furniture and equipment summary is attached for design purposes.

As part of the construction contract, the following items will be provided upon completion of construction (other items may be identified during design):

- Shelves in the supply closet
- Sign outside (Bridge to Wellness spelled out)
- Tack or magnet boards in every office and reception area (number and size are provided in the space descriptions)
- Large marker/magnet board in conference room
- Television mount in conference room
- Built-in locking cabinets in Child/Family therapist office

X. Applicable Laws

This facility shall comply will all applicable current local, state, and federal laws, regulations, and codes.

XI. Space Descriptions

Square Foot Summary			
Description	# of Spaces	Net SQ. FT. Each	Total Net SQ. FT.
Administrative Area:			
1. General Office/Reception Area	1	150	150
2. Storage Closet	1	30	30
Mental Health/Social Services/Youth Development Suite			
1. Therapy Room	1	175	175
2. Care Manager Office	1	150	150
3. Youth Development/PYD Office	1	150	150
4. Conference Room	1	250	250
Total Net SQ. FT.			**905**
Total Gross SQ. FT. - # net sq. ft. x 1.34 =			**1,213**

A. General Office/Reception Area
Key Features:

The general office space should be designed to be near the entrance of the suite and serve as a reception/waiting area. Two 4'x4' tack boards should be located in this area. It should have space for 4-8 guest chairs. This space should have VCT flooring.

B. Conference Room
Key Features:

This area should accommodate a conference table system and chairs to accommodate 16 people at either small tables or conference style. This space should have VCT flooring. This room will require a telephone and data drop. There should be a wall mounted bracket for a TV monitor and in focus. Tack boards or marker boards should be provided in this room.

C. Therapy Room
Key Features:

This room should accommodate a desk without a return. This space should be located in an area that affords clients the most privacy for their counseling. Built-in storage cabinets for toys, games, and supplies are to be provided with countertop, base and wall cabinets. Space should be provided for a round table and four chairs or small couch and two chairs, a 4-drawer lateral file cabinet, and bookcase. This space should have VCT flooring. This room will require a telephone and data drop. One tack board should be provided in this room.

D. Care Manager Office
Key Features:

This room should accommodate a desk without a return and space for round table and four chairs or small couch and chair as well as a small desk for second computer. Space should be provided for a 4-drawer lateral file cabinet and bookcase or storage cabinet. This space should have VCT flooring. This room will require a telephone and 2 data drops. One tack board should be provided in this room.

E. Youth Development Specialist/PYD Office
Key features:

This room should accommodate a desk without a return and space for a round table and four chairs or small couch and chair as well as a small desk for second computer. Space should be provided for a 4- drawer lateral file cabinet and bookcase or storage cabinet. This space should have VCT flooring. This room will require a telephone and 2 data drops. One tack board should be provided in this room.

F. Closet
Key Features:

Lockable storage space is needed for the following:

- Food and clothing pantry
- Books, games, activity supplies, and other tangible resources for students and families
- Literature

This closet should be equipped with one clothing rod and adjustable shelves. This closet should have an outlet and a data port for a printer.

Adult toilets within the school should be close to the BTW suite and accessible for staff and visitor use.

Furniture and Equipment Summary

Item Description		Units
Reception and General Office		
	Chairs-fan back	4
Conference Room		
	Conference style table system which can be arranged in small tables or to accommodate 16	1
	Chairs fan back/stackable	20
	Telephone	1
	Credenza	1
Therapy Room		
	Desk 30”x60”	1
	Secretarial chair	1
	Personal computer	1
	Telephone	1
	Small round table 36” or 42”	1
	Chairs-fan back	4
	Book case 36”x72”	2
	Lateral file cabinet 4-drawer	1
Care Manager Office		
	Desk 30”x60”	1
	Small desk	1
	Secretarial chair	2
	Personal computer	1
	Telephone	1
	Small round table 36” or 42”	1
	Chairs-fan back	4
	Book case 36”x72”	1
	Lateral file cabinet 4-drawer	1
Youth Development Specialist/PYD Office		
	Desk 30”x60”	1
	Secretarial chair	2
	Personal computer	2
	Small desk	1
	Telephone	1
	Small round table 36” or 42”	1
	Chairs-fan back	4
	Bookcase 36”x72”	1
	Lateral file cabinet 4-drawer	1

Attachment C –

MCPS Facility Design Guidelines (DRAFT)

Montgomery County Public Schools
Facility Design Guideline

DRAFT 05/28/2026

DRAFT

Department of Planning and Construction
45 W. Gude Drive,
Rockville, Maryland 20850

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GENERAL GUIDELINE REQUIREMENTS

A. Materials contained in the Montgomery County Public Schools Guidelines for Architects and Engineers are provided for information and guidance regarding preferred products, materials, and practices, and shall not be construed as waiving or granting exceptions to any element of federal, state, or local building codes, ordinances, and regulatory requirements as applicable to the specific project. These Guidelines, along with the project-specific Education Specifications and Master Specifications, are complementary. Any conflict between these Guidelines, the Education Specifications, Master Specifications, and governing local, state, or federal codes shall be brought to the immediate attention of the Montgomery County Public Schools (MCPS) Department of Planning and Construction.
B. Where manufacturers, brands, and model numbers are indicated, they are provided to establish the required type, quality, and performance standards. These references do not preclude the use of equivalent products, except in cases where specific items are necessary to maintain compatibility with existing systems or infrastructure. Such instances shall be clearly identified as “no substitutions allowed.” The Design Team shall notify MCPS in writing of any proposed alternate manufacturer, brand, or model number used in the design, and obtain approval prior to incorporation into the project documentation.
C. The project plans and specifications shall incorporate and reflect the requirements and intent of the Montgomery County Public Schools Guidelines for Architects and Engineers, the project-specific Education Specifications, and the Master Specifications. These documents shall be used collectively to inform the design and documentation process.
D. All coordination between the Design Team and Montgomery County Public Schools (MCPS) shall be directed to and facilitated through the Department of Planning and Project Manager (PM) assigned to the project. The PM shall serve as the primary point of contact for all project-related communications, decisions, and approvals.
E. These Guidelines do not preclude the use of alternate systems, methods, or materials, provided that the proposed deviation has been reviewed and approved by the MCPS Project Manager and/or Facilities Architect. For project-specific applications, all deviations and substitutions shall be submitted for review during each design phase plan review and stakeholder meeting. Each submission shall include a design reference, justification for the proposed change, and the recommended alternative. MCPS review and formal acceptance of all deviations is required prior to implementation.
F. Refer to MCPS Division of Planning and Construction website.

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SUMMARY OF REVISIONS

Date	Division	Topic	Comments

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ABBREVIATIONS AND ACRONYMS

This list is provided for reference only and includes abbreviations used throughout this document. It is not intended to be a comprehensive list of industry terminology.

Short Form	Full Name
ADA	Americans with Disabilities Act
AED	Automated External Defibrillator
AFF	Above Finished Floor
AHJ	Authority Having Jurisdiction
AHU	Air Handling Unit
BAS	Building Automation System
BDA	Bi-Directional Amplifier
BMP	Best Management Practice
CMU	Concrete Masonry Unit
Cx	Commissioning
CxA	Commissioning Agent
DOAS	Dedicated Outdoor Air System
DPS	Department of Permitting Services
Ed Spec	Educational Specifications
ERU	Energy Recovery Unit
FAAP	Fire Alarm Annunciator Panel
FF&E	Furniture, Fixtures, and Equipment
FRT	Fire Retardant Treatment
GWB	Gypsum Wall Board
HDPE	High-Density Polyethylene
HVAC	Heating, Ventilating, and Air Conditioning
IBC	International Building Code
IAQ	Indoor Air Quality
IDF	Intermediate Distribution Frame
LEED	Leadership in Energy and Environmental Design
LFI	Learning for Independence
MCPS	Montgomery County Public Schools
MDF	Main Distribution Frame
MDOT	Maryland Department of Transportation
MEP	Mechanical, Electrical, and Plumbing
MERV	Minimum Efficiency Reporting Value
MNCPPC	Maryland-National Capital Park and Planning Commission
MOU	Memorandum of Understanding
NFPA	National Fire Protection Association
NIC	Not In Contract
OD	Outside Diameter
PA	Public Address
PEP	Preschool Education Program
PM	Project Manager
POR	Program of Requirements
PV	Photovoltaic
RTU	Rooftop Unit
SCB	School Community-Based
STC	Sound Transmission Class
TAB	Testing, Adjusting, and Balancing
TPO	Thermoplastic Polyolefin
UL	Underwriters Laboratories
VFD	Variable Frequency Drive
VOC	Volatile Organic Compound
VRF	Variable Refrigerant Flow
WAP	Wireless Access Point
ADA	Americans with Disabilities Act
AED	Automated External Defibrillator

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MOU's & CODE AGREEMENTS

MCPS Project Managers will provide MOU(s) to Design Team for reference in the design & permitting process.

Fire/Life Safety Codes Agreements

General

Topics Include but not limited to:

- Fire Watch Requirements
- Existing Exhaust Hoods
- Exterior Exit Doors
- Fire Extinguishers in Schools
- Fire Lanes
- HVAC Smoke Detection
- Smoke Detector Controlled Doors
- Manual Fire Alarms
- Latching of Doors
- Residential Ranges and Ovens in Buildings
- Visual Devices
- Existing School Facilities
- Partial Occupancy of New Facilities Under Construction
- Requirements to Allow Partial Occupancy by Students
- Relocatable Classrooms

Department of Health and Human Services

- Confirm with MCPS regarding Pre-Disaster Shelter Plan considerations.
- For projects with Linkages to Learning and/or Wellness Centers the Program of Requirements (POR) will be provided from the MCPS project manager. Design team is required to incorporate these design requirements and coordinate any conflicts with the MCPS project manager.

Occupancy Letter For Courtyards (Montgomery County DPS)

- MCPS to provide standard waiver letter to the Design Team stating the courtyard occupant load is not included in the occupant count (non-simultaneous use).
- Design Team is required to coordinate with the Department of Permitting Services (DPS) prior to the building permit submission and will provide the letter with the building permit submission.
- Design Team shall coordinate with MCPS for projects falling under other AHJ's.

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NON-EDUCATION SPECIFICATION SPACE NOTES

Circulation

Stair Towers

General

- The stair tower shall not extend to the roof level unless required by code.
- Provide power outlets at every floor in stairwells for building services cleaning equipment.

Area of Refuge

- Design team is to ensure areas of refuge comply with codes and regulatory requirements.
- MCPS requires an area of refuge be incorporated at all stair towers.
  - Design team to incorporate area of refuge on each floor where at grade exit is not provided.
  - Provide a two-way communication device located at each area of refuge in stairwells. Communication device is to be tied into the Fire Command center where buildings are over 100,000 sf.
  - Design team to provide detail for two-way communication instructional signage in accordance with IBC 1009.8.2.
  - Provide lighted signage in corridor (similar to exit signs) and perpendicular to travel stating “Area of Rescue Assistance.”



Figure 1 Area of Rescue Assistance Sign

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Courtyards

General

- Unless specified otherwise or required by AHJ, courtyard drainage systems are to be designed to carry the 100-year storm event. Design team to confirm.
- Ensure exterior courtyard sidewalks and drainage systems are sloped to drain away from the building. Ensure ADA slopes are met.
- Design team to provide canopy(s) or similar cover over all courtyard doors.
- If possible, provide a storage room accessible from the courtyard to store maintenance equipment. If storage space is not feasible, the design and layout of the courtyard shall be well considered for maintenance equipment access.
- Door hardware keying and card readers to be coordinated during design for courtyard and courtyard storage doors.
- Provide exterior power at courtyards for use by maintenance and building services
- Add Alternate Items:
  - Outdoor amphitheater
  - Extended canopy

Compactor Room

General

- The compactor room shall be detached from the school building to avoid rodent issues. No open chase or anything connecting to the main building.
- Power, water, sprinkler, and drain connection to sanitary are required.
- The overhead door shall have an electric operator.
  - Location of the overhead door shall be towards the loading area/parking lot.
  - See also Overhead Doors.
- A regular exterior man door should also be provided for access without the need to open the overhead door.

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01 00 00: GENERAL REQUIREMENTS

Not Used.

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02 00 00: EXISTING CONDITIONS

Existing Conditions

General

- Design Team to coordinate Underground locations with Utility companies prior to Bid.
- Design Team to receive HazMat report from MCPS Environmental Health Specialist from Asbestos Abatement Unit/Pest Control.
- Design Team to receive test results for PCB and Lead from MCPS Indoor Air Quality Specialist from Division of Maintenance.

Geotechnical Testing

General

- Geotechnical testing is strongly encouraged at each BMP location prior to placement of facility to ensure its suitable location for bioretention. Separation from seasonal high-water table is critical to ensure that the media does not become saturated and unable to function effectively.
- Structural engineer to coordinate geotechnical boring locations with geotechnical engineer.
- Testing should not take place during regular hours. MCPS project manager to coordinate with school and community programs.
- MCPS to be verified should any alternate foundation system be recommended and/or used in projects.
- Design Team to notify MCPS of areas with high water tables.
- Assumed amount of unsuitable soils to be removed and/or replaced to be shared with MCPS and included in project documents.

Demolition

General

- After 65% CD review, Design Team shall coordinate with MCPS Project Manager.
  - Provide a final salvage list in the specifications and on the drawings.
  - AED and Stop the Bleed Kits are typically salvaged and stored by the contractor. Coordinate with MCPS and provide notations as necessary.
- Design Team is to consider utility termination for in design work. Contractor will be responsible for coordinating during construction with MCPS Project Manager and the below services:
  - Data: Confirm Service with MCPS Project Manager.
  - Water: WSSC or Design Team to confirm.
  - Gas: Washington Gas
  - Electricity: Confirm Service with MCPS Project Manager.
  - Security Cameras: Department of Safety and Security
    - Tied into Electricity
    - Tied into Telephone

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- Telephone: MCPS IT System Specialist/Telecom Services & Department of Safety and Security.

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03 00 00: CONCRETE

General

- Ensure enclosure detail is provided where excessive gaps are present between slab edges and walls.
- See also Division 09 00 00 and Division 32 00 00.

Slab On Grade

General

- Provide detail at all doorways tying interior SOG and exterior concrete to avoid exterior slab heaving and/or door swing conflict.
  - Recommend providing doweled rebar connection between slab edges.

Composite Decking

General

- Decking

Concrete Mix Design Table

General

- Concrete mixtures to be used such that the average Global Warming Potential (GWP) of all concrete on the project is less than or equal to 225 kgCO2E/yd^3

Use the below table for minimum requirements of concrete mix designs. Design team to verify with all applicable codes and regulations and to NOTIFY OWNER OF ANY DEVIATION.

CONCRETE MIX DESIGN TABLE										
MEMBER	**LOCATION**	**f'c**	**W/C**	**F**	**S**	**P**	**D**	**C**	**3/4" AGGREGATE**	**1" AGGREGATE**
FOUNDATION WALLS AND PLASTERS	INTERIOR (typ)	4500 PSI	0.45	F0	S0	P0	D0	C1	N/A	N/A
FOUNDATION WALLS AND PLASTERS	EXTERIOR	4500 PSI	0.45	F2	S0	P0	D1	C1	6+/-1.5%	8+/-1.5%
FOOTINGS	INTERIOR (typ)	3000 PSI	0.55	F2	S9	P9	D9	C1	N/A	N/A
FOOTINGS	EXTERIOR	4500 PSI	0.45	F2	S9	P9	D9	C1	6+/-1.5%	8+/-1.5%
SLABS-ON-GRADE	INTERIOR (typ)	3500 PSI	-	-	-	-	-	-	N/A	N/A
SLABS-ON-GRADE	EXTERIOR	4500 PSI Min.	-	-	-	-	-	C4*	*N/A	*N/A
SLAB ON STEEL DECKING	INTERIOR (typ)	3500 PSI	3500 PSI	F2	S9	P9	D3	C19	N/A	N/A

Notes: Provide concrete mixes in accordance with ACI301 for the exposure categories identified in the table.

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Repair Mortars

Bonding & Anti-Corrosion Agent

- Basis of Design: Ardex Bonding & Anti-Corrosion Agent
- Purpose: Used to promote adhesion between repair mortars and existing concrete surfaces, and to protect embedded steel reinforcement from corrosion.

Concrete Resurfacing Compound

- Basis of Design: Ardex CD – Concrete Dressing
- Purpose: A resurfacing compound designed to restore the appearance and surface profile of worn or spalled concrete.

Concrete Reinforcement

General

- Design Team to note and specify contact lap splices for rebar reinforcement.
    - This is required to ensure connection between concrete slab and masonry walls.
- Design Team to provide detail at all doorways tying interior SOG and exterior concrete to avoid exterior slab heaving and/or door swing conflict.

Construction Joints

General

- Fill with pourable urethane filler.
- Design team to provide detail for circular control joints at structural columns, diamond shaped joints at columns are NOT approved by MCPS.
    - Structural to show circular joints around columns on area plans and to provide details.

Polished Concrete

General

Polished concrete slabs may be used in select areas throughout the building. Refer to Master Specs. Confirm Aggregate, polish level, grit, stain etc. with MCPS.

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04 00 00: MASONRY

Concrete Masonry Units

General

- Design team is to provide details for the following conditions where applicable:
  - Detail(s) for smoke, acoustical, or fire protection infill between top of CMU and deck above.
  - Detail(s) for Joist Enclosure Detail where wall terminates at the joist and seal is required to continue to deck.
  - Detail(s) for Chase Wall Bracing Detail
  - Detail(s) for CMU wall bracing plan Detail
  - Detail(s) for Corner/Tee Intersecting Wall Reinforcing Detail
  - Detail(s) for Walls to Deck or Structure
- Coordinate with Roofing section.
- Design should incorporate masonry façade up to a 24" min. and preference is to use dark color masonry. (metal panel should not be used at the lower portions of exterior walls.)
- Refer to Wall Mock Up Panel section.
- MCPS prefers using Shear walls for lateral support systems. Any other support system to be reviewed by MCPS.

Typical Locations

- Main Building Service Areas, Gymnasium, Stairwells, and Loading Dock walls are to be constructed using CMU.
- Corridor walls are to be constructed using CMU unless otherwise approved by MCPS.
- Design Team to provide CMU construction as necessary to comply with codes and regulations.

Product

- Fly ash in CMU is not approved by MCPS.

All Other Masonry Types

General

- Provide masonry types from (1) one supplier. Other manufacturers to furnish bricks similar in cost, appearance, and quality.
- The contractor is required to build 3'x3' sample panels for MCPS to choose the brick color/finish.

Mortar

General

- Mortar mixing sand to be measured using bucket method only.

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Detailing & Execution

Brick Detailing:

General

- Required to have air space of 1" minimum (not nominal ¾"). Coordinate the size of brick ties with the structural engineer.
- Control joint shall be centered between windows, not along the edge of windows/doors due to the lintel bearing at the masonry opening or header with CFMF.

Metal Drip Edge & Flashing

General

- Use of stainless steel drip edge at grade is required.
- Provide drip edge 1" beyond the face of building.
- No stainless-steel drip edge above the windows.
- Drip edges shall be a hemmed form drip turned down immediately at the face of the wall. Do not provide a flat surface before forming the drip.
- Slope bed of mortar below metal drip edge to maintain positive drainage to exterior.
- Seal embedded flexible flashing to metal drip edge.

Reinforcement

- Provide Contact Lap Splices. This is required to ensure connection between concrete slab and masonry walls.

Execution

- In existing conditions, stop effected area of masonry work by stepping back units in each course from those in course below. Do not tooth in work.
- Cleaning requirements to be brush and bucket no pressure washers.

Masonry Lintels

- Avoid use of hung plates in masonry exterior masonry walls.
- Where precast "U" lintels are used spans are to be limited to 12'-4"

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05 00 00: METALS

Framing

General

- In addition to locations defined by Architect/Structural engineer, signed and sealed shop drawings required for stage framing, ceiling overhangs at stage area, Media Center hard ceiling areas.
- Structural framing plans should include lists of unit loads where the mechanical units are to be supported.

Roof Access & Roof to Roof Ladders

General

- Provide access ladders & hatches for servicing DOAS, RTUs, ERUs and VRF as needed to service equipment, filters and belts service.

Roof Hatch

General

- Design team to consider opening size, ships ladder length and height, and structural supports to avoid head height conflicts.

Size:

- 30”-36” w x 60” L (preferred)(54” L min.)

Fall Protection

General

- Basis of Design: Dakota Safety, SafetyRail 2000.
- Fall protection: use general industry standards. Check current OSHA requirements. 42” parapet or guardrail (not roof-mounted guardrail).

Roof Ladder(s)

Material & Type:

- Aluminum Ships Ladder

Location(s)

- Ships ladders to be used for interior and exterior access.

Mounting

- Ensure fastening point is provided within 12” of top of parapets.

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Roof Deck

General

- No attachment to be permitted to roof deck including but not limited to, bulkheads, pipes, mechanical duct supports, and joist enclosures.
  - Design team to provide detail for clamp support.

Handrails (Interior)

General

- Finish: Stainless Steel Brushed #4. (including center rail at stairs)
- See 32 00 00 Exterior Improvements - Exterior Railings.

Elementary Schools

Railing Requirements

- Provide dual looped handrails with the following dimensions:
  - 36 inches to the top of the upper handrail
  - 25 inches to the top of the lower handrail
- The design team is responsible for confirming conformance with ADA, IBC, and all applicable local codes and regulations.

Return/Termination Requirements

- Elementary handrails shall feature dual looped returns.
- The termination must include a loop that connects the upper and lower handrails, forming a continuous return.
- Wall returns are not recommended unless explicitly approved by MCPS.
- Straight or unreturned terminations are not permitted, as they pose potential safety hazards and do not meet best practice design standards.

Middle & High Schools

Railing Requirements

- Provide single handrail designs in accordance with ADA and all codes and regulations.

Return/Termination Requirements

- To ensure safety and compliance with accessibility standards, all single handrails must terminate with either:
  - A wall return, where the handrail curves back to meet the wall surface, or
  - A continuous loop return, where the handrail bends downward in a closed loop.
- Straight or unreturned terminations are not permitted, as they pose potential safety hazards and do not meet best practice design standards

Guardrails (Interior)

- Provide 48” high guardrail to be provided at spaces that overlook floors, although the code requirement is 42” AFF.

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- Finish: Powder Coated

Stainless Steel Corner Guards

Location

- Kitchen

Product

- Type: Surface mounted
- Material: Stainless Steel

Ballet Barres

Product:

- Basis of Design: Gerstung International - Designer Pro Barre Brackets
- Single and/or Double

Mounting

- Provide Mounting Boards
  - 1" Thick
  - 2" wider than bracket base.

Therapy Swing Hook

General

- Coordinate with MCPS Physical Therapy Department.
  - Common Swing Product (NIC)
    - SouthPaw Adult Sling Swing 0134

Details

- Provide Hook Eye Hole at 8'-0" AFF
- Ensure 12'-0" clear diameter space is provided
- Provide angled bracing extending down near the eyehook but above ceiling. Bracing is not to be exposed below ceiling.
- Hook to be painted to match ceiling color.

Locations

- Occupational/Physical Therapy
- Refer to Educational Specifications

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Aluminum Expansion Joint Covers

General

- Interior Wall
  - Provide corner EJ cover with clips.
- Floor & Slab
  - Provide threshold covers.
  - Recessed slab expansion joints are not preferred.

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06 00 00: WOOD, PLASTICS, AND COMPOSITES

General

- Casework to be pre-manufactured unless otherwise approved by MCPS. See also 12 00 00: Furnishings.

Exterior Grade Plywood

General

- Exterior grade plywood is to be suitable for extended exposure to weather.
- Formaldehyde Treated Lumber is prohibited.

Fire Retardant Treatment (FRT)

General

- Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
- Treat all exterior rough carpentry items.
- Do not use treated wood in direct contact with the ground.
- Treat wood blocking installed in built-up thickness for roofing terminations except top layer in direct contact with roofing membrane.
- Roof blocking and plywood to be fire retardant.

Custom Casework

- Where custom casework are provided, notes should be added to details regarding matching color and grains. Reference AWI Wood Casework Standards.

Electrical/Tele-data Backing

- Provide plywood backing for equipment on all walls in electrical/teledata rooms per specifications

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07 00 00: THERMAL AND MOISTURE PROTECTION

Through Wall Flashing

General

- Use termination bars at top of flashing.
  - Embedded flashing in masonry joints is not to be used.
- Ensure flashing detail is provided at the base of all walls.
- Ensure positive drainage is provided to exterior of building.
- Designs should consider the placement of drip edges to avoid excessive vertical jogs.
- Masonry to have minimum 2000 psi. Also refer to specifications.

Material:

- Stainless Steel, confirm with code requirements.

Weep Vents

General

- Provide notation on drawings for mason to coordinate weep vents with proposed grade level.

Type:

- PVC Waffle Weeps
  - Color should match mortar color as close as possible. MCPS to approve color.

Location:

- Provide open head joints at top of masonry cavity walls or other means of providing ventilation at the top of the cavity wall. Alternate solutions shall be approved by MCPS.
- As required for proper cavity drainage.

Metal Wall Panels

General

- Where metal wall panels are provided:
  - Care should be taken by the Design Team to coordinate rib locations and any wall penetrations to avoid awkward placement between or straddling ribs.
  - J tracks with weep holes should be provided at the base of panels and above the flashing where base panels are accessible by occupants to avoid exposure to sharp/cut edges.

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Spray Fire Proofing

General

- Make considerations for construction sequencing when detailing structure adjacent to walls (generally exterior walls).
  - Spray foam needs to be applied to beam prior to wall construction in order for all sides of beam to be protected.
- Alternate enclosure detailing is also acceptable as long as all code requirements are met.

Wall Mock Up Panel

General

- Design team shall provide details and drawings for mock up panels in construction drawings. Detailing to include but not limited to the following:
  - Thermal insulation
  - Air/Vapor application
  - All façade materials eg. Masonry, Metal Panel etc.
  - Glazing & Opening detailing
  - Coping/Parapets (as necessary)
  - Interior and Exterior corner conditions.
- Mockup panels to be approved prior to construction/install. Design team to provide in contract documents.

Roofing

General

- 20 Year Warranty typical.
- Provide flat seam panels on parapets over 24".
- Coordinate all types with roofing manufacturer requirements.

Thermoplastic Polyolefin (TPO)

General

- Used for low slope new and replacement roofs.

Material

- 80 Mil. TPO– Fully Adhered, horizontal surfaces (Confirm with Manufacturer)
- 60 Mil. TPO – Fully Adhered, vertical surface (Confirm with Manufacturer)

Standing Seam Metal Roofing

General

- Used for sloped roof conditions and outbuildings.

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Built-Up Roofing

General

- Used for existing conditions where full replacement of roof is not part of the scope.

Walkways

- Provide 4'-0" wide walkway
  - Layout path from roof access to and around rooftop air handling units (AHU).
  - Fully Adhered and heat welded at edges. Confirm with manufacturer standard requirements.

Coping

General

- Standing seam joints to be used.
- Provide detail on drawings for standing seam.

Typical Expansion Joint

General

- Basis of Design: 5" Expand-O Flashing

Interior Insulation & Sound Proofing

General

Provide STC 50 min. for classroom partitions, Principal, Assistant Principals, counselors office, and other offices where discussions of sensitive information may require additional sound isolation. Design team and MCPS to review during 1/4 scale review of spaces.

- Design team to provide notation that contractor is to fill gaps around door frames between stud and hollow metal frame with insulation.

Green Roofs

General

- Preferred type to utilize trays.
- Coordinate Absorption of stormwater with SWM system.

Roof Penetrations for MEP

Dog Boxes

- For roof penetrations, stainless steel to be used for dog boxes, rain hoods, etc.
  - Galvanized is **NOT** to be used.
- At Dog Boxes provide exit seals to limit water infiltration.
  - B.O.D. Sigrist Exit Seal

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Equipment Mounting

General

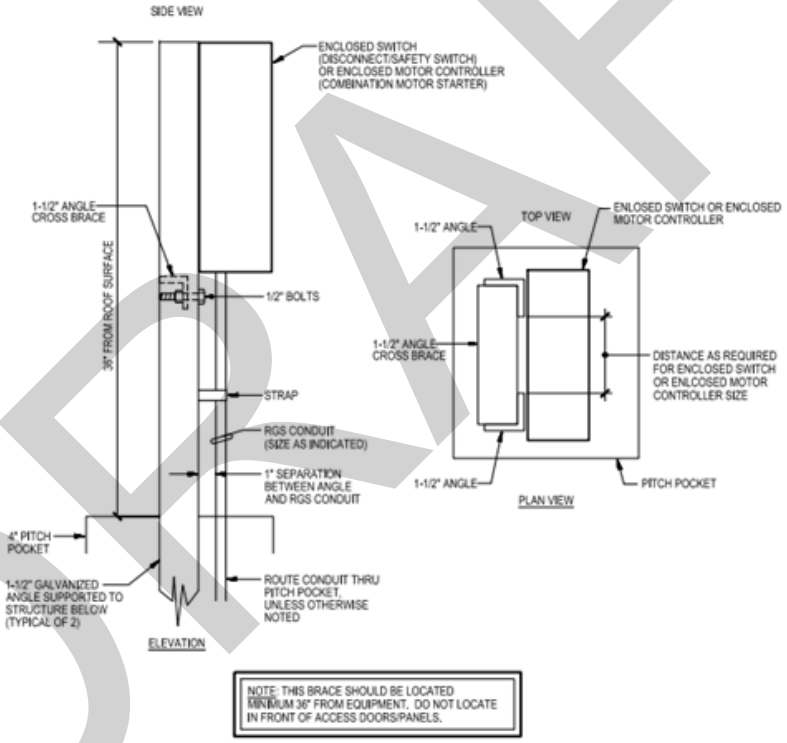
- There are two recommended mounting structures that can be used for mounting rooftop equipment electrical disconnects, receptacles and photo cells.

Product

- Provide 60-inch-high roof-mounted electrical pedestal and base assemblies as required for rooftop equipment and maintenance access in accordance with the MCPS Master Specifications. Design team to indicate locations on roof plan drawings.

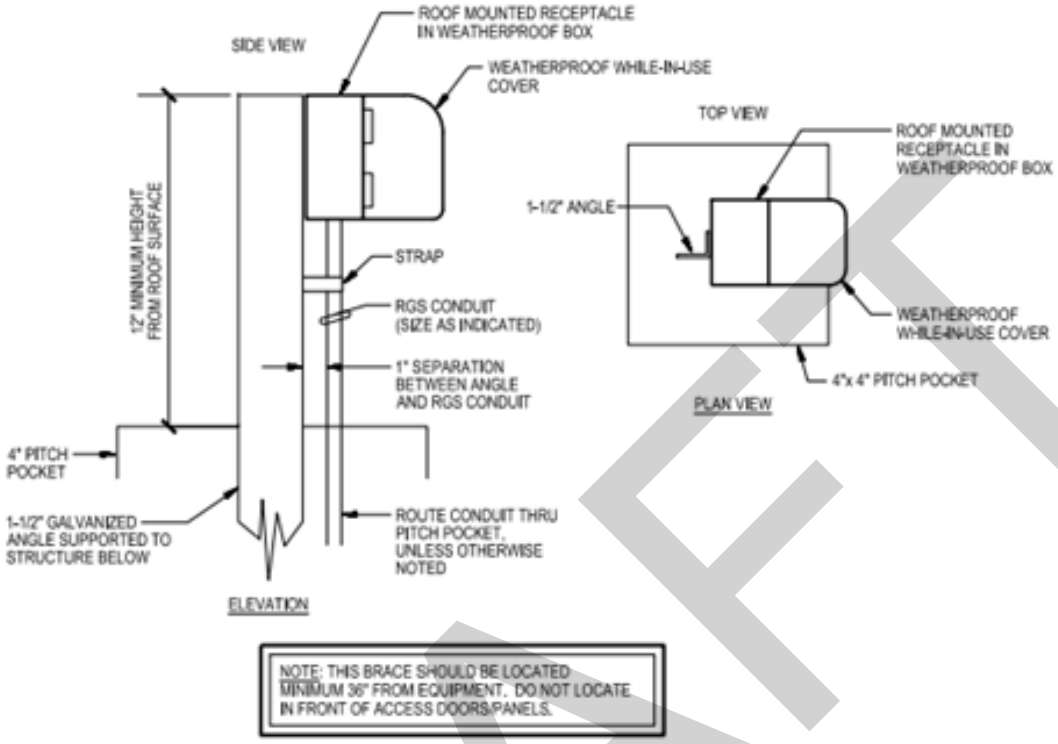
Detailed

- See the below details for constructing using angle iron for mounting electrical equipment power boxes.



Detail 1 Disconnect Mounting on Roof

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Detail 2 Receptacle & Photo Cell Installation On Roof



Figure 2 Mechanical Equipment Shut Off Mount

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08 00 00: OPENINGS

General

- Typical Window/Curtainwall/Storefront set back is 3" from face of veneer.
- At all Curtainwall/Storefront/Window sills, sill flashing detail to show flashing turned up within Curtainwall/Storefront/Window sill connection and between caulking joints.
  - Turning flashing up will prevent water infiltration if/when exterior caulking degrades.
- Skylights are not approved by MCPS.

Glazing:

General

- Consider the future replacement/maintenance challenges
  - The maximum single panel glazing size is 12 sqft.
  - Clear tint to be provided only.

Aluminum Windows

General

- Required to use an aluminum spacer only. No rubber style spacer.
- Insulated glazing stops are aluminum, not rubber.

Storefront & Curtainwall

General

- MCPS Acceptable Manufacturer List:
  - EFCO
  - YKK AP America
  - Tubelite
  - Oldcastle Building Envelope
  - Kawneer North America
- Curtain Wall/Storefront acceptable manufacturer to be listed as an acceptable manufacturer in the aluminum window specification section.Designs should avoid terminating walls at exterior glazing/mullion where acoustical separation is required.
  - Where instances do arise, provide mullion partition gap closure details and meet the required STC rating of the partitioning wall.

Operable Windows

Typical Locations

- Provide at the following locations:
  - Kitchen
  - Cafeteria
  - Classrooms

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- Offices

Requirements

- Kitchen and Cafeteria operable windows to receive insect screens. No other operable windows to have an insect screen.
- Hopper Style - Confirm vent with MCPS.
- Ensure Window latch type is ADA compliant.
- Limit operable windows to 4" max opening distance from exterior face of fixed frame to interior face of operable frame.
- At grade operable windows should limit opening to avoid protrusions past the veneer.
- No operable windows are to be provided in stairwells.

Overhead Doors

General Notes

- All electrified Overhead Doors to have accompanying man door for access to space.
- Exterior surfacing to slope away form building.
- Threshold:
  - Threshold to be recessed so that door sits below interior finish floor level to prevent water infiltration into space.
  - Ensure slope of threshold area is to the exterior.
  - Provide steel edge protection angle at exterior face of building slab at overhead door openings.

Doors

Exterior

- Provide hollow metal doors and frames at all entrances unless otherwise approved by MCPS.
- Doors with two glass lites (top and bottom) shall be used only at the main entrance to the building due to the security shade installation challenges.
- ADA push button door openers to be installed on one of the exterior doors at the main entrance and the door to the Admin suite from the vestibule.
  - Note: Door from vestibule to admin suite does not get an auto opener.
- The courtyard door shall swing in from the courtyard side with panic hardware to avoid anyone being trapped in the courtyard.
- No Vision Panels to be provided at Gymnasium exterior doors.
- Exterior door sills positive drainage away from building to avoid water infiltrating the building.

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Interiors

Corridors

- Length of the recessed door alcove/pocket shall be an additional 3”min. longer than the width of the door to avoid conflict with door swing arc. (eg. 3’-3” from face of frame with a 3’-0” door.)

Hollow Metal Doors & Frames

General

- Roof access door to swing out on roof side.

Hollow Metal Doors

- Steel stiffened, 14 gauge, with 16 gauge stiffeners, 12 gauge top and bottom channels, and 16 gauge reinforcing full height at leading edge and hinge edge.
- Finish: Painted

Typical Locations

- All Exterior doors.
- Back of House Locations
  - Loading Docks
  - Mechanical Room
  - Electrical Room
  - Kitchen Receiving Entrances

Hollow Metal Frames

General

- Door panels to be 14 ga. with 16 ga. reinforcement full height at leading edge and hinge edge.
- Welded with base anchors and four (4) anchors per jamb located above and below the electro-magnetic locks.
- Knock Down Construction in metal stud walls and where no side light is provided.
- Finish: Painted

Flush Wood Doors

General

- Doors between classrooms in elementary school shall be flush doors, with no lite.
- Species: Maple

Typical Locations

- Provide at locations not mentioned under Hollow Metal Doors. Confirm with MCPS per project.

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Door Hardware

General

- All doors in the group bathroom shall have door hold open. (where doors are provided)
- Trash room doors need to have an outdoor Best key.
- Provide door viewers at the kitchen receiving door
- One for ADA and one at normal height.
- Provide screw on weather stripping at all exterior doors not adhesive rubber gasket
- One door at all exterior entrances to be roughed-in for card readers.
- Stairwell doors to have a single point unlocking feature in fire command center or at main vestibule near FAAP need wiring details for this work.
- Provide Electric latch detection at all exterior doors. Confirm wiring detail with MCPS project manager.

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09 00 00: FINISHES

Carpet

Location

- Admin offices and conference rooms
- Media Center
- Carpet is not allowed to use in the corridor unless approved by MCPS.

Product

- Provide Tile carpeting at areas listed above unless otherwise approved by MCPS.

Resilient Tile

Locations

- Throughout building unless otherwise noted.
- Media Center Maker Space
- Elementary school platform behind curtain
- Stair entry landings
- Admin except areas to receive carpet (see carpet)

CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
B. Perform the following operations immediately after completing resilient product installation:
    1. Remove visible adhesive and other surface blemishes from resilient products.
    2. Sweep or vacuum floor thoroughly.
    3. Damp-mop surfaces to remove marks and soil.
C. Prior to the general cleaning a classroom shall be selected for a sample cleaning. When ready the contractor shall arrange for inspection and approval by MCPS Building Services Manager. Upon approval the sample room cleaning shall be used as a basis for general cleaning.
D. Protect resilient products from stains, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
E. Floor Polish: Remove soil, visible adhesive and surface blemishes from resilient stair treads before applying liquid floor polish.
A. Vinyl Composition and Rubber Flooring
    1. Stripping
        a. Strip floors using an approved floor machine and black stripping pad. Use Essential Industries, Green Essence 8881FX, Green Strip only.
        b. Rinse floors using at least two (2) coats of hot water rinse.
        c. Allow floors to dry completely before applying any finish coat(s). Use wet-dry vacuum to remove excess water if necessary.
    2. Apply Finish

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a. Apply six coats (2,000 to 2,500 SF/gal) of Essential Industries, Green Essence 8801FFX, Green G2 Finish with clean pre-rinsed lamb's wool applicator at minimum one hour drying time between each coat.
b. Allow final coat to dry 24 hours before allowing traffic on finished floor.

Resinous Flooring

General

- Integral base at all locations were resinous is used.
- At stairs, tread nosing shall be painted under seal coat a contrasting color.

Locations

- Stairs & Mid Landings
- Kitchen floor (or quarry tile)

Product

- Resinous pour with flake is generally recommended.
- Color: To be reviewed by MCPS.

Epoxy Flooring

General

- Integral base at all locations were epoxy is used.

Locations

- Mechanical Room,
- Building Services Closet,
- Trash Room
- Heat pump Rooms

Product

- Color: Gray

Rubber Tile Floor

Locations

- Security Vestibules
- Gym Vestibules
- Interior Ramps

Rubber Base

Locations

- All locations not listed in porcelain alternate base materials.
  - Ensure back of house and closet locations are included.
- Cove base to be used throughout.

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Ceramic Tile

Locations

- Restrooms
- Corridors (with gypsum walls)

Product

- Base to be 4" minimum.
- Corners to have bull nosed profile, including base.

Porcelain Tile

Locations

- Restrooms (Alternate Wall Base)
- Corridor Wall Base (Preferred)

Product

- Provide Through Body Color
- Base to be 4" minimum.
- Corners to have bull nosed profile.

Quarry Tile

Location:

- Kitchen (Alternate)
- Corridor Wall Base (Alternate)

Product

- Provide Through Body Color
- Base to be 4" minimum.
  - Corners to have bullnose profile

Notes and Concerns

- Ensure verbiage is included in the specifications for waterproofing testing.
  - *"Do not install tile or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight."*
- Provide marble threshold at entry door and at floor to shower transition.

Thresholds

Location:

- Restroom entry and/or tile floor transitions for restrooms
- Showers

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Profile

- Double Bevel, ensure ADA compliance
  - Detail Note: Hold face of beveled transition to corridor/room face of door frames to avoid jogging cuts of flooring.

Wood Flooring

- Elementary School Platform
  - Provide stained hard wood floor at steps and in front of curtain only.
- Middle School and High School Stage to receive wood floors
  - Hard wood floor to be stained in front of main curtain.
  - Behind curtain, wood floor to be painted black.

Gym Floor

Material

- Basis of Design: Robbins, Air-Channel Star
- Finish: Water based sealer and paint finish
  - All courts apply (2) two coats of sealer and four coats of finish.

Game Lines: High, Middle, and Elementary Schools

General

- Keep all game lines No less than 3'-0" from any obstruction such as end walls, side walls, operable wall, or bleachers.
- Logos cannot be trademarked. We will use Gametime wraps or MCPS approved alternative. Logo has to fit inside the 12'-0" circle at center court.
- Only Main Basketball and Main Volleyball games lines shall be painted inside main basketball courts for HS and MS. All other games lines inside the main basketball for HS and MS, shall be T's and L's. T's and L's that occur in the border or logo will be cut in with ¼" gaps. Solid game lines shall be painted outside of main basketball courts.
- All basketball keys and 3'-0" borders will be stained for high schools and only the borders for middle schools.

High School

Main Basketball

- One court 50'-0" x 84'-0".
- Mark full layout, keys, three-point, and center circle lines with 2" Black lines.
- End lines keep a distance of 4'-0" from the inside of the end line to the face of the backboard.
- Provide 19'-9" three-point lines.

Side Basketball

- Use main basketball half court lines.
- Position auxiliary baskets-rims lengthwise to the gym.

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- Provide 2'-0" L x 0'-2"W foul lines at all auxiliary baskets. Line color shall be Base Gold.

Main Volleyball

- Center 30'-0" x 60'-0" court using 2" White lines.
- Include attack lines 10'-0" from center and outside serving area lines.
- All lines should be shown even though it occurs on the main basketball court.

Side Volleyballs

- Include two (2) to Three (3) 30'-0" x 60'-0" Side Volleyballs using 2" Brown blend V lines when lines are outside of the main basketball court
- T's and L's should be used if the line appears on the main basketball court.
- Include perimeter lines, attack lines 10'-0" from center and outside serving area lines.

Badminton Courts 20'-0" x 44'-0"

- Add six (6) to eight (8) 20'-0"x 44'-0" regulation courts using 1 ½" Tan Blend U Line.
- Courts are laid out parallel with length of basketball court.
- No badminton full lines inside the basketball court, use T's and L's.
- Use tick mark to mark 7'-0" from the center for pickle ball non-volley zone (NVZ).
- Maximize the area to provide as many regulation courts as possible.

Middle School

Main Basketball

- Main court size varies depends on size of gym. Mark full layout, keys, three-point line, center circle with 2" Black lines.
- End lines keep a distance of 4'-0" from the inside of the end line to the face of the backboard.
- Provide 19'-9" three-point line

Side Basketball

- Use main basketball half court lines
- Provide 24" x 2" foul lines at all auxiliary baskets. Line color shall be Base Gold.

Main Volleyball

- Center 30'-0" x 60'-0" court using 2" White lines.
- Include attack lines 10'-0" from center and outside serving area lines.
- All lines should be shown even though it occurs on the main basketball court.

Side Volleyballs

- Include two (2) to three (3) 30'-0" x 60'-0" Side Volleyballs using 2" Brown blend V lines when lines are outside of the main basketball court
- T's and L's should be used if the line appears on the main basketball court.
- Include perimeter lines, attack lines 10' from center and outside serving area lines.

Badminton Courts 20'-0" x 44'-0"

- Add six (6) to eight (8) 20'-0"x44'-0" regulation courts using 1 ½" Tan Blend U Line color.
- Courts are laid out perpendicular with length of basketball court.

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- No badminton full lines inside the basketball court, use T's and L's.
- Use tick mark to mark 7'-0" from the center for pickle ball non-volley zone (NVZ).
- Maximize the area to provide as many regulation courts as possible.

Elementary Schools

Main Basketball

- Main court size varies depends on size of gym.
- Mark full layout, including the key
- No three-point lines
- Center circles (6'-0") with 2" Black lines.
- Center circles 12'-0" and 15'-0" color selected by school
- End lines keep a distance of 4'-0" from the inside of the end line to the face of the backboard.

Side Basketball

- Use main basketball half court lines
- Provide 24" x 2" foul lines at all auxiliary baskets. Line color shall be **Base Gold**.

Main Volleyball

- Center of basketball court, include one regulation 30'-0" x 60'-0" court using 2" **White lines**.
- Include attack lines 10'-0" from center and outside serving area lines

Side Volleyballs

- Include (2) 30'-0" x 44'-0" Side Volleyballs using 2" **Brown blend V** lines.
- On three sides use basketball lines as layout.
- Center Poles shall be 2'-0" away from center divider/line.

Badminton Courts

- Add (3) 20'-0" x 44'-0" regulation courts using 1 ½" **Tan Blend U Line** color
- Courts are laid out perpendicular with length of basketball court
- Layout only perimeter using full lines

Light Gauge Stud Construction

General

- Provide steel reinforcement with baseplate for all low wall conditions.
- Provide slotted track to accommodate deflections at all full height partitions. Details and specifications must be provided.
- Provide specifications and details for slotted track to accommodate deflections.

Common Locations

- Behind Low lockers
- Behind Cubbies
- At student workstation seating bars
- Throughout Building

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Gypsum Wall Board (GWB)

General

- Install GWB ½" thick above deck to avoid water wicking.
- Where possible provide moisture barriers at bottom of gypsum board. Confirm barriers provide necessary UL rating.

Drywall Partitions:

Product

- As a value engineering (VE) alternative to CMU in corridors, high impact 5/8" thick gypsum wall board to be used up to 8'-0" AFF in corridors. Use of GWB in corridors must be accepted by MCPS.
  - Should GWB finish be approved by MCPS in corridors, provide ceramic or porcelain tile wainscoting in corridors up to 48"AFF.
- Impact-resistant 5/8" thick gypsum wall board to be used up to 8'-0" AFF in all spaces except corridors.
- Corner Beads
  - Products
    - Basis of Design: CertainTeed Pre-Cut Drywall Corner Beads - AquaBead
    - Size: ¾" Radius
  - Locations
    - All Public Spaces
    - Classrooms
    - Offices
    - Staff Spaces
    - Workrooms
- Do not provide at bulkheads, windows, and back of house areas.
- Stainless Steel Corner Guards. Refer to section 05 00 00 Metals.

Interior Paint

Finishes

- Concrete Masonry Units (CMU)
  - Finish: Semi-gloss.
  - All interior CMU to receive (2) two filler coats and (2) two finish coats. Tint the second coat.
- Gypsum Wall Board (GWB)
  - Finish: Egg-shell (unless approved by MCPS.)

Ceilings

Typical Locations with No Ceilings

- Mechanical Room,
- Building Services Closets
- Trash Room

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- Heat pump Rooms
- IDF and MDF Closets

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10 00 00: SPECIALTIES

Knox-Box

Product

- Provide Knox-Vault 4400 Series as required by Fire Marshal. Design Team to confirm requirements with Fire Marshal and DPS.

Location

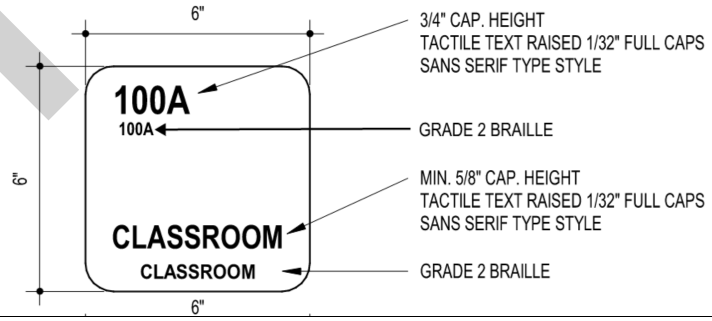
- Confirm Mounting Height and Locations with Fire Marshal and DPS.

Interior Room Signage

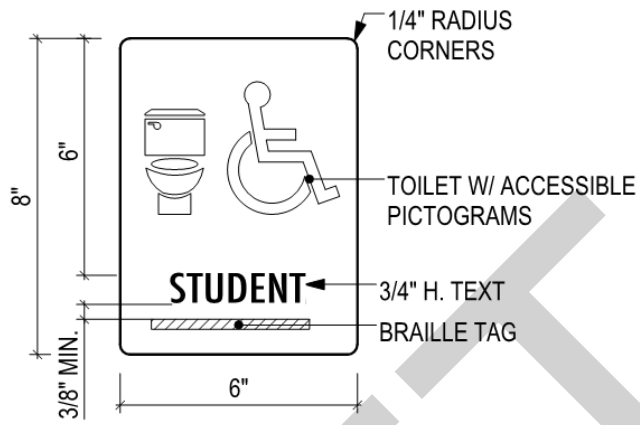
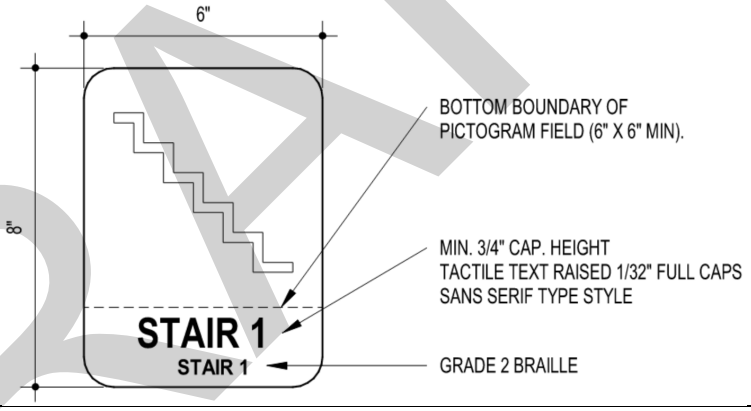
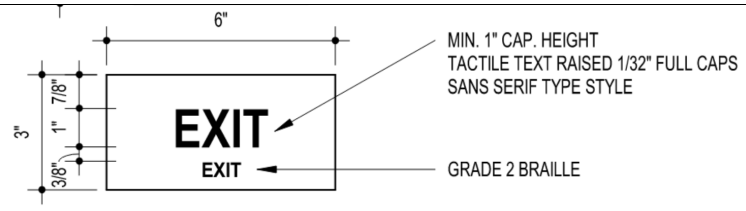
Product

- Material: Non-Glare Acrylic
- Thickness: 0.080-inch
- Surface-applied and painted graphics are not acceptable.
- Provide caulking around all room signage.
- Manufacturers:
  - Best Sign Systems inc.
  - Mohawk Sign Systems, Inc.
  - Bayuk Graphic Systems, Inc.
  - Digital Color Graphics,
  - Supersine Company
  - Adcorp
  - Signs and Wonders

Signage Detail Table

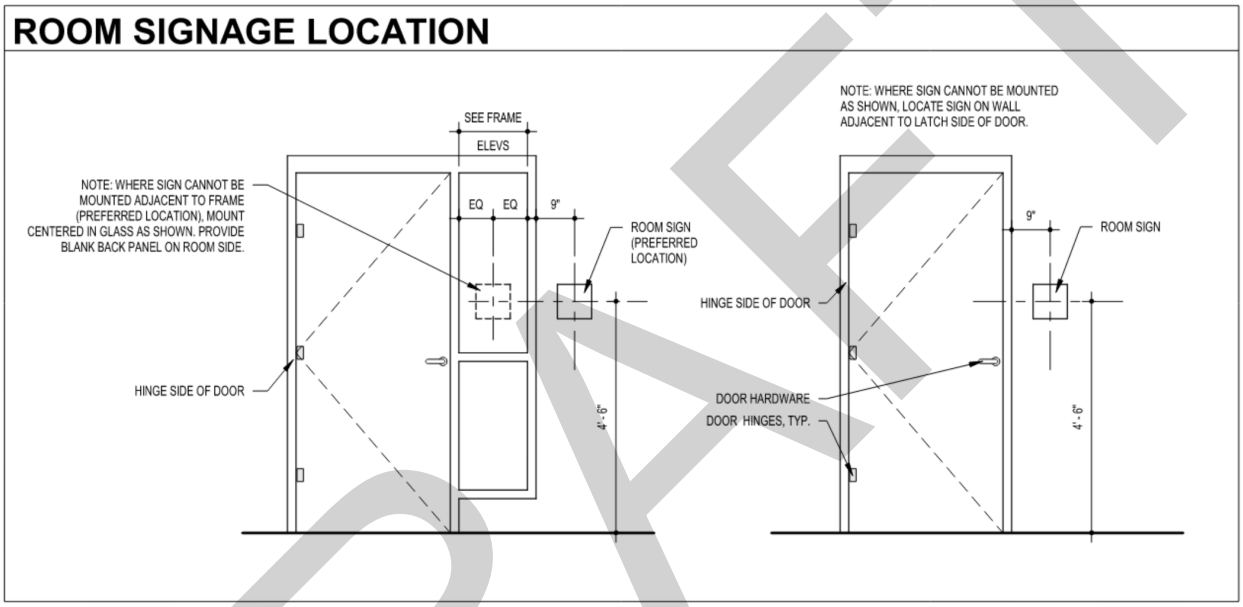
ROOM SIGNAGE ELEVATIONS	
General Room Signage	

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Student/Inclusive Single User Restroom	
Adult/Single User Restrooms	See Similar Student/Inclusive Single User Restroom Label "ADULT"
Single User Group Restroom	
Group Restrooms	
Stair Signage	
Exit Signage	 *Provide sign adjacent to door at all doors with exit light.

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Assistive Listening System Sign	 *PER ADAAG 4.30.7(4) and 4.1.3(19)(b)



Detail 3: Typical Room Signage Mounting Locations

Plaques

General

- County Plaque provided for new construction & replacement projects only.
- State plaque also required if the project is state funded.
  - Refer to state Guidelines for Plaques.
- If the school is newly named, the naming description plaque to be added.

Product

- Material: Bronze
- Size: 18”W x 12”H
- Text: Helvetica

Locations

- Vestibule/Lobby areas. Architect to review locations with MCPS.

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Canopies

Locations

- At all exterior door(s) a canopy or similar cover is required.

Execution & Details

- Canopies are not to be through-bolted through exterior walls design team to provide details for concealed and embedded canopy connections.
- Architect and Structural Engineer should ensure coordination of details between the design team, MCPS, and the basis of design manufacturer.

Metal Lockers

General

- All lockers to have 3-point latch system.
  - Note: Single point latch lockers do not stay shut when a lock is not used causing circulation obstructions.
- Provide setback for all lockers were adjacent to rounded GWB corner or bull nosed masonry corners.

Student

- Knocked-down, Standard, Sloped top
- Concrete base 4”
- Wardrobe lockers in the corridor are not vented.

Elementary

- No locks for ES corridor lockers for students.
- Corridor lockers shall be 60”H (max.) x 15”W Double Stacked

Middle

- Size:60”H (max.) x 15”W
  - If not against a wall, lockers should be lower to allow for visibility.
- Provide built-in combination locks.

High School

- Size:60”H (max.) x 15”W
  - If not against a wall, lockers should be lower to allow for visibility.
- Provide built-in combination locks.

Athletic Lockers

General

- Provide ventilated doors.
- Provide built-in combination locks.

Elementary

- None.

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Middle

- Size:72”H(max.) – 3 Tiered
- Confirm required # with Ed. Spec.

High

- Size:72”H(max.) – 2 Tiered
- Confirm required # with Ed. Spec.

Staff Lockers

- Size: 72”H x 12” W.
- Provide built-in combination locks.

Toilet Accessories

Toilet Accessory Table

TOILET ACCESSORIES PRODUCT TABLE					
ITEM #	DESCRIPTION	BOBRICK	A.S.I.	BRADLEY	REMARKS
1	PAPER TOWEL DISPENSER	B-262	210	250-15	AT ALL CLASSROOM SINKS AND SINGLE USE RESTROOMS.
2	SOAP DISPENSER				OWNER PROVIDED/CONTRACTOR INSTALL
3	TOILET TISSUE DISPENSER	B-2888	0030	5402	2 ROLLS COVERED
4	SANITARY NAPKIN DISPOSAL	B-254	0852	4722-15	
5	MIRROR 18”X24”	B-165 1824	0620-L	720	PRE-K AND KINDERGARTEN RESTROOMS ONLY.
6	MIRROR 18”X36”	B-165 1836	0620-L	720	IN ALL SINGLE USE RESTROOMS.
7	MIRROR 24” X72”	B-165 2472	0620-L	720	MOUNTED 1’ AFF TO B.O. FRAME - PLACE IN GROUP RESTROOMS AND PRE-K
8	GRAB BAR – 36”	B-6806.99	3801-36	812 Series	
9	GRAB BAR – 42”	B-6806.99	3801-42	812 Series	
10	CORNER GRAB BAR	B-62616.99	3274P	8122-0591833	
11	COAT HOOK	B 682	7382	9134	IN ALL SINGLE USE RESTROOMS. KITCHEN, PRINCIPAL AND GYM RESTROOMS
12	ELECTRIC HAND DRYER	World L-974			GROUP RESTROOMS ONLY
13	SHOWER SEAT – LEFT HAND	B-5181	8206L	9565	
14	SHOWER CURTAIN ROD	B-207	1214	9538	SIZE AS REQUIRED
15	SHOWER CURTAIN	204-2	1200-V	9535	SIZE AS REQUIRED
16	SHOWER CURTAIN HOOKS	204-1	1200-SHU	9536	AS REQUIRED
17	UTILITY SHELF W/ HOLDERS	B-224x36	1315-3	9983	BUILDING SERVICE CLOSETS
18	MENSTRAL DISPENSER **(HS&MS)**	EVOGEN EV3 WM (WHITE METAL) NO-TOUCH MENSTRUAL CARE DUAL VENDOR (EVNT3)			ALL WOMEN’S RESTROOMS FOR STUDENTS & SINGLE USER TOILET COMPARTMENTS: MOUNTING HT – 27” MAX.,

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19	MENSTRAL DISPENSER (ES)	FEMININE HYGIENE PADS ONLY ENVIRO GARDS	1 GIRL'S GROUP TOILET FOR STUDENTS; MOUNTING HT – 27" MAX. TO BOTTOM

Toilet Partitions

General

- Provide pilasters at urinal privacy partitions and ensure space between pilasters at urinals complies with ADA clear space.

Products:

Material:

- **Type:** High-density, polyethylene (HDPE) panel material
  - Having 100 percent post-consumer recycled content.
- Thickness: no less than one (1") inch thick.
- **Edging:** Eased (Chamfered or Rounded).
- **Color and Pattern:** Basis of Design - Paisley (Bradley Corp.)
  - Homogenous color and patterns throughout the thickness of the material.

Acceptable Manufactures:

- Bradley Corporation
- Scranton Products
- Yemm & Hart Green Partition
- ASI Global Partitions
- Hadrian

Mounting

- **Overhead Bracing:** Heavy-duty, anti-grip, corrosion-resistant.
- **Pilaster Shoes and Sleeves (Caps):** 4 inches high.
- **Brackets (Fittings):** Full-Height (continuous)
- **Material:** Manufacturer's standard design; extruded aluminum
- **Heat-Sink Strip:** Manufacturer's standard continuous, extruded aluminum strip fastened to exposed bottom edges of solid-polymer components to prevent burning.

Hardware:

- **Hardware and Accessories:** Heavy-duty operating hardware, and accessories.
- **Material:** Stainless Steel

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Figure 3: Toilet & Urinal Partition

AED Kits

General

- Shall be provided and installed by the MCPS Department of Systemwide Safety and Emergency Management
- The plan locations shall be determined by MCPS Department of Systemwide Safety and Emergency Management staff during the design, and A/E to show in the drawing.
- The final location to be coordinated with the MCPS project manager and the principal. MCPS project manager to coordinate with appropriate MCPS staff.
- AED Kit and Stop the Bleed Kit shall be installed stacked. The bottom edge of the lower kit shall be at 27" AFF to comply with ADA requirements.

Locations

- Main Lobby
- Near Gymnasium Lobby

Stop the Bleed Kit

General

- Shall be provided and installed by the MCPS Department of Systemwide Safety and Emergency Management.
- For Middle & High Schools the plan locations shall be determined by MCPS Department of Systemwide Safety and Emergency Management staff during the design, and A/E to show in the drawing.
- For Elementary Schools the kit is kept in the Health Suite.

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- If there is an existing kit in the building, the MCPS project manager is responsible to coordinate with the MCPS Department of Systemwide Safety and Emergency. Management for a new location and with the Division of Maintenance and Operation for the installation.
- AED Kit and Stop the Bleed Kit shall be installed stacked. The bottom edge of the lower kit shall be at 27" AFF to comply with ADA requirements.

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11 00 00: EQUIPMENT

Projection Screen

Product

- Non-Tensioned
- Aspect Ratio: 16:9
- Screen Size: Preferred Width of +/-12'-0".
- Viewing Surface Material & Color: White
- Extra Drop Color: Black
- Border Color: Black
- Height: 36" above viewing floor, 6" min. above raised floor.

Typical Locations

- All Purpose Rooms
- Auditoriums
- See additional requirements in Ed. Specs.

Fold Up Dividers

General

- Fold Up Divider shall be used to divide the main gymnasium into (2) two spaces.
- If the second gymnasium is connected to the main gymnasium, movable partition shall be used to separate the main gymnasium and second gymnasium.
- No roll up dividers shall be used.

Product

- Approved Manufacturers:
  - Draper,
  - Spalding
  - Gared - PSS Performance Sports Systems.

Kiln

General

- Refer to the Educational Specifications for the number of kilns to be provided. Each kiln to have exhaust hood.
- Kilns should be located at the far end of the Storeroom/Kiln Room.

Product

Elementary

- Kiln
  - Basis of Design: Paragon TNF 82-3
  - Size: 30"W x 30"D x 36"H
  - Electrical: 240 volt; 30 amp; 7200 Watts; Single Phase

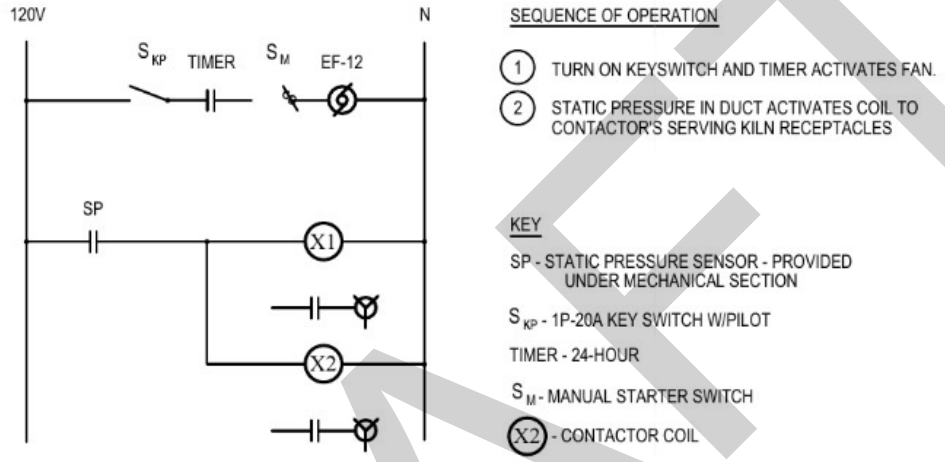
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Middle & High Schools

- Kiln
  - Basis of Design: L&L JD230EZ – 48 amp model.
  - Plug: 15-50p
  - Electrical: 208V, 60 Amp Circuit: 3 Phase

Exhaust Hood

- Provide a Local switch with 24-hour timer.
- Positive ventilated.



Detail 4: Example Kiln Electrical Wiring Diagram

PugMill

- Model:
- Power Requirements:

Spray Booth

- Location: Typically in Kiln Rooms
- MCPS requires vented spray booths.
- Model: Leguna Pro-V
  - Power: 115v or 220v

Ceramic Pottery Wheel

Distillers (Science/Chemistry)

- Location: Prep Rooms on countertop
- Need to be near drain and have dedicated water line hookups.
- Hookups to be provided typically in all HS and MS Science & Chemistry prep rooms. Confirm with Ed Specs.

Ice Machines

- Ensure drains are provided where ice machines are located.

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Residential Range and Vent

Locations

- Provide in rooms for School Community Based (SCB) & Learning for Independence (LFI) Classrooms.
- Refer to Educational Specifications.

Product

Vent

- The vent above range shall be a residential, re-circulating type.
- Exhausting outside is not required.

Trash Compactors

Product:

Elementary & Middle

- Basis of Design: Harmony 450 SS
  - https://harmony1.com/harmony-products/indoor-stainless-steel-compactor/

High

- Basis of Design: IDC 10T compactor.
  - IDC 10T Compactors - Big Stuff, Inc.

Fume Hoods at Science

General

- Provide dual entry type. This type maximizes the space and minimizes the fume hood size.
- Refer to Educational Specifications.

Wood Fiber Acoustical Wall Panels

Product:

- Basis of Design: Armstrong Tectum Panels
- Acoustical insulation on the back. Back to receive the painted finish.

Location

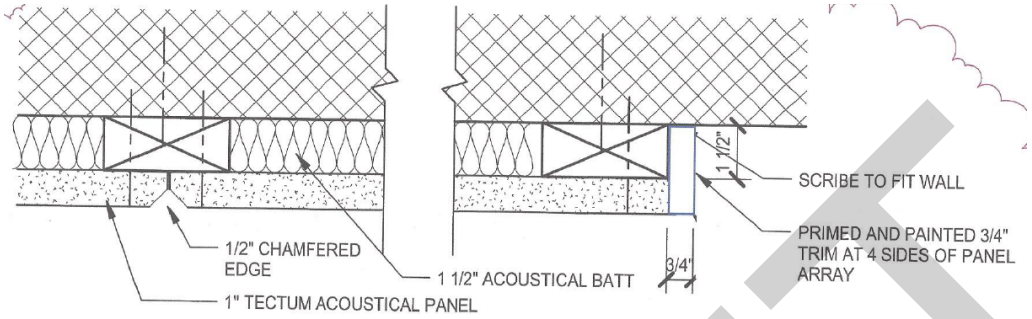
- Not Limited to but including:
  - Gymnasium
    - No fabric wrapped panel in a gymnasium.

Mounting and Construction Details

- Provide wood edge protection around tectum panels in gymnasium(s).
- Do not caulk or fill screw mounting holes in panels
- Paint all tectum panels. Colors, patterns and designs should be carefully considered.

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- Paint all exposed fasteners to match panels.
- See Tectum Wall Panel Attachment Detail below.



Detail 5: Tectum Wall Panel Attachment and Framing.

Gymnasium Equipment:

General

- Provide "climbing ropes" 4'-0" apart min.
- Provide "chin-up bars"
- Horizontal bar and associated floor sleeve/anchors shall be installed per Ed. Specs in HS gym only.
- Refer to Gym Flooring section.

Wall Padding

Mounting & Installation

- The bottom of the wall padding to be at 4" AFF max. Confirm with codes.
- Use (3) continuous French cleats for mounting each pad to the wall.
- Secure with flange at bottom of pads and fasten with (3) 1 ¼" decking screws, 2" from each end and one in the center. Athletic flooring base will require notching to accommodate bottom flange. Provide detail of padding including bottom flange in drawings.

Equipment Lists

General

- Design team to coordinate the required gymnasium equipment to be included in contract with the MCPS project manager.

High School Equipment List

Qty.	Equipment Type	Manufacture	Model #
10	Badminton/Pickleball Combo Poles	Sports Imports	DG11-PBC
4	Volleyball Poles	Sports Imports	DE-11
2	Heavy Duty cranks	Sports Imports	HDNR
8	Badminton Nets	Senoh/Sports Imports	SBN-20
2-3	Volleyball Nets	Senoh/Sports Imports	HM50

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1	Floor markers	Floor Marx	6 Pack Master Set
2	Volleyball Wall Rack (2 poles*if needed).	Sport Imports	WR10
3	Badminton Wall Rack(4poles*if needed).	Sports Imports	BWR10
1	Equipment cart	Senoh/ Sports Imports	DU22

Middle School Equipment List

Qty.	Equipment Type	Manufacture	Model #
8 to 10	Badminton/Pickleball Combo Poles	Sports Imports	DG11-PBC
4	Volleyball Poles	Sports Imports	DE-11
2	Heavy Duty Cranks	Sports Imports	HDNR
6 to 8	Badminton Nets	Senoh/Sports Imports	SBN-20
2 to 3	Volleyball Nets	Senoh/Sports Imports	HM50
2	Volleyball Wall Rack (2 poles) *If needed	Sports Imports	WR10
2 to 3	Badminton Wall Rack(4poles) *if needed	Sports Imports	BWR10
1	Floor markers	Floor Marx	6 Pack Master Set
1	Equipment cart	Senoh/Sports Imports	DU22

Elementary School Equipment Layout

Qty.	Equipment Type	Manufacture	Model #
4	Badminton/Pickleball Poles	Sport Imports	DG11-PBC
4	Volleyball Poles	Sport Imports	DE-11
1	Heavy duty Crank	Sports Imports	HDNR
3	Badminton Nets	Senoh	SBN-20
2	Volleyball Nets	Senoh	HM50
1	Floor markers	Floor Marx	6 Pack Master Set
1	Equipment cart	Senoh	DU22
2	Volleyball Wall Rack (2 pole) *if needed	Sports Imports	WR10
1	Badminton Wall Rack (4pole) *if needed	Sports Imports	BWR10

Scoreboards

General

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- Provide (1) one scoreboard in Middle Schools at the main gym.
- Provide (2) two scoreboards in the main gym of High Schools and (1) one scoreboard in the secondary gym(s).

Kitchen Equipment:

General

- Walk-in refrigerator and freezer should be on the emergency generator.
- Delivery access between loading dock and cooler/freezer should be wide enough to accommodate pallets.
- Provide a door bell at the loading dock door to the Cafeteria Manager Office.
- Kitchen equipment must not require proprietary service. If proprietary equipment is required, service and support must be provided for the life of the equipment.
- Corkboards should be located outside the Managers Office.

Elementary School Kitchen

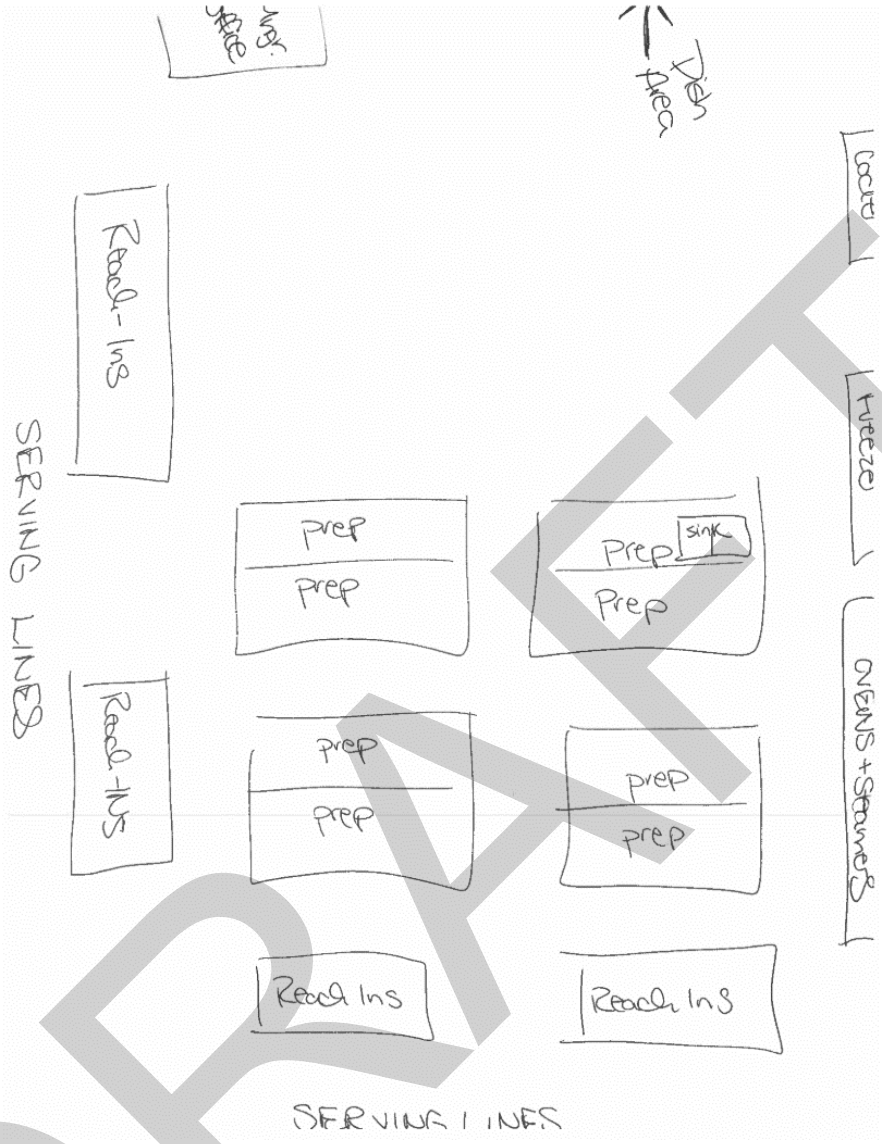
Front of House

- Front-of-house layouts shall support efficient student circulation with clearly defined entry and exit paths through the serving area.
- Kitchen front walls facing the cafeteria shall incorporate glazed panels to allow natural light into the kitchen and maintain visual connectivity.
- Door locations shall be configured to support a one-way circulation pattern through the serving line where feasible.
- Wall surfaces above or integrated with glazed panels may include graphics, signage, or applied imagery to create a welcoming, age-appropriate cafeteria environment. MCPS Facilities Architect.
- Graphics may be applied directly to glazing or adjacent wall surfaces, provided light transmission and visibility are maintained. Designs to be approved by MCPS Facilities Architect.

Back of House

- Back-of-house layouts shall be organized to support efficient food service operations within a compact, rectangular floor plan.
- Delivery access shall allow direct movement of products into dry storage and walk-in refrigeration/freezer units.
- Adequate food preparation space shall be provided directly in front of cooking equipment and behind the serving line.
- The rectangular configuration shall support clear circulation and minimize cross-traffic between functional zones.
- The manager's office shall be located to allow direct visual oversight of kitchen production and service areas.
- The three-compartment sink shall be located away from food preparation and serving areas to support sanitation and food safety requirements.

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Sketch 1 Single Serving Line and Prep Kitchen Example: NTS

Secondary School Kitchen

Front of House

- Front-of-house layouts shall be designed to minimize the perception of long wait times and encourage student participation in meal programs.
- Serving configurations shall limit long queues extending into the cafeteria.
- Serving lines shall be arranged so that a portion of student waiting occurs within the defined serving line rather than in open cafeteria space.
- Serving line layouts shall position hot wells at the back of the line, with reach-in refrigeration units located directly behind for restocking.

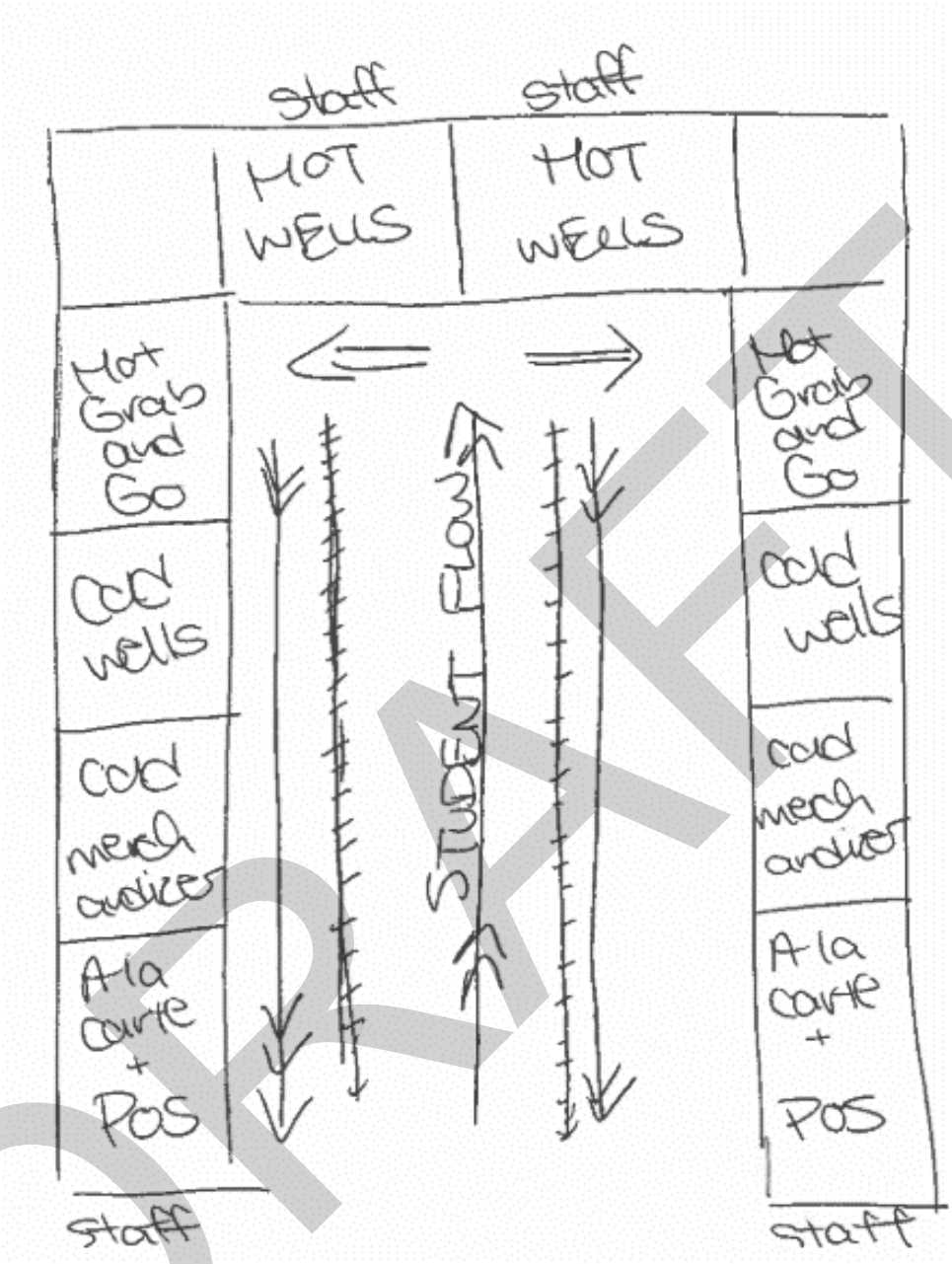
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- Circulation shall allow students to turn and proceed sequentially through hot grab-and-go, cold wells, cold merchandising, à la carte, and point-of-sale (POS) stations before exiting back into the cafeteria.
- Dividers or barriers shall be used to clearly define serving queues and direct student traffic flow.
- Divider materials and finishes shall align with countertop materials where possible to create cohesive appearance.
- Dedicated space shall be provided behind each serving line for restocking and staff movement.

Back of House

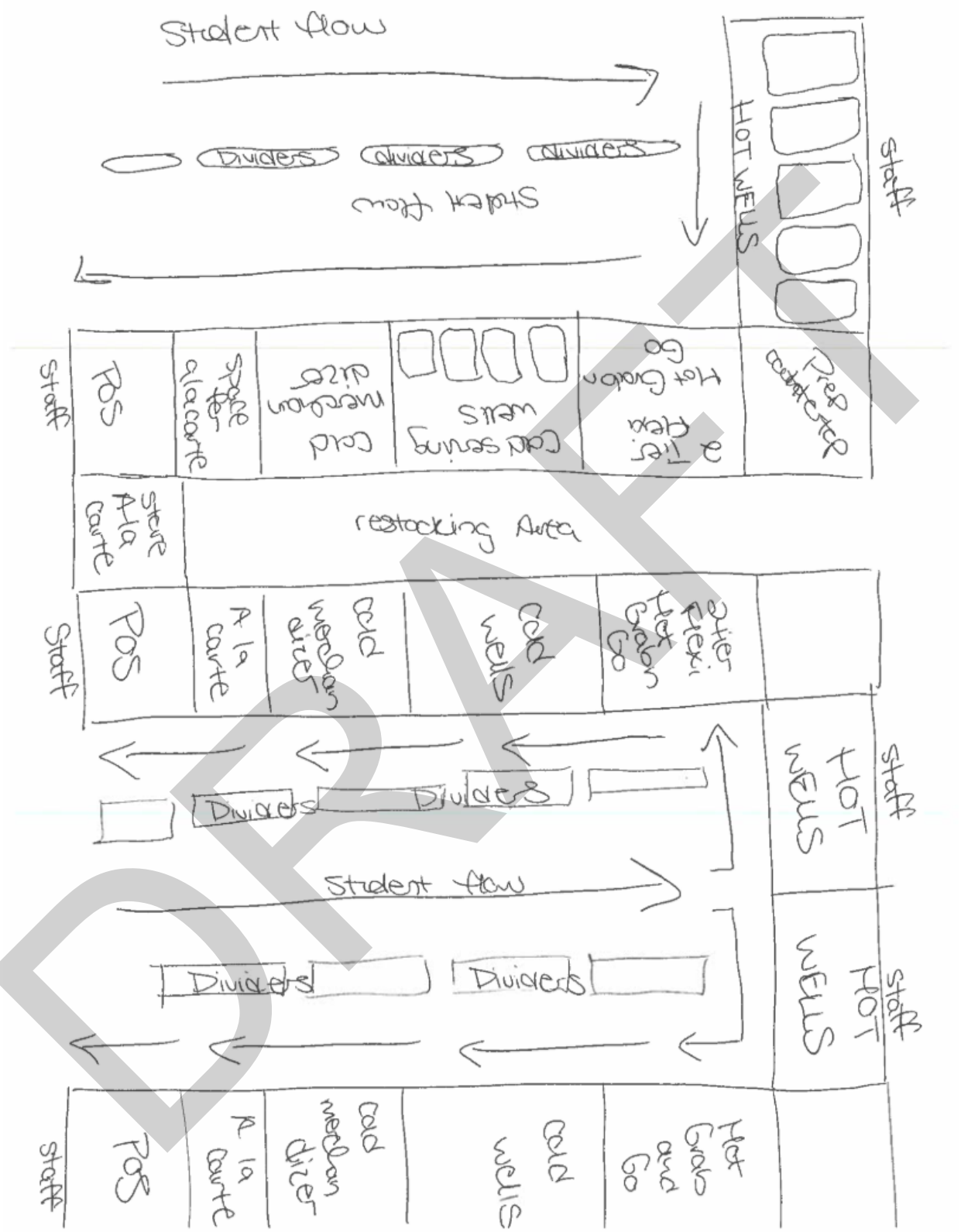
- Back-of-house layouts shall be designed to support a clear, continuous operational food service flow.
- Receiving areas shall allow food deliveries to move directly into dry storage and walk-in refrigeration/freezer units.
- Food products shall flow logically from storage areas to designated food preparation areas without backtracking.
- Preparation tables shall be arranged back-to-back and located in front of cooking equipment (ovens and steamers) and behind reach-in refrigeration units.
- Reach-in refrigeration units shall be located directly behind each serving line to facilitate efficient restocking during service.
- Adequate staff circulation clearance shall be provided between serving lines and reach-in refrigeration units.
- Sufficient space shall be provided adjacent to the three-compartment sink for drying racks and ware-drying operations.
- The warewashing area shall be located in a separate room or be sufficiently separated from food preparation and serving areas to prevent cross-contamination.
- The manager's office shall be positioned to allow maximum visual oversight of food production and serving operations.

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Sketch 2 Spit Kitchen Serving Line Example: NTS

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Sketch 3 Dual Serving Line Example: NTS

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Loading Corridor/Dock Area

- Provide Loading Dock area be suitable for a 20'+ foot truck, away from students. Loading dock designs should minimize slopes for both the raised concrete area and truck parking.
- Loading
- Entire path between loading dock and walk-in coolers be wide enough to fit pallets through.
- Doorbell from back door to Cafeteria Managers Office – increased safety.

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12 00 00: FURNISHINGS

General Casework

ADA Sink, Wall and Base Cabinets

- Provide a minimum of 30" clear above the casework sinks to install soap and paper towel dispensers.
- Provide waterproof core particle board at all sink countertops. No joints should be located within 3'-0" of the sink.
- Provide Student countertop sinks at:
  - Pre-K/Kindergarten Classrooms 26" high,
  - All other ES classrooms shall be 30" high.
- Design team to indicate faucets at Pre-K & K classroom sinks to be on the side to provide easier access to students.
- Design Team to note/provide detail calling out all countertops to have 1" radius at exposed outside corners.
- Shelves are plywood core with only front and back surfaces shall be edged.
- Casework to receive 4" rubber base on all exposed faces (including toe kicks).
- Provide PVC edging for all exposed PLAM edges.
- Non ADA cabinets shall not have backs in cabinet to allow for cleanout/wall access.

Teacher's Wardrobe

General

- Indicate and Provide the following:
  - Duplex electrical outlet to charge personal phone/devices. (Coordinate with Electrical)
  - Mirror with Pin Tray
  - File Cabinet
  - Lockable Doors
  - Closet Rod in main compartment
  - Chain Door Stops
  - Finger Door Latches
  - Adjustable Shelves
  - Refer also to MCPS typical detail.

Basis of Design

- Stevens Advantage – Wardrobe 25667 or equal

Cubbies:

General

- Ensure cubby lay out allows for ADA access.
- Where cubbies are not located directly against a wall, a low wall with a wood top (WD top) is required at the back of the cubbies. At these locations, coordinate the width

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and thickness of the top cap with adjacent door frames and window sills to avoid conflicts and ensure a clean, integrated installation.

Materials

- Tops
  - Hardwood or 3/4" plywood with wood veneer and hardwood edging.
  - ½" Radiused exposed edges.
- Exposed Sides :
  - 3/4" plywood with wood veneer and hardwood edging.
- Base: 4" tall with resilient base applied to face.

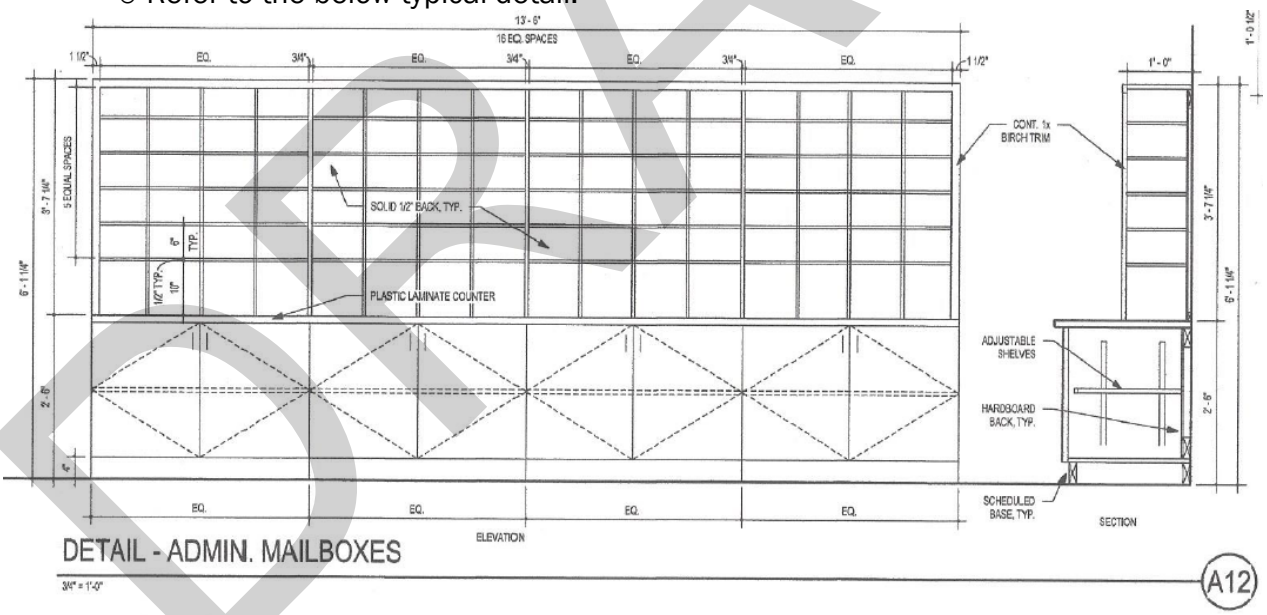
Dimensions: (Per Cubbie)

- 12" W x 48" to top.
- Compartments
  - Bottom (Shoes): 9 ½"clear
  - Middle (Coat): 2'-3" clear
  - Top (Papers): +/- 3"

Admin Mailbox

General

- Confirm the required number of mail boxes with Educational Specifications.
  - Refer to the below typical detail.



Detail 6: Typical Staff Mailboxes

Furniture

General

- Refer to Educational Specifications for items to be not in contract (NIC).
- Design team to provide furniture layouts, review with MCPS, and the coordinate necessary utilities required.

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- MCPS project manager is responsible to receive the final furniture drawings from the furniture vendor and distribute them to the contractor and MCPS design team.
- Perimeter bookcases are movable bookcases under FF&E budget. Design Team to show them in the drawings, but indicate them as NIC.
  - Depth of movable bookcase to be 18”-26”.
- Admin Lobby counter, Lobby desks, and Media Center are NIC. Design Team to provide locations on drawings and coordinate with data and power to desks.

Laboratory Casework

General

- Plumbing for water & gas, and electrical conduits to be installed by GC/Subcontractor. Laboratory casework does NOT come pre-piped. Coordinate Arch specs and MEP.
- All Science lab casework:
  - Plumbing fixtures, water, and gas piping need to be specified and drawn in contract documents
  - Design team to provide drawings for division of scope of work.
- The MEP contractor will be responsible for a warranty for all mechanical work on the Science casework
- Visible piping to be painted after the piping is installed and tested by the mechanical contractor.
- Provide accessible trench where utilities are be provided to demonstration tables and lab work tables. Trench to be flush type to accept floor finish. Fasteners to be concealed or flush.
- One large deep 18" x 18" x 20" sink should be provided for cleaning materials. Locate the sink so that there is a min. of 3’-0” counter space on either side.

Demonstration Tables

General

- Demonstration tables to be fixed.
- Design team to incorporate power and data for teacher’s desk in demonstration table where teacher desk adjacent to table.

Chemistry Lab:

General

- Check with the codes, including Montgomery County codes for ventilation and storage requirements.
- The demonstration desk needs one 220-volt outlet and two 120-volts.

Music Storage

General

- Basis of Design: Wenger
- Refer to Ed Specs. for casework type requirements.

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Horizontal Blinds

General:

- Horizontal louver blinds to be provided only if the project is very minimal renovation/addition. Roller shades are preferred. Coordinate with MCPS.

Roller Shades

General

- Design Team to coordinate chain tensioner device locations where manual shades are provided. P-Clips, Bars, and wands are not to be used.
- Design Team to accommodate room between structural columns and window frame for shade assembly.
- At corner windows allow for shade assembly form both directions to cover glass in both directions at the corner or provide 1'-0"x 1'-0" solid corner.
- Provide plan tags for type of shade application at all required locations.
- Provide shades mounted above the jambs at interior sidelights to provide adequate coverage.

Products

- Recommended Manufacturers:
- Shade Material & Locations
  - Type: Blackout
    - Locations: Exterior windows at grade, interior side lites, door lites & sidelites to corridors, and non-corridor windows to courtyards.
  - Type: 5% Shade
    - Locations: Exterior windows above first floor.
  - Type: Dual Shade (Blackout & 5%)
    - Locations: Admin Offices
  - Type: Motorized
    - Locations: Exterior high-volume glazing and clerestory locations.
    - Material: see Blackout and 5% Shade descriptions.
    - Operation: Singular key switch for the same area.

Display Boards

General

- MCPS Standard Teaching Wall Details / teachers station is located opposite side of room from corridor

Marker Boards

General

- Refer to Ed Spec requirements for locations and widths.
- Marker Boards in Gymnasiums are to be provided without chalk trays.
- Typical Dimensions: height is 5'-0" tall, widths vary. Refer to Master Specifications for frame width.

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Elementary Schools

- Provide marker boards and tack boards at the below elevations:
  - Classroom– Pre-K & K: 1'-6" AFF
  - Classroom– Grade 1-5: 2'-0" AFF
  - Art/Music/Gymnasium/Dual Purpose – ES: 2'-0" AFF

High Schools, Middle Schools, & Staff Areas:

- Provide marker boards and tack boards at 3'-0" AFF.
- Refer to Elementary Schools where early education programs are provided.

Music Staff

- At general and instrumental music provide full width or min. 5'-0" to 6'-0" for staff lines.

Tack Boards

General

- Refer to Ed Spec requirements for locations and widths.
- Typical Dimensions:
  - Full Size: Height is 5'-0" tall, widths vary.
  - Above Markerboards: 12" or 2" map rails are provided.
    - Refer to Ed Spec for required locations.

Stage Curtains

General

- All stage curtains **must** be made of IFR material. **Fire treated cotton is not acceptable.**
- No proprietary curtain control systems are permissible.

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13 00 00: SPECIAL CONSTRUCTION

Not Used.

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14 00 00: CONVEYING EQUIPMENT

Elevator

General

- Design Team shall accommodate the mechanical system for the elevator shaft on an emergency circuit per elevator inspector requirements.
  - A letter confirming that the shaft will not exceed the required temperatures during a power outage, may be substituted if permitted by the AHJ.
  - See also section 23 00 00 Heating, Ventilation, and Air Conditioning.
- Design Team shall provide lights at landings on an emergency circuit.
- Design Team to ensure that at Least one (1) elevator is able to accommodate an ambulance stretcher. Coordinate location with MCPS.
- If an elevator is equipped with an oil minder the drawings should point out a location that is tamper proof.
- Design Team to indicate that the elevator shaft walls are to be painted white.

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21 00 00: FIRE SUPPRESSION

Fire Safety:

Pull Stations

General

- MCPS maintains a Memorandum of Understanding (MOU) with the County Fire Marshal's Office governing the placement and requirements of fire alarm pull stations. The Design Team shall review the current MOU, available in the front-end specifications provided by the Project Manager, and coordinate with the MCPS Fire Safety Compliance Technician to ensure all fire alarm system designs comply with its provisions.
- Inspector Test Locations should be located 6'-0" or higher above finished floor.

Typical Locations

- Main Entrance, All Purpose Room, Gym, Auditorium, boiler room, near the kitchen exit, and near the most remote exit form the main entrance.

Fire Extinguishers & Cabinets

General

- MCPS maintains a Memorandum of Understanding (MOU) with the County Fire Marshal's Office regarding the selection, type, and placement of fire extinguishers. The Design Team shall review the current MOU, included in the front-end specifications provided by the Project Manager, and coordinate with the MCPS Fire Safety Compliance Technician to verify that fire extinguisher locations and specifications conform to the approved standards.
- Fire extinguishers will be provided by MCPS post construction.

Type

- Cabinets: Fully recessed. (Preferred)

Typical Locations

- Typical Fire extinguishers will be installed after the completion of the construction with the exception of the Elevator Machine Room fire extinguisher which will be provided by the MCPS Fire Safety Compliance Technician prior to the elevator inspection.

Sprinkler System

General

- The Design Team shall account for sprinkler head placement in areas with unique or complex ceiling configurations, such as all purpose rooms with ceiling clouds. Sprinkler coverage, alignment, and aesthetics shall be coordinated to ensure code compliance and visual integration with the ceiling design intent.

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Layout

- The Design Team shall account for sprinkler head placement in areas with unique or complex ceiling configurations, such as all purpose rooms with ceiling clouds. Sprinkler coverage, alignment, and aesthetics shall be coordinated to ensure code compliance and visual integration with the ceiling design intent.
- Special attention should be paid to the placement of stairwell doors in relation to sprinkler standpipes.

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22 00 00: PLUMBING

Fixture Mounting Heights

Follow the below chart for mounting heights. Architect/Designer to confirm compliance with ADA, IBC & ANSI standards.

FIXTURE MOUNTING HEIGHTS					
Fixture	Pre-K & PEP	K	1-3	4-5	MS/HS & Adult
Lavatories	24”	24”			
ADA Lavatory	24”	24”	28”	24”	*
Water Closet Seat HT	11”	15”	15”	15”	15”
ADA Water Closet Seat HT	15”	15”	18”	18”	18”
Urinals	-	-	*16”	*16”	*24”
ADA Urinal	-	-	*16”	*16”	*16”
Mop Sink	36”	-	-	-	-
Hose Bib (Exterior)	18”	-	-	-	-
Hose Bib (Interior)	16”	-	-	-	-
*Confirm with ADA, IBC, & ANSI					

Fixtures

Lavatories

General

- All wall hung lavatory fixtures shall be supported with concealed floor mounted carriers.

Sink Bubblers

General

- Sink mounted bubblers are not permitted in MCPS Schools.

DRAFT

Water Cooler w/ Bottle Filling Station

General

- Design team to note height and placement of water cooler on drawings.
- Where possible, water coolers are to be located within alcove to prevent conflicts with corridor/restroom traffic.
- Provide tile backsplash on all three walls and tile flooring below.

Product

- Provide a filtered bottle filling station with an integrated, versatile bi-level ADA-compliant drinking fountain at each designated location.

Typical Locations

- Near music/instrumental classroom.
- In or near Gymnasium
- In or near Cafeteria
- Near the exterior door to the outdoor play area(s)
- Near Pre-K & Kindergarten Classroom areas
- Near PEP Classroom areas.
- Spread throughout the building on each floor.

Hose Bibs

Typical Locations

- Provide hose bib at courtyards for use by building services.
- Provide a hose bib at the perimeter of the building near the hard surface play areas.
- Design team shall coordinate with the MCPS for the placement of hose bibs around the perimeter of the building.

Trench Drains

General

- Ensure coordination with structural to avoid conflicts at composite floor decks and water proofing of flooring system.

Locations

- Group Restrooms/locker rooms.
- Outside of shower stalls. Confirm locations with MCPS plumbing engineer.

Round Floor Drains

- At washer dryer areas, showers, restrooms and as necessary.

Back Flow Valves

General

- Design Team to confirm backflow valve requirements with the MCPS plumbing engineer.

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Roof Drains

General

- Design team to provide detail for roof drain and to note that a PVC threaded connection is not to be used for roof drain connection to the main stormwater PVC drain pipe. Connect the roof drain with a threaded cast iron pipe extension coupled to the PVC stormwater drain pipe with a neoprene flexible coupling.
  - Basis of Design: Fernco Proflex.
- Specify that a flood test is to be conducted for all roof drains to ensure connections are made properly.
- Include in the specifications that the roof installer needs to come back to the school after 1 year and tighten all roof drain bolts by hand.

Toilets

General

- All toilets must be floor mounted

Cleanouts

General

- Provide cleanouts before and after the bathrooms. Locate cleanouts in an accessible and appropriate location. Reference Brown Station drawings.

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23 00 00: HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

Mechanical Systems

General

- Provide access ladders for servicing DOAS, RTUs, ERUs and VRF as needed to service equipment, filters and belts service.
- Provide adequate space to service HVAC equipment. Provide at least 2'-0" of clearance or manufacture's minimum clearance (whichever is greater) on all serviceable sides of each piece of equipment. Coordinate layout with MCPS.

Split Systems

- Provide dedicated split systems for all IDF and MDF closets above door ensure drainage does avoids all equipment.
- Ensure drain connections are provided for mechanical drain pans

Radon Vents

General

- Design Team is to show radon vents on drawings and ensure code requirements are met.
- Provide adjacent power above roof where vents do not receive fans for potential fan installation after completion of project.

Refrigerant Piping Supports

General

- Provide (1) saddle per pipe.
- Provide clevis hanger with saddle and sip tie for a maximum of 2 pipes (one branch) per clevis hanger.
- Provide pipe saddle mounted to trapeze framing with pipe clamps and insulating inserts for areas with (3) three or more

Product

- Saddles: Basis of Design - Snap-A-Saddle

Thermostat Cover

General

- Provide wire cage guards for wall-mounted thermostats and control devices located in high traffic areas.
- Wire guard should allow for user access through the guard without removing the guard entirely.

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Typical Locations

- Gymnasium
- Auditorium
- Corridors
- Cafeterias
- All Purpose Rooms

Product

- Basis of Design: Honeywell Thermostat Guard Models CG510A, CG511A, & CG512A

Control Wiring

General

- Final runs of control devices to the MDF/IDF room is to be part of MCPS' low-voltage vendor's scope outside of design team's scope of work.

Serviceable Parts Above Ceiling

General

- Serviceable parts are to be located within 2'-0" of finished ceiling height.

Servicing Roof-Mounted Equipment

General

- All elevated equipment must have easily accessible platformed work areas with appropriate guardrails and fall protection. Provide ladders to access platforms.

No Impeding Servicing of Equipment

General

- Design team shall coordinate and take care to ensure that no architectural, structural, mechanical, electrical, plumbing, fire protection, etc., impedes access to servicing equipment.

Roof Hoists

General

Provide structure for attaching chain hoist to lift heavy equipment to roof. Coordinate project requirements with MCPS.

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26 00 00: ELECTRICAL

Spare Fuse Compartments

General

- Ensure space is provided for lockable spare fuse compartments in mechanical or building services areas. Coordinate compartment locks to be cored with a building Best key cylinders. See also specifications.

Additional Receptacle Locations

General

- At Courtyards Provide exterior outlets to accommodate outdoor teaching stations, maintenance, etc.
- Coordinate location(s) on roof near radon vents without fans for future connection.
- Provide power within stairwell for building services cleaning.
- Refer also to Ed Specs. for required locations.
- All new elementary school projects need to achieve an Energy Use Intensity of 24 or lower. Coordinate also with sustainability requirements.

Lighting

Site Lighting

General

- Provide LED wall-mounted light fixtures with hooded or full-cutoff designs that minimize light spill and glare. Fixtures shall be selected and positioned to ensure illumination of the intended area while preventing direct visibility of the light source from a distance or adjacent properties.
- Lighting systems **must** use non-proprietary protocols (i.e. Bacnet IP)
- Design team is to utilize 2x4 grid flat panel LED lighting throughout the majority of the building, 2x2 LED flat panel fixtures to be considered only where necessary.
- Alternate light fixture types will be considered by MCPS for specialty areas. MCPS to approve RCP.
  - Where pendent fixtures are to be used, design team is to review the bottom of fixture height with MCPS.
  -

Light Pole Base

- Basis of Design
  - Manufacturer: Old Castle
  - Product: Omni Pole Base
- Base to have conduit raceway channels below grade.
- Provide slotted bolt patterns at base for anchoring light poles.
- Design team to specify bolt anchor bolt cover wide enough to conceal the anchoring slots on the top of the concrete base.

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Locations

- Placement of light poles should be placed outside of sidewalk circulation to avoid impeding path of travel.
- Exterior wall lighting and site lighting locations to be reviewed and coordinated with MCPS.

Controls Power

General

- Coordinate all power requirements for Controls and ensure that requirements are shown on the drawings.
- Provide dedicated circuits for building control devices **before** the main disconnect, not after, for proper maintenance.

Smart Metering

General

- Bacnet IP protocol electric metering hardware is required. Provide a Bacnet gateway if needed. Coordinate with 23 09 00 smart metering.

Fusible Disconnects

General

- Provide fusible disconnects at all equipment.

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27 00 00: COMMUNICATIONS

Bi-Directional Amplifier (BDA)/ In-Building Radio Signal Amplification System

General

- An allowance should be provided for testing, design, and installation of the BDA system by the contractor. Contractor to follow DPS standards for the BDA system.
- The design of a BDA system is not typically in the design services scope.

Network Wiring

General

- All low-voltage wiring shall comply with the MCPS Color Guide below for cable identification and labeling. The Design Team shall ensure that wiring colors are consistent with the established standards for system type, function, and location to maintain uniformity across all MCPS facilities.

Pathways

- Service pathways from the street should be provided with as minimal bends as possible terminating directly in the MDF.
- Provide interdicting for all services into the MDF closets.
- Provide Fire stopping for all penetrations.
- Design for 295’ max. run length from IDF to termination points for copper lines.

Color Guide:

- Yellow — Lighting
- Red — Fire Alarm
- White — P.A. System
- Green — Security (Cameras, Access Control, Vape sensors)
- Purple — B.A.S. (Building Automated System)
- Orange — B.A.S.
- Brown — B.A.S.
- Blue — Data
- Black — Wireless Access Point (W.A.P.)
- Grey — Intrusion Security

Surface Mounted Conduits

General

- In renovation areas, provide metal surface raceway (e.g., Wiremold) for surface-mounted electrical installations. Surface-mounted metal conduit may be used in back-of-house or utility spaces.
- All surface-mounted raceways and conduits shall be painted to match the adjacent wall or surface finish.

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Basis of Design

- Manufacturer: Wiremold
- Product: V4000 Line (where power & data are needed)
- Product: V700 (Where data only is needed)
- Color: White

IDF Racking

- Network infrastructure is provided by MCPS in separate contract. Design team to coordinate with MCPS.
- Design team should make considerations for:
  - 2 post racks
  - Additional space for maintenance on either side of the racks.
  -

Data Drop Locations

- Provide a minimum of (2) two data drops for all offices and conference rooms. Located on separate walls.
- Exterior pathways shall be provided for and coordinated with MCPS for all High and Middle Schools.
- Pathways to be provided for courtyards.

Roof Penetration

General

- Provide a single roof penetration to serve as future network access. Location should be near an IDF closet however, not directly into the IDF closet itself to avoid damage to any water infiltration..
- Provide pathway from penetration to the closest corridor for future runs to the IDF.
- Provide roof pedestal with weather tight junction for future connections near as penetration device. Pedestal must meet electrical conduit size requirements.

Cable Passthrough

General

- Provide cable pass-through detail at multimedia production rooms. Confirm any other locations with Ed Specs.

Details

- Masonry Conditions - Turn one closure CMU unit on its side to provide passthroughs. Bullnose all exposed cell edges.
- Drywall Conditions - Provide 6”H x 18”W framed opening with rounded corner guards.

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PA Systems

General

- PA system needs to provide min. 3 extra gateways or up to 30%, whichever is greater, for future expansion capacity per system
- PA system design needs to provide a dB level, appropriate for the room use, consistent throughout all areas.
- Provide PA phones at Main Office, Principal's Office, APs Offices and all other locations required by the AHJ. Coordinate additional locations with MCPS.
- Provide volume control in Conference Rooms and Principal's Offices.
- Provide data pathways for all PA and Sound Systems (including exterior and athletic field requirements)

Production Audio-Visual Systems

General

- Data requirements for production spaces (i.e. Control Rooms) must be coordinated with MCPS Design and Construction IT Systems Engineer.
- Noise making equipment (i.e. dimmer switches) should not be located in the areas programmed for recording (i.e. Recording Studio)
- Ease of access for audio-visual connections must be provided for future maintenance and changes to the audio-visual systems (i.e. racks, boards, etc)

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28 00 00: ELECTRONIC SAFETY AND SECURITY

Fire Command Center

General

- The design team to confirm if the Fire Command Center is required for the project, and its design requirements per applicable codes.
- Stairwell doors to have a single point unlocking feature in fire command center or at main vestibule near FAAP need wiring details for this work

Card Readers

Design Process

- MCPS will coordinate proposed locations of card readers with the Department of School Safety and Security. Upon receiving approved plan locations, the Design Team shall coordinate final card reader placement and integration with the door hardware consultant to ensure full system operation and compatibility.

Locations

- All exterior doors to be roughed in for card readers. Indicate exterior door with symbol on drawings with "RCR" for rough in card reader (rough in only, no actual card reader) and "CR" for installing card reader.
- At the main entrance, there shall be a card reader at 3 locations,
  - One (1) of the exterior doors at the main entrance,
  - One (1) at the interior door from the security vestibule to the main office,
  - One(1) at the interior door between the security vestibule and the school main lobby area.
- A door to the fire command center shall have a card reader.
- Exterior doors in kindergarten classrooms are to receive card reader access from the play area.

Room Numbering

General

- Ensure that final school room numbers are used for all addressable devices and on Annunciator Panel.

Isolation Relays

General

- Provide isolation relay(s) to prevent line voltage from damaging expensive control panel equipment

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Pull Station Covers

General

- Ensure pull-station false alarm covers are shown on the design drawings.

Fire Door Hold Opens

General

- Coordinate magnetic door hold open requirements per MCPS/Fire Marshall MOU.

Evacuation Messages

General

- Coordinate with MCPS to determine languages to be provided for evacuation messages.

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31 00 00: EARTHWORK

- Refer to 32 00 00 Site improvements for planting requirements.

- Design team to contact MDE to determine if there are registered in-ground fuel tanks during project feasibility and relay that information to MCPS Sustainability and Compliance Team

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32 00 00: EXTERIOR IMPROVEMENTS

Asphalt Surfacing

General

- Provide wedging detail where asphalt is unfinished during construction around items and surfaces of dissimilar heights.
- Provide pathways and sufficient space for a lift or bucket truck to maintain glazing above 1 story

Typical Parking & Drive Aisles

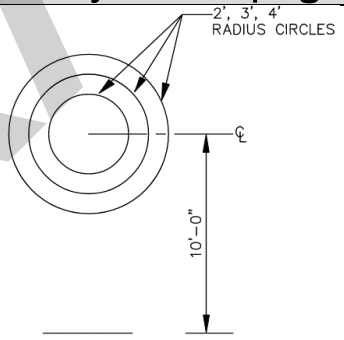
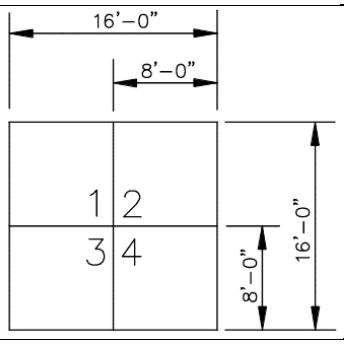
- 9.5 mm Hot Mix Asphalt superpave PG.64-22 Low ESALS's

Middle and High School Basketball Courts

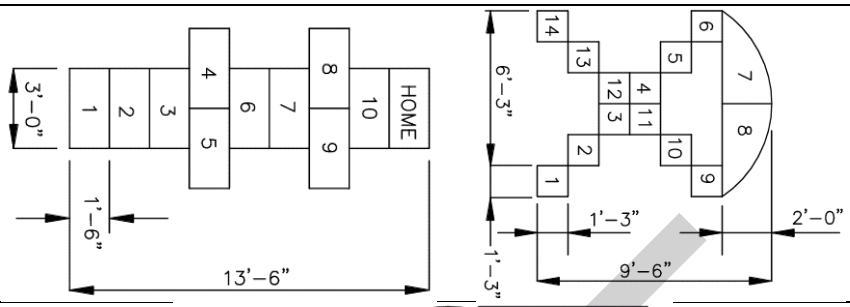
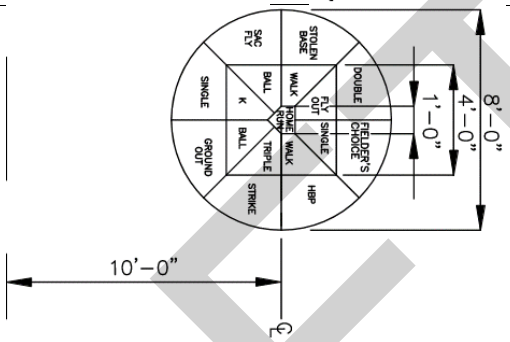
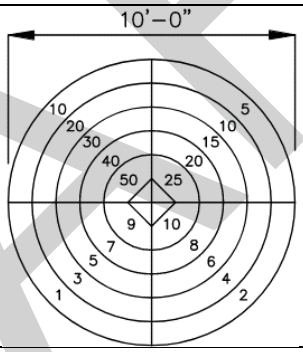
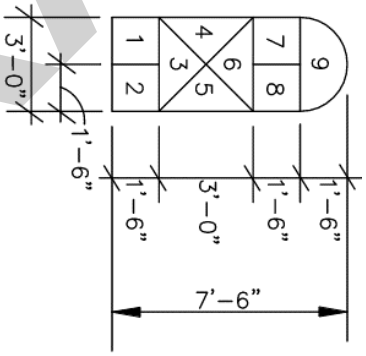
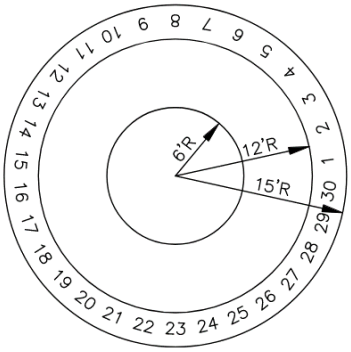
- 9.5 mm Hot Mix Asphalt superpave PG.64-22 Low ESALS's

Elementary School Basketball and Play Surface

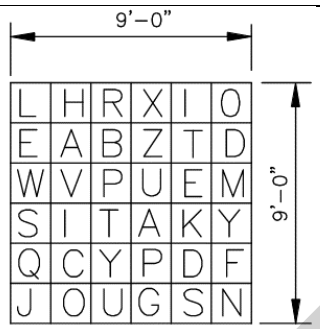
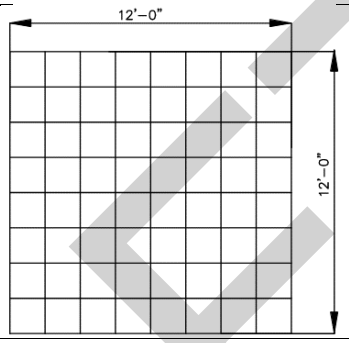
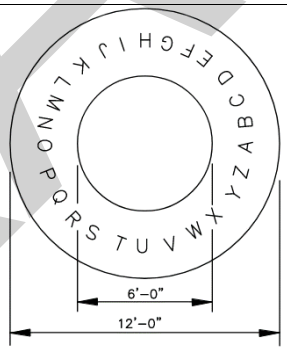
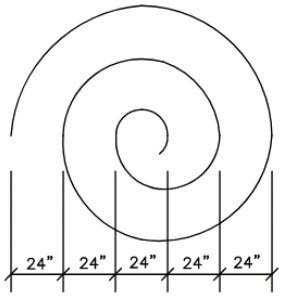
- Base Layer: 9.5 mm Hot Mix Asphalt superpave PG.64-22 Low ESALS's
- Top Layer: 4.75 mm Hot Mix Asphalt superpave PG.64-22 Low ESALS's
  - Additional thickness required for more frequent use and durability
  - See MCPS design team regarding surface color & design.
- Refer to Educational Specifications for required size and number of hard surface play areas.

Typical Hard Surface Play Area Striping	
Concentric Circles (Grades 1-5)	
Four Square (Grades 1-5)	

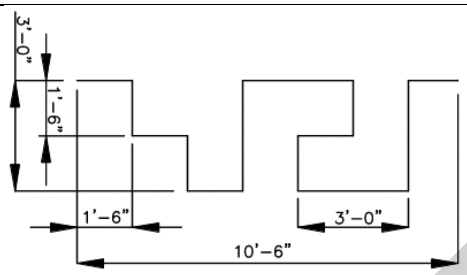
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Hop Scotch (Grades 1-5)	
Baseball Spinner Game (Grades 1-5)	
Circular Toss Target (Grades 1-5)	
Numbered Grid Window (Grades 1-5)	
Circular Number Game (Grades 1-5)	

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Alphabetical Grid 18” Squares (Grades 1-5)	
Blank Gridded Square (Kindergarten)	
12” Shapes (Kindergarten)	
Circular Letters (Kindergarten)	
Swirl (Kindergarten)	

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Zig-Zag Striping (Kindergarten)	

Pervious Pavement

General

- Design Team to verify with MCPS if pervious pavement is to be used.
- Design Team to coordinate basis of design manufacturer design requirements and standard details with Department of Permitting Service (DPS). Ensure DPS drainage requirements are met.
- Concrete header to be provided where dissimilar paving is provided.
  - Dimensions: 8"w x 18"d min.
    - Note that bottom of header is to be lower than excavation depth required for adjacent paving including subsurface aggregate, soil, etc.
  - Provide rebar reinforcement.
- Civil drawings to indicate areas where pervious pavement is to be provided.
- If using pervious pavers, ensure pave puller tool is noted in specs to be turned over to MCPS building services at the end of the project.

Fire Lanes

General

- Provide fire and rescue access lanes with a minimum width of 20'-0", located at least 10'-0" from the building, and paved to provide all-weather access. If local fire code or AHJ requirements are more stringent, the more stringent requirements shall govern.
- Per the MCPS Memorandum of Understanding (MOU) with the County Fire Marshal, "No Parking" traffic signs may be installed in an arrangement approved by the Fire Marshal in lieu of painting the curbs at designated fire lanes.
  - Design Team to coordinate sign locations with fire marshal and MCPS and provide details.

Drive Aisle, Parking, And Bus Loops

General

- Passenger loading zones shall provide a vehicular pull up space 8'-0" wide minimum and 20'-0" long min. along an access aisle that shall not overlap the vehicular way. Coordinate with MCPS.
- Access aisles shall be 60" wide minimum and extend the full length of the vehicle pull-up spaces they serve.

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- Design teams shall carefully evaluate building and drop-off canopy height and placement near bus loops to prevent potential bus and vehicle collisions. Low canopies adjacent to bus loops are discouraged due to the risk of buses striking overhead structures. Ensure more than adequate clearance is provided for safety.

Loading Docks

General

- Considerations for pedestrian, bus, and vehicular traffic crossings should be incorporated into the designed flow of traffic to avoid conflicts and ensure safety.
- Considerations for delivery drop-off timing and bus/vehicular drop-off should be made when designing traffic flows.

Exterior Concrete

General

- Exterior Sealants are required at Stairs, Ramps, and Loading Docs to protect against delamination from the use of Rock Salt in the winter.

Concrete Sidewalks

- Concrete joints to be tooled to 1/3 the depth.
  - For heavy duty concrete only, provide saw cuts.
- Note to provide ½"felt at expansion joints with caulk.
- Light Broom finish perpendicular to path of travel.
- All obstructions to have 36" in clear travel space.
- Concrete to be min. 4500 psi or SHA #6.
- Provide sidewalks at drop-off areas per the standard minimum widths below, to be confirmed with MCPS during design.
  - ES 10' min.
  - MS 12' min.
  - HS 14' min.

Accessible Paths

General

- No obstructions are permitted within accessible paths, i.e. light poles.
- Provide accessible paths to all exterior program spaces such as fields, play areas, etc.

Curb Cuts

- Provide curb cuts and tactile warning pads at all drive isle crossings.
- All ADA parking area crossings to be 8" concrete.

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Exterior Stairs

General Notes

- Provide reinforced cheek walls on either side of stairs.
  - 8” wide min.
  - Edges to be chamfered.

Nosing

- Provide four (4) tooled beveled grooves at the nosing of all exterior concrete stairs, as illustrated in the image below.



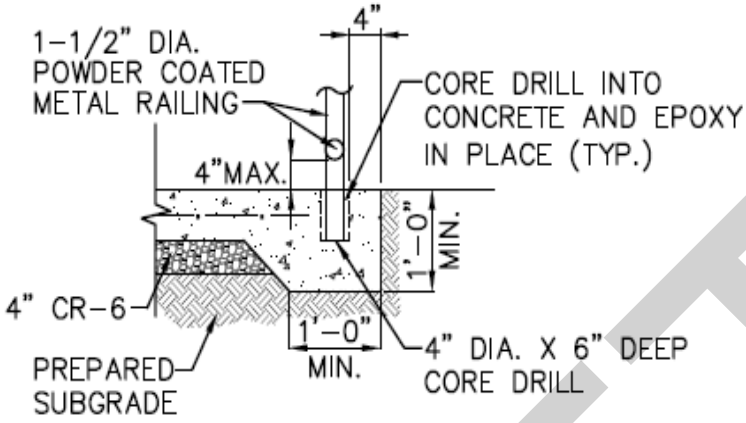
Figure 4 Tooling at Exterior Stair Nosing

Exterior Railings

General

- Finish: Powder Coated Black
- Powder coat to be applied in shop.
- Design team to provide note to avoid and minimize field welding and application of finish where at all possible.
- 5’-0” max between posts.
- Keep core drill for handrail posts 4” min. from edge of concrete.
- Provide detailing to ensure epoxy at posts stopped ½” below concrete, provide caulking around post to avoid water infiltration and cracking from freeze/thaw cycles.

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Detail 7 Example Handrail Post Detail

Fences and Gates

General

- All exterior fences shall be 2"x2" wire mesh standard black vinyl-coated with knuckled edge.
- Fence mesh openings may not be larger than 1 ¾ inches measured horizontally between the corners of the mesh openings.
- Fences should be consistent with ASTM F2049, Standard Safety Performance Specification for Fences/Barriers for Public, Commercial, and Multi-Family Residential Use Outdoor Play Areas.

Posts & Bases

- Where curbs are provided under fences, curb shall be 12" wide min.
- Where posts are provided in lawn areas, concrete base to be crowned above proposed grade.
- Where fences are provided at asphalt courts, asphalt to extend 12" past fencing.
- Provide detailing to ensure epoxy at posts stopped ½" below concrete, provide caulking around post to avoid water infiltration and cracking from freeze/thaw cycles.

Gates

- Provide chain link tension tabs on gates. (J-Bolt are not acceptable.)
- Gates must not have protruding latches or other protrusions at a height less than 54" from the ground

Chain-link Fence At Retaining Walls

General

- Chain link guard fence to be 48" minimum.
- Provide skateboard deterrents for low site walls

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Above Segmental Retaining Wall

- Design Team to provide detail containing items below:
  - Embed post 12" min. into courses below cap block. Design team to verify if additional depth is required.
  - Top courses to be filled with continuous grout.
  - Provide epoxy around post and above masonry cap to ensure positive drainage and avoid freeze/thaw cracking of masonry cap.

Above Cast-in-Place Concrete Wall

- Design Team to provide detail showing epoxy around post up to ½" below finished face. Caulk to be provided where post meets epoxy and applied above top of concrete wall to ensure positive drainage and avoid spalling from freeze/thaw cycle.

Access Road Gate Detail

Gate Details

- Provide square or boxed gate types at large openings.
  - Triangular or single-pole gate designs shall not be used, as they are difficult to see at night and pose a potential "clothesline" hazard to pedestrians or cyclists.
- Design team to coordinate latch type with MCPS.

Bollards

General

- Provide bollards as required for both public and service area applications. The Design Team shall coordinate locations with MCPS.

Architectural Bollards

General

- Provide removable bollards at all designated drop-off zones to allow controlled vehicular access when required.

Basis of Design

- Manufacturer: Reliance Foundry
- Product: Bollard R-7576
- Color: To be reviewed by MCPS.

Service Area Bollard

General

- Provide concrete-filled schedule 40 steel pipe bollards at all service and loading areas.

Construction

- Material: Concrete filled Schedule 40 Steel Pipe.
- Color: Yellow

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- Dimensions: 6”diameter x 48” above finish grade to top of cap
- Galvanized Cap: 7 ½” Tall with 1 ½” reveal at base of cap.
  - Schedule 40 Steel Pipe.
  - Provide top and bottom plates.
- Bollard is to extend into base and below grade min. of 36”
- Concrete Base: +/- 18” diameter
- Detail to show layer of roofing felt as a bond break between bollard and concrete base.
- Detail to indicate positive drainage away at base.

Typical Locations & Placement

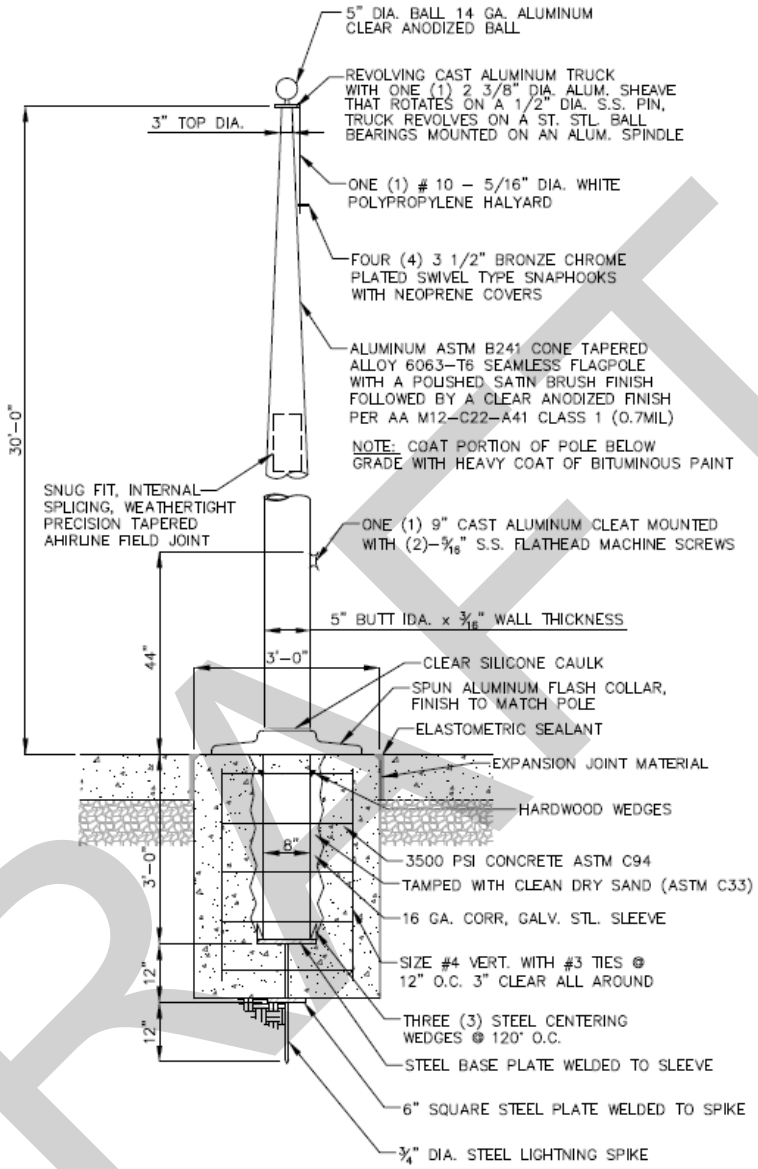
- Service Areas – Spaced 10’-0” O.C.
- Overhead Doors – On either side of opening at 2’-0” away from exterior wall.

Standard Flag Pole Detail

General

- Provide 5’-0” concrete sidewalk and skirt for access.
  - Slope concrete a minimum of 1/4" per foot away from all sleeve sides.
- Ensure detail indicates 4 swivels are provided to allow for two flags. (MD & U.S.)
- Elementary, Middle and High Schools to have one flagpole near main building entrance.
- Design Team to coordinate additional locations of flag poles with MCPS.
  - Commonly High Schools are to have additional flagpoles at stadiums.
- Extend the ground sleeve one-half inch above the finished concrete elevation.

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Detail 8: Typical Flag Pole Detail

Exterior Digital Signs

General

- Provide controller with cell activity.
- Electrical
  - Provide 1" min. conduit for electrical connection. Coordinate with electrical sign manufacturer.
- Fiberoptic
  - Provide 1 1/2" or greater waterproof PVC or EMT conduit for the fiber optic connection.

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Exterior Trash and Recycle Center

General

- Provide concrete base three part recycle and trash bins at the exterior of the building.

Product

- Basis of Design: WAUSAU Tile - 3-part bin (bottles/cans, trash, and mixed paper)
- Material: Concrete
- Anchors: ½" threaded inserts

Location

Standard Bike Rack

General

- Provide single wide loop bike racks constructed of OD tubular steel pipe. Coordinate requirements with MCPS.

Product

- Basis of Design: Stanley Model BRWS-101
  - Bolted Base with lockable escutcheon.

Location & Placement

- 5'-0" Min from Fire Hydrant and Sidewalk
- 4'-0" Min. from loading zone, bus stop, bus shelter and/or bus bench.
- 3'-0" min. from building, walls, curbs, parking meters, light poles, signs, tree space, trash cans, utility meters or manholes.

Site Deterrents

General

- Provide skateboard deterrents for low site walls.
- Limit bird roosting/nesting within the site (overhangs, perches, etc).
  - Provide bird-spikes or painted hardware cloth as required.

Playground Equipment

General

- Playground Equipment installation is procured separately by MCPS.
- Design Team is required to design pad, drainage, fencing, and surrounding area. Design Team is required to coordinate area with MCPS and Playground Equipment designer and/or installer.

Surfacing

- In existing conditions where equipment remains, engineered wood fiber shall remain unless otherwise noted and should be designed to comply with ADA requirements for depth etc.

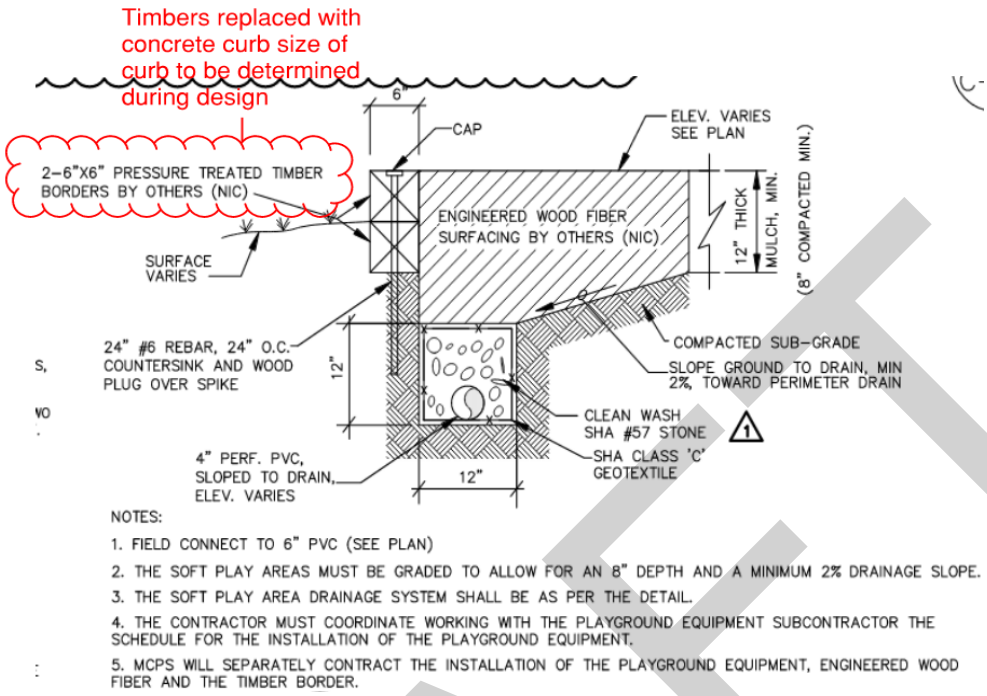
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- A poured access pad shall be designed for ADA access to playground equipment

Equipment Requirements

- Platforms may be no taller than:
  - Grades 1-5: 72”
  - Pre-K & K: 48”
- Climbing walls and other equipment may not have fall height exceeding:
  - Grades 1-5: 84”
  - Pre-K & K: 60”
- Equipment may not be yellow. (Yellow attracts bees and wasps)
- Prohibited equipment:
  - Swings and any other equipment attached to trees or other objects not installed by MCPS-approved playground installers
  - Enclosed tunnels without openings or spy holes permitting observation of children inside
  - Fully-enclosed dome climbers
  - Log rolls
  - Track rides
  - Any equipment with fall heights exceeding 84 inches & 60 inches for Pre-K.
  - Clatter bridges (bridges with moving parts)
  - Tunnel slides
  - Trampolines
  - Climbing ropes not secured at both ends
  - Chain net climbers
  - 3D matrix net climbers (such as Playworld PlayWeb) unless the vendor provides annual inspection and maintenance.
  - Playworld Vortex
  - GameTime Hanging Pod
  - Equipment with major components constructed of wood and/or bare metal
  - Any other equipment deemed not permissible by MCPS Systemwide Safety Programs.
- Benches and other equipment may not be installed within 6’-0” of fences and walls per ASTM requirements.

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Detail 9 Typical Drainage Detail at Engineered Wood Fiber Playground Surfacing

Athletic Fields

General

- MNCPPC will take over the maintenance of play fields at Elementary and Middle schools.
  - Designs Teams are required to follow MNCPPC requirements for play fields.
  - MNCPPC will inspect fields during construction GC or CM to coordinate all inspections.
  - Design Team to provide drawing indicating area where parks specifications and details are to be applied.
- See Appendix A for Typical High School Field Layouts.

Baseball & Softball Fields

General

- For all ES, MS, and HS, skinned (dirt) fields to have 20 feet high, straight backstops.
  - Provide Team benches
  - Provide 6'-0" high fences in front of benches. see CBES for field layout.
  - No canopy/overhang at the top of the backstops.
- For Grass Fields no backstops, no benches, and no fences to be provided.

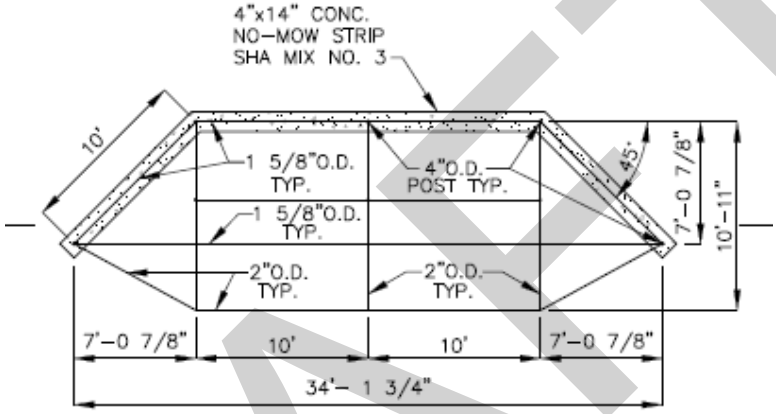
Backstop Details

General

- Overall Dimensions:
  - Length: approx. 34'-0"

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  - Left and Right Sections at 45-degree angle: 10’-0”
  - Middle Section approx. 20’-0”
- Posts & Cage:
  - Width: Approx. 7'-0”
  - 4'-0" Deep vertical posts (typical)
  - 2" O.D. posts & perimeter framing (typical)
  - 5/8" O.D. cross members & supports
- Concrete Base:
  - 4" D x 14" W Concrete No-Mow Strip with posts attached.
- See below typical Detail 10: Baseball & Softball Backstop.



Detail 10: Baseball & Softball Backstop

Soccer Field

General

- Refer also to Educational Specifications.

Goals

- Design Team to include soccer goals in contract at high school stadiums only. Coordinate with MCPS Facilities Architect for product.
- Refer to Figure 5: High School Soccer Goal Note: The cross bar at base is required to be at the middle of the horizontal legs to avoid conflicts with the football goal posts.

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Figure 5: High School Soccer Goal

Basketball Court

General

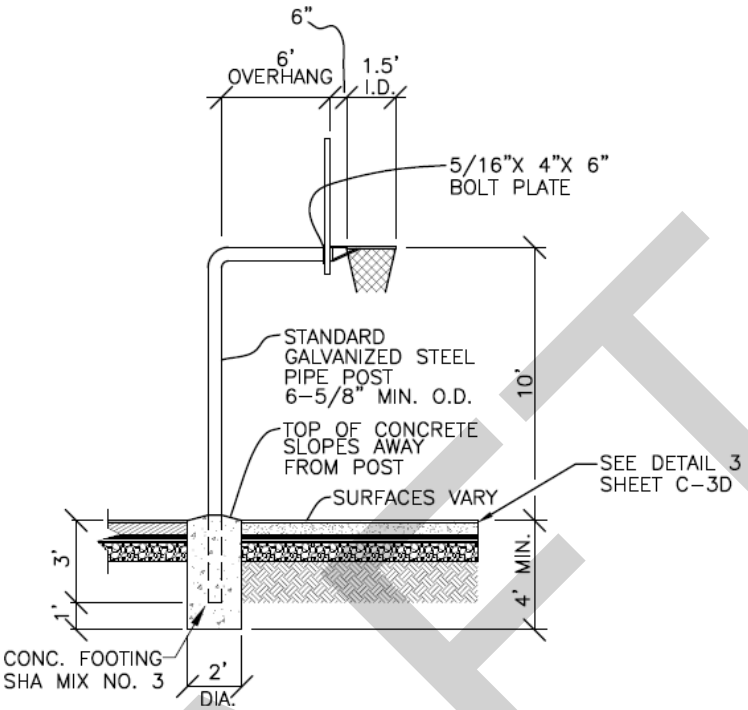
- Refer to Educational Specifications for number of courts required.
- See Asphalt Surfacing for surfacing materials and requirements.

Backstops

General

- Basis of Design: AALCO, Model G66-601
- Provide pin to prevent backstop slippage.
- See Detail 11: Typical Exterior Basketball Hoop for typical design.

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Detail 11: Typical Exterior Basketball Hoop

Site Signage

General

- Reserved parking signs to be coordinated with school principal and MCPS.
- Confirm materials with MDOT Standards.

Base

General

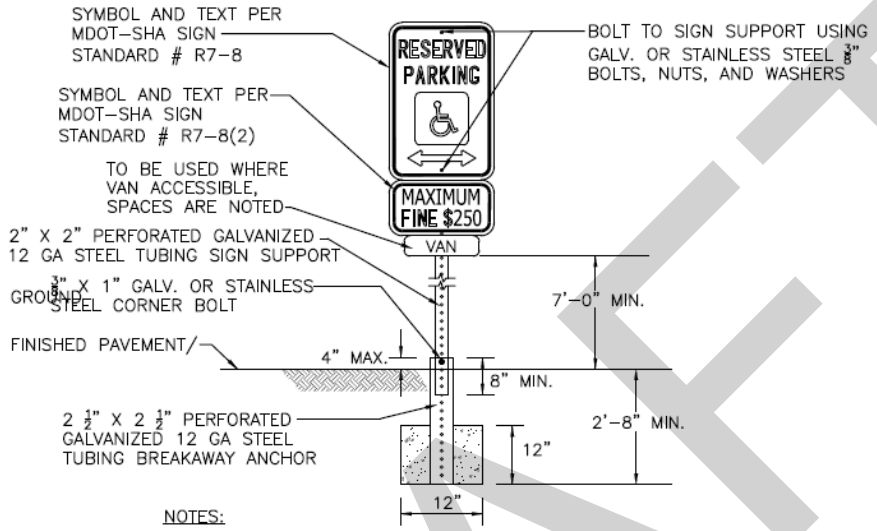
- Design Team to provide signage in conformance with MDOT SHA standards.
- Provide sleeve in concrete base below grade and stub up for connection to sign post. The design of the sign post and base is to have separate sleeve and post to allow for

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easy replacement of sign and post by building maintenance. See below detail for reference. Ensure concrete is crowned to drain water away from the post.

Placement

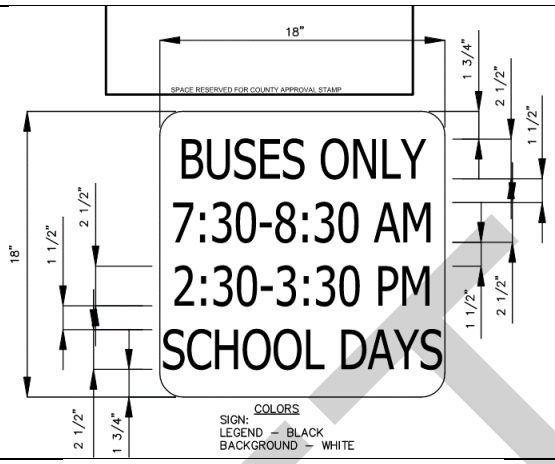
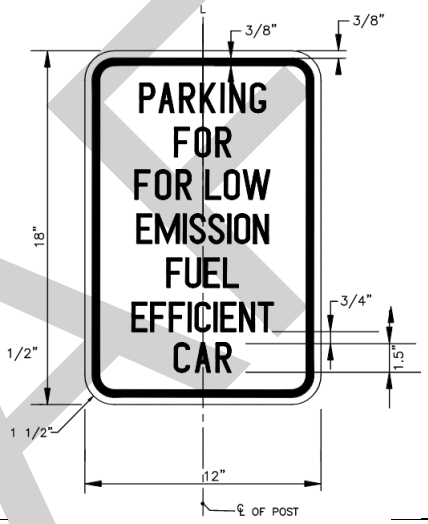
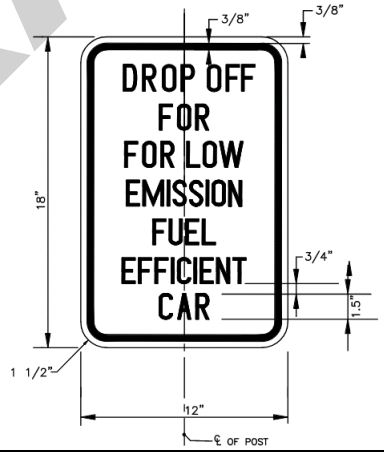
- Provide sign at 12" behind face of curb/sidewalk.
- See Detail 12: Site Signage Post below for example.



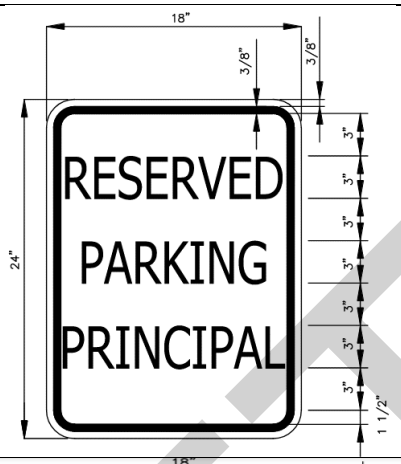
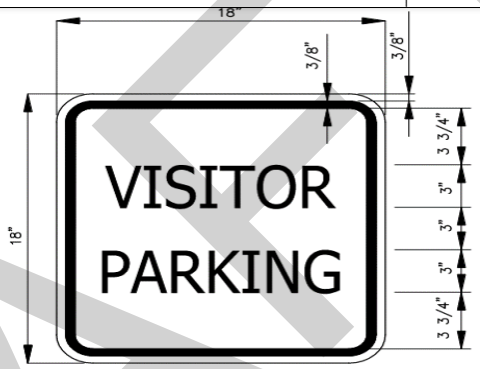
Detail 12: Site Signage Post

TYPICAL SITE SIGNAGE ELEVATIONS	
Fire Lane Signage *Confirm requirements with Fire Marshal.	

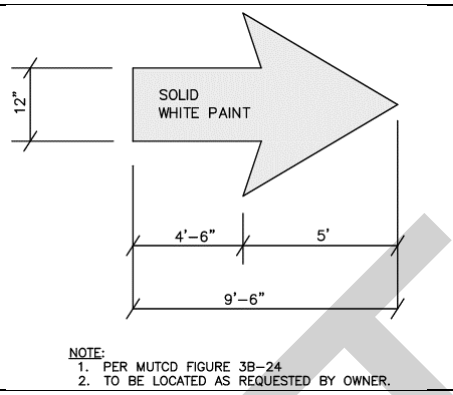
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BUS DROP OFF SIGN	
LOW EMISSIONS VEHICLE PARKING	
DROP OFF/LOW EMISSION VEHICLES	

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RESERVED PARKING *Confirm reserved parking spaces with MCPS Project Manager and Principal.	
VISITOR PARKING	
NO SMOKING or VAPING SIGN	
POROUS PAVEMENT SIGN - 18”X24” - 2” Lettering	

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Surface Arrow	

Fire Lane Construction for Fire Apparatus Support

General

- Design Team to confirm design requirements for fire apparatus per the fire marshals' requirements and interpretation of NFPA.
- Design Team should avoid placing utility vaults or manholes within Fire Lane.

Lawns and Grass

General Sod Locations

General

- Provide 6" min of top soil.
- Soil to be crowned for proper drainage.
- Provide Sod requirements to property line even if outside the LOD.
- Basic design (minimal design with grass and paved areas) to be the base bid, and extensive design and landscape design to be an add/alternate.
- Avoid landscaping at exterior ramp switchbacks where possible.
- Maintenance accessibility concerns between ramps and with slopes.

Bioretention Design Standards

Geotechnical Testing

- Geotechnical testing is strongly encouraged at each bmp location prior to placement of facility to ensure its suitable location for bioretention. Separation from seasonal high-water table is critical to ensure that the media does not become saturated and unable to function effectively.

Bio-Soil Media

- All Bio media must be mixed off site by a qualified soil manufacturer to ensure uniform blending. The content of the soil shall be verified with a delivery ticket and document (certificate and or lab tests) that it meets regulatory media requirements. Mixing the filter media on-site with excavation or loading equipment is not sufficient.

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- The current soil specification consists of 1/3 perlite or Solite, 1/3 compost and 1/3 topsoil. The perlite shall be coarse grade horticultural perlite. The compost shall be high grade compost free of stones and partially composted wood material including 35% by volume (of compost) triple-shredded hardwood mulch. The media depth should be a minimum of 18" in depth with 36" required to support cells with trees and shrubs. The pH of the soil bed material should be tested to ensure it is a range from 5.5 to 6.5.

Choker Course/Separation Layer

- A 2 to 4-inch layer of choker stone (e.g., typically ASTM D448 No. 8 or No. 89 gravel double washed clean and free of fines) should be placed beneath the filter media and over the underdrain stone. A sand layer is not recommended (and should be avoided) as it is prune to clog due to migrations of fines from upper layer and or construction activities.

Underdrain

- An underdrain likely will be used in all bioretention facilities. The underdrain must be encased in a layer of ASTM D448 No.57 stone that is washed clean and free of fines. It is encouraged to partially restrict or enhance underdrain orifice necessary to promote infiltration as well as plant production. Partial restriction devices can be achieved by using an adjustable restrictor plate, valve or other proprietary technology.

Reservoir Storage Layer

- ASTM D448 No.57 stone should be utilized for the reservoir storage layer. Larger reservoirs are encouraged to support increased water storage capacity as well as support vegetation health through wicking processes.

Side Slopes

- The maximum side slope ratio for earthen embankments is 3:1.

Vegetation/Planting

- In addition to meeting all water quality and performance requirements, the aesthetic integration of BMPs shall be a design consideration. Vegetation selection, layout, and maintenance strategies shall promote a healthy, well-kept appearance that complements the overall campus design. A visually appealing BMP that fits well within the site context is more likely to be perceived by MCPS students, staff, and the community as a positive and educational site amenity.

Planting Strategy

Layout

- Geometric groupings /Bands: Vegetation should be designed and planted in distinct patterns, such as creating groups of four or more plants in rectangle shapes or planting species separately from each other in repeating geometric clusters or bands, so that weeds are easily recognized.

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Planting Density

- Density should be increased to fill all voids spaces (mulch area). The intent is for vegetation to have an 85-90% plant coverage and very little (10-15%) bare ground exposed after one year and very limited mulch areas the following years.
- Herbaceous plant spacing
  - Herbaceous plants spaced 18-24" apart – one-gallon containers.
  - Ground cover spaced 8-10" apart - quarts or large plugs.
  - Shrubs spaced 24-36" apart depending on mature size -2-3-gallon containers.
  - Trees depend on their mature size to determine appropriate spacing. Suggest no smaller than 1 ½" caliper.

Plant Selection

- Plants shall be native to Maryland and capable of withstanding the environmental site conditions of a bioretention facility. Vegetation shall be hardy to salt, reasonably hardy to deer pressure. They should be heavy grade, not restoration grade. Inlet plants will need to withstand high volumes and velocity of stormwater and pollution. Basin plants need to withstand fluctuation in moister, inundated at times and very dry at times.
  - Herbaceous Plants and Grasses:
    - Critical to low maintenance is to match the mature size of the plant to the size of the BMP. Smaller footprints will need shorter, smaller growing species. Larger BMP footprints will need plants that cover a greater area. Note: Large volume of vegetation removal from larger growing grasses can increase maintenance costs.
  - Green Mulch/Low Growing Ground Cover:
    - The planting design should include a layer of vegetation for a low growing ground cover to minimize or eliminate the need for mulch. This layer of vegetation may be seen as a "green mulch" that provides the functions of both vegetation and mulch, including preventing weed growth and erosion. Ground covers should be spaced appropriately to form a dense vegetation layer that reduces erosion and weed pressure.
  - Trees & Shrubs:
    - Trees and shrubs provide year-round seasonal interest and planting structure, as primary activities occur in schools (September-June), outside of summer planting season. Shrubs and trees help improve the function and reduce maintenance requirements of bio systems. When selecting tree and shrub locations, the designer should ensure consistency and clear organization across the site, reflect the character of the architecture, and establish a neat appearance.
- Adequate spacing should be provided to account for the mature size of trees and shrubs and must account for current and future site conditions to ensure that trees and shrubs do not create any safety hazards, interfere with pedestrian, vehicular traffic, and are at least 20' from the foundation of buildings. Trees may be planted in all bios as site conditions allow the shading from trees helps to reduce weed pressure and infiltration of stormwater. However, trees should not be planted directly on top of the underdrain.

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- Shrubs can be planted in all bio types, the roots penetrate bio media, promoting infiltration and the soil biota. Where possible, shrubs should be woven around trees to clarify the visual structure of the landscape, while providing year-round interest.

Planting Specifications:

- Planting should be done generally between mid-March through June and mid-September through mid-October (i.e., spring and fall) to avoid temperature extremes and frost.
    - Material checks: Upon delivery, tickets should be checked to ensure they match the plant species, quantities, and sizes delivered. The plants should be checked to ensure they are the species listed on the approved plans or project specifications.
    - The on-site contractor should verify that plants are in good condition when they arrive. Plants should have no obvious signs of damage, pests, or disease. This includes major leaf damage, a large portion of broken stems or branches, or an obvious infestation of insects. Leaves should not be wilted. Before installing plants, any weeds in pots or on root balls should be removed.

    - Plant storage:
        - Plants should be installed as soon as possible after they are received but should be planted no later than 1-2 days after delivery to increase the chance of survival. If it is not possible to plant immediately, vegetation should be stored in a cool and shaded location with roots covered to protect them from extreme temperature and direct sunlight. Roots should be kept moist; this usually means watering daily.



Figure 6: Example illustration of a 500-square-foot bioretention with three species, with the number of plants required to create *85%*. Illustration from: Vegetation in Stormwater Best Management Practices, The Maryland Department of the Environment, 2019.

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Watering Instructions

- Water plants for 6 weeks following installation, unless more than a ½ inch of rain falls in any week for which watering is scheduled. During the 6-week period following installation, please follow this schedule:
  - 3 times a week for the first 2 weeks
  - 2 times a week for the next 2 weeks
  - 1 time a week for the last 2 weeks

    Contractor to adjust schedule accordingly due to rain fall
- Watering Notes:
  - All watering should use a hose with nozzle end breaker or a sprinkler. Be mindful that sprinklers do not water evenly and will need to be monitored for the flow patterns. Areas that are getting missed will need subsequent hand watering or sprinklers adjusted to get full watering coverage. Water must be applied in sufficient quantities to maintain moist soil to a depth of at least 4 inches. Water must be applied at low water pressure directly to the root zone of each plant, allowing water to be absorbed into the planting pit soil until saturated, but without runoff.
  - If planting late in the season (November) the watering schedule may be shortened. Due to the late install please water once the weather warms up for one month. In severe dry days beyond the schedule outlined above, please monitor plantings for wilting and water as needed especially the first year.

<u>Mulch</u>

- All newly installed plantings require a 2-3" layer of hardwood shredded undyed mulch for reducing weed pressure and retaining moisture around plant roots for the plant establishment phase. Triple-shredded hardwood mulch has been found to be less likely to wash away than other forms of mulch (such as pine).

Signage

- Signage should be installed at each bioretention facility. Additional sustainability signage guidance is currently being developed by the Division of Sustainability and Compliance. The MCPS approved standard sign should be placed at each bmp location. Additional site-specific signage may also be included.

Overflow Drain

- Where possible, landscape fabric or woven geotextile fabric can be placed over drain perforations to reduce solids such as waste from entering and clogging.

Key Planting Criteria:

Mulch	All newly installed plantings require a 2-3" layer of hardwood shredded undyed mulch for reducing weed pressure and retaining moisture around plant roots for the plant establishment phase.
Minimum density of Vegetation	85% ground coverage evenly spaced across the surface area of the BMP within one year of installation and maintained thereafter.
Ground Cover	All facilities should use a dense low growing ground cover to act as a "green mulch" that the functions of

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	both vegetation and mulch
Layout	Vegetation should be planted in Geometric Clusters/Bands to easily distinguish weeds.
Trees and shrubs	Recommended for all facilities (see above)
Bio Soil specification	pH range between 5.5-6.5 Follow DPS blend, but utilize additional hardwood mulch for compost
Choker Layer	Lay a 2-to-4-inch layer of choker stone (e.g., typically No.8 or No.89 washed gravel) over the underdrain stone.
Underdrain	
Reservoir Storage Layer	#57 stone must be uniform, angular, double-washed, clean, free of all fines. Larger reservoirs are encouraged
Geotextile Fabric	Should be avoided, except to support side slopes that do not inhibit infiltration
Side slopes	Max side slopes is 3:1

Reference Tables & Figures

		Total Area (square feet)				
Recommended Plant Spacing (inches on center)	**Individual Plant Spacing Area, A_i (sq. ft.)**	**100**	**250**	**500**	**750**	**1,000**
6	**0.2**	509	1,273	2,546	3,819	5,092
8	**0.3**	286	716	1,432	2,148	2,864
10	**0.5**	183	458	916	1,375	1,833
12	**0.7**	142	357	714	1,071	1,428
18	**1.7**	58	147	294	441	588
24	**3.1**	31	79	159	238	318
36	**7.0**	14	35	71	107	142

Table 1: Number of Plants Required per BMP sq footage. Illustration from: Vegetation in Stormwater Best Management Practices, The Maryland Department of the Environment, 2019.

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Species	Average Plant Spread (inches)	Individual Plant Spacing Area (A_i) in sq. ft.	Total Filter Bed Area Covered (A_f) in sq. ft.	Number of Plants
Blueflag iris (*Iris versicolor*)	30	4.9	250	50
Royal fern (*Osmunda regalis var. spectabilis*)	30	4.9	125	25
Swamp rose mallow (*Hibiscus moscheutos*)	42	9.6	125	12
			500	89

Table 2: Example calculating the number of plants per species to create 85% cover within a 500-square-foot area. Illustration from: Vegetation in Stormwater Best Management Practices, The Maryland Department of the Environment, 2019.

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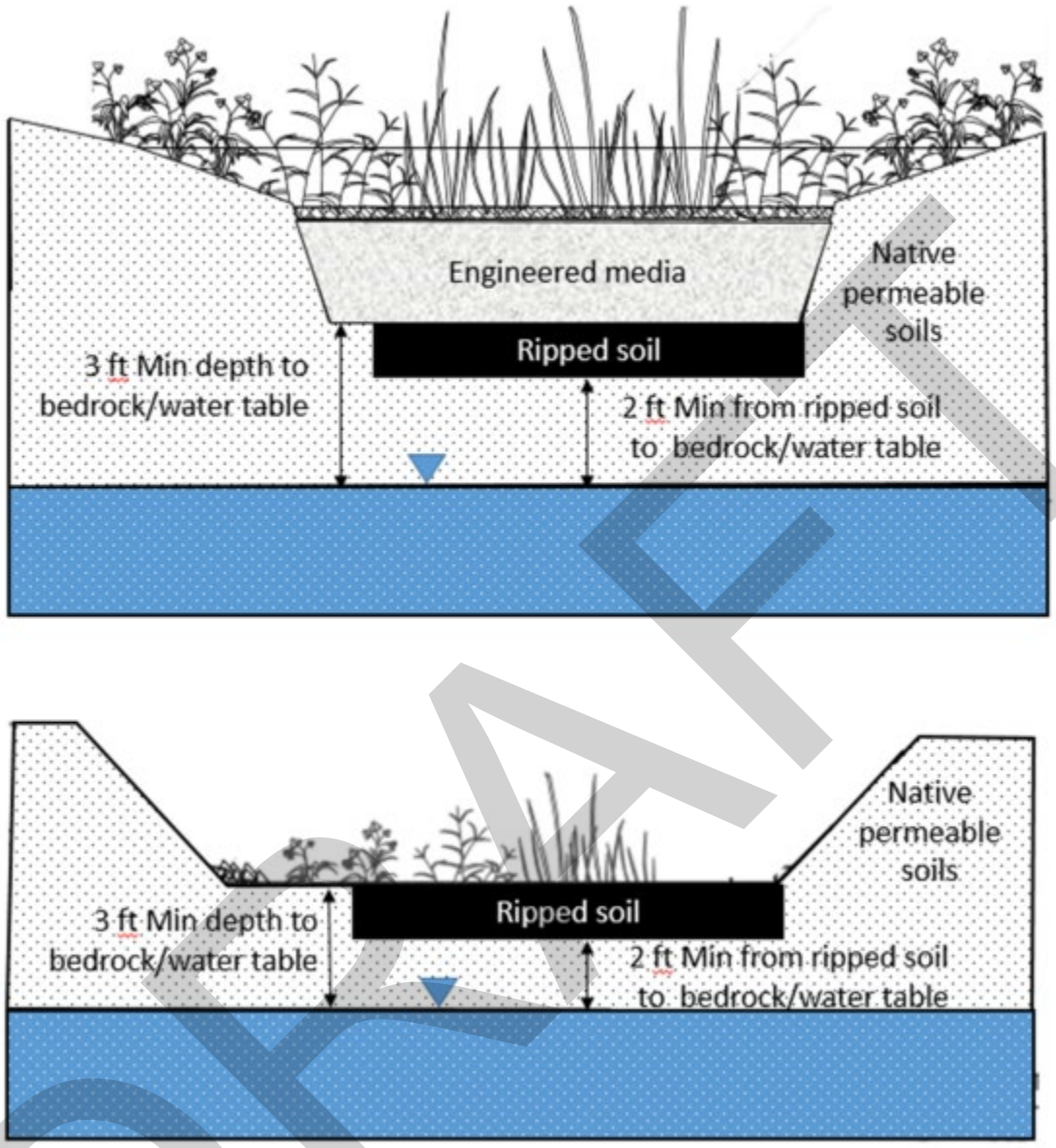


Figure 7: Schematic illustrating separation distance from bottom of infiltration BMP and soil ripped zones to water table or top of bedrock. Minnesota Stormwater Manual, Minnesota Pollution Control Agency, 2013.

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Figure 8 Demonstration of the rake technique with a bucket with teeth (top) and scoop technique using a bucket with a smooth blade (right). During the final pass of excavation, the rake technique should be used to break up the soil and promote exfiltration. Source: Minnesota Stormwater Manual, Minnesota Pollution Control Agency, 2013.

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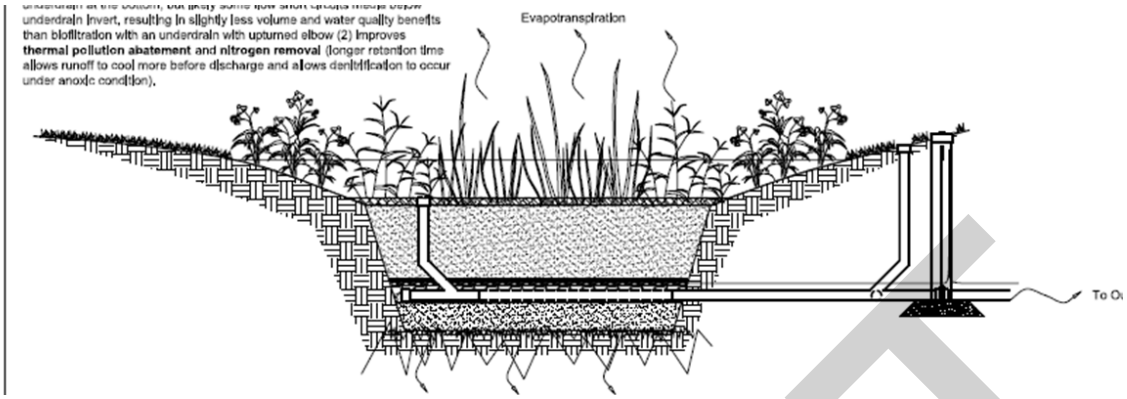


Figure 9 Illustration of a cross-section of a bioretention BMP with an elevated underdrain. Source: Minnesota Stormwater Manual, Minnesota Pollution Control Agency, 2013.

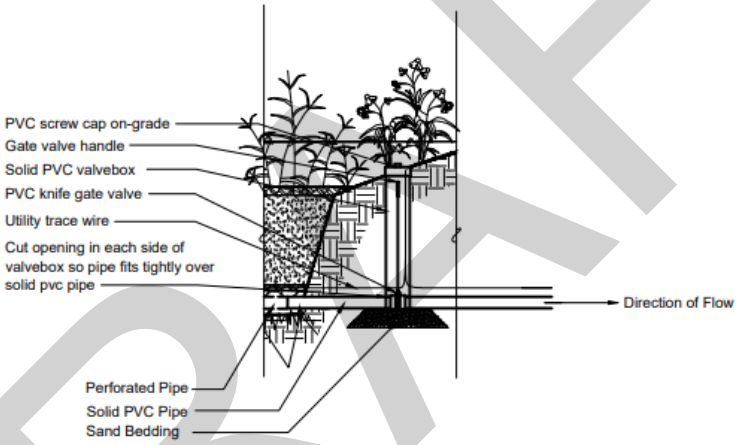


Figure 10: Example of an underdrain valve design. Source: Minnesota Stormwater Manual, Minnesota Pollution Control Agency, 2013.

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33 00 00: UTILITIES

General

- Designs shall include provisions for future relocatable classrooms, including site locations and necessary utility infrastructure. Coordinate proposed locations with MCPS. The Design Team shall provide drawings for underground rough-ins at designated relocatable classroom sites and shall consider current code requirements related to fire protection, where applicable.

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APPENDIX A : HIGH SCHOOL FIELD LAYOUTS

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Attachment D –

MCPS Outline Specifications (DRAFT)

Montgomery County Public Schools

Master Specifications Draft

DRAFT 05/28/2026

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Department of Planning and Construction
45 W. Gude Drive,
Rockville, Maryland 20850

GENERAL GUIDELINE REQUIREMENTS

A. Materials contained in the Montgomery County Public Schools Master Specifications are provided for information and guidance regarding preferred products, materials, and practices, and shall not be construed as waiving or granting exceptions to any element of federal, state, or local building codes, ordinances, and regulatory requirements as applicable to the specific project. These Master Specifications, along with the project-specific Education Specifications and Facility Design Guidelines, are complementary. Any conflict between these Master Specifications, the Education Specifications, Facility Design Guidelines, and governing local, state, or federal codes shall be brought to the immediate attention of the Montgomery County Public Schools (MCPS) Department of Planning and Construction.
B. Where manufacturers, brands, and model numbers are indicated, they are provided to establish the required type, quality, and performance standards. These references do not preclude the use of equivalent products, except in cases where specific items are necessary to maintain compatibility with existing systems or infrastructure. Such instances shall be clearly identified as “no substitutions allowed.” The Design Team shall notify MCPS in writing of any proposed alternate manufacturer, brand, or model number used in the design, and obtain approval prior to incorporation into the project documentation.
C. The project plans and specifications shall incorporate and reflect the requirements and intent of the Montgomery County Public Schools Facility Design Guidelines, the project-specific Education Specifications, and the Master Specifications. These documents shall be used collectively to inform the design and documentation process.
D. All coordination between the Design Team and Montgomery County Public Schools (MCPS) shall be directed to and facilitated through the Department of Planning and Project Manager (PM) assigned to the project. The PM shall serve as the primary point of contact for all project-related communications, decisions, and approvals.
E. The Design Team is required, throughout the design process, to utilize the MCPS-provided Master Specification files as the basis for developing project-specific technical specifications. The Design Team shall edit, coordinate, and expand these provided files to reflect the specific scope, systems, and materials applicable to the project. All modifications shall maintain consistency with MCPS standards and clearly indicate project-specific requirements, unless otherwise approved by MCPS.
F. These Master Specifications do not preclude the use of alternate systems, methods, or materials, provided that the proposed deviation has been reviewed and approved by the MCPS Project Manager and/or Facilities Architect. For project-specific applications, all deviations and substitutions shall be submitted for review during each design phase plan review and stakeholder meeting. Each submission shall include a design reference, justification for the proposed change, and the recommended alternative. MCPS review and formal acceptance of all deviations is required prior to implementation.
G. Refer to MCPS Division of Planning and Construction website.

SUMMARY OF REVISIONS

This log serves to indicate any alterations to the current version of the MCPS Master Specifications made by MCPS.

Date	Division	Topic	Comments

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PROJECT SPECIFIC LOGS

This log serves to maintain record for any revisions, additions, or modifications to the provided MCPS Master Specifications proposed by the Design team that are required to achieve project specific requirements.

Date	Division	Topic	MCPS Approval

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- 033543 Polished Concrete Finishing
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DIVISION 5 – METALS
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- 051213 Architecturally-Exposed Structural Steel Framing
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- 072100 Thermal Insulation
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- 072736 Sprayed Foam (SPF) Air Barrier
- 073113 Asphalt Shingles
- 074113 Metal Roof Panels
- 074213 Metal Wall Panels
- 074213.23 Metal Composite Material Wall Panels
- 075100 Built-Up Bituminous Roofing
- 075423 TPO Membrane Roofing
- 075563 Vegetated Protected Membrane Roofing
- 076200 Sheet Metal Flashing and Trim

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077100 Roof Specialties
077200 Roof Accessories
077600 Roof Pavers
078100 Applied Fire Protection
078123 Intumescent Fire Protection
078400 Firestopping
078426 Thermal Barriers for Plastics
079200 Joint Sealants
079500 Expansion Control

DIVISION 8 – OPENINGS

081113 Hollow Metal Doors and Frames
081416 Flush Wood Doors
083100 Access Doors and Panels
083313 Coiling Counter Doors
083323 Overhead Coiling Doors
083326 Overhead Coiling Grilles
084313 Aluminum-Framed Storefronts
084413 Glazed Aluminum Curtain Walls
085113 Aluminum Windows
085619 Pass Windows
087100 Door Hardware
088000 Glazing
088300 Mirrors
088723 Safety and Security Films
088733 Decorative Films
088813 Fire-Rated Glazing
089100 Louvers

DIVISION 9 – FINISHES

092216 Cold Formed Steel Framing - Non-Structural (CFSF-NS)
092900 Gypsum Board
093000 Tiling
095100 Acoustical Ceilings
095426 Suspended Wood Ceilings
096400 Wood Flooring
096453 Stage Flooring Assembly
096466 Wood Athletic Flooring
096467 Dance Flooring Assemblies
096500 Resilient Flooring
096566 Resilient Athletic Flooring
096623 Resinous Matrix Terrazzo Flooring
096700 Resinous Flooring and Walls
096813 Tile Carpeting
096817 Textile Composite Flooring
097200 Wall Coverings
098430 Sound-Absorbing Wall and Ceiling Units
099100 Painting

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DIVISION 10 – SPECIALTIES

101100	Visual Display Units
101200	Display Cases
101400	Signage
102113.19	Plastic Toilet Compartments
102123	Cubicle Curtains and Track
102239	Folding Panel Partitions
102600	Wall and Door Protection
102800	Toilet and Bath Accessories
104400	Fire Protection Specialties
105113	Metal Lockers
107300	Protective Covers
107500	Flagpoles

DIVISION 11 – EQUIPMENT

111313	Loading Dock Bumpers
113013	Residential Appliances
114000	Foodservice Equipment
115213	Projection Screens
115223	Television Brackets
115313	Laboratory Fume Hoods
116123.16	Orchestra Pit Fillers
116143	Stage Curtains
116613	Ballet Barres
116623	Gymnasium Equipment
116843	Exterior Scoreboards
117300	Patient Care Equipment
118129	Facility Fall Protection
119513	Kilns

DIVISION 12 – FURNISHINGS

122400	Window Shades
123553.19	Wood Laboratory Casework
123583	Music Equipment Storage Casework and Accessories
124813	Entrance Floor Mats and Frames
125651	Library Furnishings
126100	Fixed Audience Seating
126600	Telescoping Stands

DIVISION 13 – SPECIAL CONSTRUCTION

133416	Grandstands and Press Box
133416.53	Bleachers

DIVISION 14 – CONVEYING SYSTEMS

142100	Electric Traction Elevators
144200	Wheelchair Lifts

DIVISION 21 – FIRE SUPPRESSION

210500	Common Work Results for Fire-Suppression

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211000 Water-Based Fire-Suppression Systems

DIVISION 22 – PLUMBING

220500 Common Work Results for Plumbing
220513 Common Motor Requirements for Plumbing Equipment
220516 Expansion Fittings and Loops for Plumbing Piping
220517 Sleeves and Sleeve Seals for Plumbing Piping
220519 Meters and Gages for Plumbing Piping
220523 General-Duty Valves for Plumbing Piping
220529 Hangers and Supports for Plumbing Piping and Equipment
220533 Heat Tracing for Plumbing Piping
220553 Identification for Plumbing Piping and Equipment
220700 Plumbing Insulation
221113 Facility Natural-Gas Piping
221116 Domestic Water Piping
221119 Domestic Water Piping Specialties
221123 Packaged Domestic Water Booster Pumps
221125 Domestic Water Circulating Pumps
221316 Sanitary Waste and Vent Piping
221319 Sanitary Waste Piping Specialties
221413 Facility Storm Drainage Piping
221423 Storm Drainage Piping Specialties
221429 Sump Pumps
223300 Electric Water Heaters
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230130.51 HVAC Air-Distribution System Cleaning
230513 Common Motor Requirements for HVAC Equipment
230516 Expansion Fittings and Loops for HVAC Piping
230517 Sleeves and Sleeve Seals for HVAC Piping
230519 Meters and Gauges for HVAC Piping
230523 General-Duty Valves for HVAC Piping
230529 Hangers and Supports for HVAC Piping and Equipment
230533 Heat Tracing for HVAC Piping
230548 Vibration and Seismic Control for HVAC
230553 Identification for HVAC Piping and Equipment
230593 Testing, Adjusting, and Balancing for HVAC
230713 Duct Insulation
230716 HVAC Equipment Insulation
230719 HVAC Piping Insulation
230800 Commissioning of HVAC
230900 Building Automation System
230934 Variable-Frequency Motor Controllers
230993 Sequence of Operations for HVAC Controls
232113 Hydronic Piping
232113.33 Ground-Loop Heat-Pump Piping

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232114 Hydronic Specialties
232123 Hydronic Pumps
232300 Refrigerant Piping
232500 HVAC Water Treatment
233100 HVAC Ducts and Casings
233300 Air Duct Accessories
233319 Duct Silencers
233423 HVAC Power Ventilators
233513 Dust Collection Systems
233600 Air Terminal Units
233700 Air Outlets and Inlets
234000 HVAC Air Cleaning Devices
235100 Breechings, Chimneys, and Stacks
235213 Electric Boilers
235216 Condensing Boilers
235700 Heat Exchangers for HVAC
236416 Centrifugal Water Chillers
236423 Scroll Water Chillers
236426 Rotary-Screw Water Chillers
236513 Forced-Draft Cooling Towers
236514 Induced-Draft Cooling Towers
237200 Air-to-Air Energy Recovery Equipment
237313 Modular Indoor Central-Station Air-Handling Units
237413 Packaged Outdoor Central Station Air Handling Units
237416 Packaged Rooftop Air-Conditioning Units
237433 Dedicated Outdoor Air Units
238126.13 Small-Capacity Split-System Air Conditioners
238129 Variable Refrigerant Flow HVAC Systems
238146 Water Source Unitary Heat Pumps
238149 Ground-Source Unitary Heat Pumps
238200 Convection Heating and Cooling Units
238241 Water-to-Water Heat Pumps

DIVISION 25 – INTEGRATED AUTOMATION – Not Used

DIVISION 26 – ELECTRICAL

260505 Selective Demolition for Electrical
260519 Low-Voltage Electrical Power Conductors and Cables
260526 Grounding and Bonding for Electrical Systems
260529 Hangers and Supports for Electrical Systems
260533 Raceway and Boxes for Electrical Systems
260543 Underground Ducts and Raceways for Electrical Systems
260553 Identification for Electrical Systems
260573 Power System Studies
260923 Lighting Control Devices
260943 Lighting Control Relay Panels
262200 Low-Voltage Transformers
262413 Switchboards

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262416 Panelboards
262550 Generator Docking Stations
262653 Electric Vehicle Charging Equipment – Level 2
262713 Electricity Metering
262726 Wiring Devices
262813 Fuses
262816 Enclosed Circuit Breakers
262817 Enclosed Switches
262913 Enclosed Controllers
263100 Photovoltaic Collectors
263213 Engine Generators
263600 Transfer Switches
264100 Facility Lightning Protection
264300 Surge Protective Devices
265100 Interior Lighting
265561 Theatrical Lighting System
265568 Exterior Athletic Lighting
265600 Exterior Lighting
265613 Lighting Poles and Standards

DIVISION 27 – COMMUNICATIONS

270533.13 Conduit for Communications Systems
270536 Cable Trays for Communications Systems
275123 Intercommunications and Program Systems
275129 Rescue Assistance Signal System
275129.17 Two-way Radio Communication Enhancement Systems
275140 Gymnasium Sound Reinforcement System
275141 Student Dining Sound Reinforcement System
275142 Music Rooms Sound Reinforcement System
275143 Wrestling, Weight, and Fitness Rooms Sound Reinforcement System
275144 Athletic Fields Sound Reinforcement System

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

280513 Conductors and Cables for Electronic Safety and Security
284600 Fire Detection and Alarm

DIVISION 31 – EARTHWORK

311000 Site Clearing
311005 Site Demolition
312000 Earth Moving
312005 Building Earthwork
312319 Dewatering
312500 Erosion and Sediment Control
313116 Termite Control
315000 Excavation Support and Protection

DIVISION 32 – EXTERIOR IMPROVEMENTS

321216 Hot-Mixed Asphalt Paving

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321220 Road and Parking Accessories
321600 Concrete Walks
321610 Concrete Curbing
321800 Athletic Field Construction
321813 Synthetic Grass Surfacing
321820 Site Athletic Equipment
321823 Synthetic Running Track Surfacing
323113 Chain Link Fences and Gates
323119 Ornamental Steel Fencing
323223 Precast Concrete Modular Retaining Walls
329000 Tree Conservation
329305 Lawns and Grasses
329500 Trees, Shrubs, and Groundcover

DIVISION 33 – UTILITIES

330840 Commissioning of Stormwater Utilities
331000 Utility Standards
331005 Water Distribution System
333000 Sanitary Sewerage
334100 Storm Drainage

DIVISION 34 – TRANSPORTATION

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SECTION 023000
SUBSURFACE INVESTIGATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract including General and Supplementary Conditions, and Division 1, Specification Sections apply to work in this section.

1.02 DESCRIPTION OF WORK

A. Existing Subsurface Conditions: A subsurface investigation has been conducted at project site to determine general subsurface conditions. A copy of the report is included in this section.

1.03 RELATION SECTIONS

A. Refer to Section 312000 "Earthmoving".

1.04 RESPONSIBILITY OF DATA

A. The Owner and Architect will not be responsible for interpretations or assumptions made by Contractor based on subsurface exploration data furnished. Data is made available for Contractor’s convenience. Opinions expressed in report are interpretation of geotechnical engineer based on analysis and tests.

B. Additional subsurface investigations may be made by Contractor at no increase to the Contract Sum. Obtain written authorization from Owner before proceeding with subsurface investigations.

C. Subsurface Materials: Boring logs indicate general character of subsurface materials encountered only at boring locations.

D. Groundwater: Groundwater levels for project site are not known. Groundwater fluctuations may occur with variations in precipitation, surface run-off and existing utility leakage.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 023000

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SECTION 024100
DEMOLITION

PART 1 GENERAL

1.01 DEFINITIONS

A. "Remove": Carefully detach or dismantle items from existing construction and properly dispose of or recycle off site, unless items are indicated to be salvaged or reinstalled.

B. "Salvage" or "Remove and Salvage": Carefully detach or dismantle items from existing construction in a manner to prevent damage. Clean, package, label and deliver salvaged items to **<<Owner>>** in ready-for-reuse condition. If indicated to be reinstalled, store in a secure area until ready for reinstallation.

C. "Reinstall" or "Remove and Reinstall": Carefully detach or dismantle items from existing construction in a manner to prevent damage. Clean and prepare for reuse and reinstall where indicated.

D. "Existing", "Existing to Remain" or "ETR": Designation for existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1. Not all existing construction to remain shall be noted with one of these terms on the Drawings; the intent is to assist the Contractor in areas where it may be difficult to determine. Existing construction shall be assumed to remain unless specifically noted to be removed - either when noted with "remove", "salvage", or "reinstall" terminology per above, or when indicated graphically in accordance with the Demolition Legend on the Demolition Drawings.

1.02 REFERENCE STANDARDS

A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1. Hold the preinstallation meeting at the Project site; perform a walkthrough to review the existing conditions and highlight areas of particular concern.
2. Review structural concerns and deficiencies in the existing building(s).
3. Review demolition schedule**<< , including phasing; or None - N/A>>**.
4. Review specific elements indicated to remain or to be salvaged, and review procedures for protection and / or storage of those elements.
5. Review Owner's occupancy and noise requirements.

B. Coordination: Coordinate **<< phasing; and staging>>** requirements with Owner's occupancy of the existing building.

1. Coordinate with Division 01 sections for **<< Owner's occupancy; phasing; and noise>>** requirements.
2. **<< Equipment and Furnishings to be Salvaged (By Owner):>>** Owner's personnel shall remove existing equipment and furnishings from spaces to be demolished prior to the beginning of the Work. Except for any built-in equipment specifically indicated on the Drawings to remain and be protected, the Contractor will not be required to work in furnished areas and will not be responsible for the condition of furniture or equipment left in place. ******Verify whether items will be removed or remain in place on a case-by-case basis. Coordinate with paragraph below.******

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3. **<< Equipment and Furnishings to be Salvaged (By Contractor)>>**: Contractor shall remove existing equipment and furnishings from spaces to be demolished prior to beginning of the Work. Refer to Salvage List for a complete listing of items to be removed from the existing facility and transported to another facility within Montgomery County, Maryland. ******Important to provide a complete list of items to be salvaged so Contractor can price accurately.******
4. **<< Equipment and Furnishings to Remain In Place:>>** Contractor shall provide protective coverings over existing equipment and furnishings to remain in place during the Work. Cover equipment and furnishings with 6 mil plastic sheeting, and tape around all seams and edges to prevent dust intrusion. For overhead work, provide padding or blankets over horizontal surfaces prior to plastic sheeting, to protect against dropped items. Ensure all items are protected prior to the start of demolition.

1.04 SUBMITTALS

A. Photographic Documentation: Submit photographic record of the existing conditions, either as still photographs or as a video-recorded walkthrough. Contractor shall perform walkthrough of existing conditions with Owner's representative prior to site mobilization.
   1. Photographic documentation shall clearly show existing damage and wear on existing surfaces that may be interpreted as being caused by subsequent demolition and construction operations.
   2. For still photographs, submit marked-up plan(s) indicating locations where photographs were taken and direction photograph is facing. Include a written narrative to describe existing damage and other conditions as deemed necessary.
   3. For video recordings, include a spoken narrative to describe locations and existing conditions, or provide a supplementary written narrative.
   4. Submit all photographic documentation as digital photo / video files, and supplementary narratives and plans as PDF files. Submit as part of the initial submittal package required prior to release of the first request for payment.

B. Shop Drawings: Submit demolition plans and survey as required by OSHA and local AHJs.
   1. Engineering Survey: Provide structural survey of existing building(s). Provide additional surveys if unforeseen conditions are revealed during the course of the Work.
   2. Indicate extent of demolition, removal sequencing, bracing and shoring, and location and construction of barricades and fences.
   3. Indicate elements to be salvaged and elements that are to remain in place and protected.

C. Sustainable Design Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

D. Refrigerant Certification: Provide a written statement, signed by refrigerant recovery technician, certifying that refrigerant materials were recovered in accordance with EPA regulations. Statement shall include certified technician's full name and business name as applicable, address, and date of recovery. ******Include if project involves demo of HVAC units******

E. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.05 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Technicians removing or disposing of any equipment or appliance containing ozone-depleting refrigerants shall be certified in accordance with EPA Section 608 Technician Certification. ******Include if project involves demo of HVAC units******

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PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

A. Perform an initial walkthrough and visual survey of the existing building(s). Take photographic documentation of the existing conditions per submittal requirements above.

B. Perform structural engineering survey of the existing conditions as required by OSHA and local AHJs.

C. Receive verification in writing that hazardous materials remediation is complete before proceeding with demolition work.

3.02 PREPARATION

A. Remove and salvage items indicated to be reinstalled or turned over to Owner. Clean items and protect in secure packaging, and store in a secure location on-site.

3.03 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. All demolition work shall be considered unclassified. Barring discovery of hazardous materials or undocumented structural components, where elements are indicated to be demolished, the bid price shall be for complete demolition of the element, regardless of the individual component makeup of that element.

B. Refrigerant Recovery: Certified recovery technician shall remove refrigerant from all applicable equipment and appliances prior to the start of demolition activities. ******Include if project involves demo of HVAC units******

C. Hazardous Materials: It is not expected that hazardous materials will be encountered during performance of the Work. ******Verify hazardous materials status and include either this paragraph or the paragraph "D" below******

1. If suspected hazardous materials are discovered during demolition operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCBs, and mercury.

D. Hazardous Materials: Hazardous materials are present in the existing building, and a report is available indicating locations. Do not commence demolition work in an area until written confirmation is received that abatement activities in that area are complete. ******Verify hazardous materials status and include either this paragraph or the paragraph "C" above******

1. Hazardous materials abatement will be performed under a separate contract; coordinate with Owner for abatement scheduling. ******Verify with MCPS for abatement in separate contract or under this contract******
2. Hazardous materials abatement will be performed as part of this Project; refer to abatement requirements elsewhere in the Contract Documents. ******Verify with MCPS for abatement in separate contract or under this contract******
3. If suspected hazardous materials that were not previously documented and abated are discovered during demolition operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCBs, and mercury.

E. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.

1. Obtain required permits.

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2. Fire Safety: Comply with applicable requirements of the International Fire Code; Chapter 33, and with **<<NFPA 241>>**.
    a. Use of explosives is not permitted.
    b. Hot Work: Remove all combustibles from areas where hot work is required, including use of cutting torches, welding, or heating equipment. Maintain fire watch for entire duration of hot work and for a minimum 30 minutes after completion of hot work.
        1) Keep portable fire extinguishers within 30 feet of locations where hot work is being performed for entire duration.
    c. Maintain egress routes and emergency access routes at all times; do not allow demolished materials to accumulate and block routes.
    d. Remove combustible demolished materials from the building by the end of each work day. Temporarily store combustible materials in noncombustible containers with self-closing lids until they can be removed from the building.
    e. Do not burn demolished material on site.
3. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
4. Provide, erect, and maintain temporary barriers and security devices.
5. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
6. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
7. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
8. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.

F. Do not begin removal until receipt of notification to proceed from Owner.

G. Do not begin removal until built elements to be salvaged, relocated, or reinstalled have been removed.

H. Protect existing structures and other elements to remain in place and not removed.
1. Provide bracing and shoring.
2. Prevent movement or settlement of adjacent structures.
3. Stop work immediately if adjacent structures appear to be in danger.

I. Minimize production of dust due to demolition operations. Do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

J. Perform demolition in a manner that maximizes salvage and recycling of materials.
1. Comply with requirements of Section **<< 017419 - Construction Waste Management and Disposal>>**.
2. Dismantle existing construction and separate materials.
3. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

K. If items of potential historic interest are discovered during the course of the Work, such as cornerstones or plaques, consult with the Owner prior to proceeding. If Owner wishes to preserve these items, carefully remove and salvage, and store in on-site location designated by Owner.

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3.04 EXISTING UTILITIES

A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner, and Owner's approval in writing.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner, and Owner's approval in writing.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone. Identify and mark, in same manner as other utilities to remain, utilities to be reconnected.

3.05 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Existing construction and utilities indicated on drawings are based on casual field observation and existing record documents only.

1. Verify construction and utility arrangements are as indicated.
2. Report discrepancies to Architect before disturbing existing installation.
3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Separate areas in which demolition is being conducted from areas that remain occupied.

1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Division 1 Section "Temporary Facilities and Controls" **<< in locations indicated on drawings; _____; or None - N/A>>**.

C. Maintain weatherproof exterior building enclosure, except for interruptions required for replacement or modifications; prevent water and humidity damage.

D. Protect existing work to remain.

1. Prevent movement of structure. Provide shoring and bracing as required.
2. Perform cutting to accomplish removal work neatly and as specified for cutting new work.
3. Repair adjacent construction and finishes damaged during removal work.
4. Patch to match new work.

E. Remove existing work as indicated and required to accomplish new work.

1. Remove items indicated on drawings.

F. Services (Including but not limited to **<< HVAC; Plumbing; Fire Protection; Electrical; Telecommunications; and _____>>**): Remove existing systems and equipment as indicated.

1. Maintain existing active systems to remain in operation, and maintain access to equipment and operational components.
2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.

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3. Coordinate with Division 1 for limitations on outages and required notifications to Owner, as applicable.
4. Verify that abandoned services serve only abandoned facilities before removal.
5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings. Remove back to source of supply where possible, otherwise cap stub and tag with identification.

G. Floor Finishes: After removal of existing floor finishes including backings, underlayments, and thick set mortar beds, remove all residual adhesives and glue. Provide grinding, sanding, or shot-blasting of existing concrete floor slab to achieve the proper surface to receive new indicated floor finish. Coordinate slab surface preparations required for each new indicated floor finish with appropriate subcontractor.

H. Carpet: Coordinate with Division 9 carpet manufacturer and Division 1 Construction Waste Management section for recycling of existing sheet or tile carpet. Remove carpet carefully and remove all loose debris and metal (tacks, nails, stretcher strips). Coordinate with Carpet and Rug Institute guidelines for removal and disposal of adhesives. Cut sheet carpeting and carpet padding into four foot sections and tightly roll and wrap. Stack carpet tile on 36 inch or smaller pallets, no higher than 4 feet, and shrink wrap. Store in a protected, dry location in preparation for delivery to reclamation/recycling facility.

I. Acoustical Ceiling Panels: Coordinate with Division 9 acoustical ceiling panel manufacturer and Division 1 Construction Waste Management section. Remove ceiling tiles and stack neatly on pallets; wrap or band pallet loads. Store in a protected, dry location in preparation for delivery to recycling facility.

J. Concrete**<< and Terrazzo; or None - N/A>>**: Cut neatly in straight lines with power-driven saw with diamond-tooth blade or other type specifically intended for concrete and masonry. Break up and remove carefully, avoiding damage to adjacent flooring that will remain exposed in the finished work.

K. Masonry: Remove masonry in whole units at exposed surfaces, new openings, and unless otherwise indicated, to allow for toothing-in of new masonry.
   1. Solid masonry may be cut with power saw where masonry edges will be concealed by the finished work. Do not cut hollow masonry.

L. Existing Surfaces to Receive Finishes: Remove miscellaneous hangers, exposed nails not serving as fasteners, and similar protrusions; remove adhesive residue and tape; fill anchorage holes; and otherwise patch and restore surface to be a uniform substrate suitable for applied finishes.

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3.06 DEBRIS AND WASTE REMOVAL

A. Comply with requirements of Division 1 for Construction Waste Management and Disposal.

B. Remove all debris, trash, and other materials not indicated to be salvaged or reinstalled from the site.

C. Leave site in clean condition, ready for subsequent work.

D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION 024100

SECTION 033000
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ACI 117 - Specification for Tolerances for Concrete Construction and Materials.

B. ACI 211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide.

C. ACI PRC-213 - Guide for Structural Lightweight-Aggregate Concrete.

D. ACI 223R-10 - Guide for the Use of Shrinkage-Compensating Concrete.

E. ACI 301 - Specifications for Concrete Construction.

F. ACI 302.1R - Guide to Concrete Floor and Slab Construction.

G. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.

H. ACI 305R - Guide to Hot Weather Concreting.

I. ACI 306R - Guide to Cold Weather Concreting.

J. ACI 308R - Guide to External Curing of Concrete.

K. ACI 318 - Building Code Requirements for Structural Concrete.

L. ACI 347R - Guide to Formwork for Concrete.

M. ACI MNL-66 - ACI Detailing Manual.

N. ACI PRC-213 - Guide for Structural Lightweight-Aggregate Concrete.

O. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

P. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.

Q. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.

R. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars.

S. ASTM A820/A820M - Standard Specification for Steel Fibers for Fiber-Reinforced Concrete.

T. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

U. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.

V. ASTM C33/C33M - Standard Specification for Concrete Aggregates.

W. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

X. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.

Y. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens).

Z. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete.

AA. ASTM C150/C150M - Standard Specification for Portland Cement.

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BB. ASTM C157/C157M - Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.

CC. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.

DD. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

EE. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete.

FF. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

GG. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete.

HH. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete.

II. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.

JJ. ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.

KK. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

LL. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.

MM. ASTM C845/C845M - Standard Specification for Expansive Hydraulic Cement.

NN. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

OO. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete.

PP. ASTM C989/C989M - Standard Specification for Slag Cement for Use in Concrete and Mortars.

QQ. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.

RR. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

SS. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.

TT. ASTM C1260 - Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).

UU. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

VV. ASTM C1582/C1582M - Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete.

WW. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.

XX. ASTM C1609/C1609M - Standard Test Method for Flexural Performance of Fiber-Reinforced Concrete (Using Beam With Third-Point Loading).

YY. ASTM C1708/C1708M - Standard Test Methods for Self-Leveling Mortars Containing Hydraulic Cements.

ZZ. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types).

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AAA. ASTM D1752 - Standard Specification for Preformed Sponge Rubber, Cork, and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

BBB. ASTM D2103 - Standard Specification for Polyethylene Film.

CCC. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars.

DDD. ASTM D5084 - Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.

EEE. ASTM D8139 - Standard Specification for Semi-Rigid, Closed-Cell Polypropylene Foam, Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.

FFF. ASTM E1155/E1155M - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.

GGG. ASTM E1155M - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers (Metric).

HHH. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

III. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

JJJ. AWS D1.4/D1.4M - Structural Welding Code - Steel Reinforcing Bars.

KKK. COE CRD-C 48 - Handbook for Concrete and Cement Standard Test Method for Water Permeability of Concrete.

LLL. CRSI (DA4) - Manual of Standard Practice.

MMM. NSF 61 - Drinking Water System Components - Health Effects.

NNN. NSF 372 - Drinking Water System Components - Lead Content.

1.02 SUBMITTALS

A. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
   1. For curing compounds, provide data on method of removal in the event of incompatibility with floor covering adhesives.

B. Mix Design: Submit proposed concrete mix designs. Reports or laboratory tests prepared more than 12 months prior to the date submitted for review are not acceptable.
   1. Indicate proposed mix design complies with requirements of **<<ACI 301>>**, Section 4 - Concrete Mixtures.
   2. Indicate proposed mix design complies with requirements of **<<ACI 318>>**, Chapter 5 - Concrete Quality, Mixing and Placing.
   3. Indicate proposed mix design complies with fiber reinforcing manufacturer's written recommendations.
   4. Indicate proposed mix design complies with admixture manufacturer's written recommendations.
   5. Indicate proposed mix design complies with expansive component manufacturer's written recommendations.
   6. Indicate proposed mix designs meet the an average Global Warming Potential (GWP) of all concrete on the project of less than or equal to 225 kgCO2E/yd3 for lifecycle stages A1-A3.

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C. Submit recycled-content data, designating percentages of post-consumer and pre-consumer recycled material.

D. Reinforcing Steel Shop Drawings: Comply with requirements of MNL-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.
   1. Prepare shop drawings under seal of a Professional Structural Engineer experienced in design of work of this type and licensed in the State in which the Project is located.

E. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.

F. Informational Submittals:
   1. Provide qualifiaction data for foundation installation contractor.
   2. Provide ACI Flatwork Finisher Certificate for flatwork installer in accordance with **<<ACI 301>>**.

G. Welder's Qualifications Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

H. Void Form Product Data: Provide data on void form materials and installation requirements.

I. Formwork Shop Drawings: Indicate pertinent dimensions, materials, bracing, and arrangement of joints and ties.
   1. Include the design engineer's stamp or seal on shop drawings.

J. Permanent Insulated Foam Panel Formwork Shop Drawings: Include calculations or selections from manufacturer's prescriptive design tables that indicate compliance with applicable building code and manufacturer's requirements.
   1. Include test reports for performance criteria specified.
   2. Include the designing engineer's stamp or seal on shop drawings.

K. Samples for Pigment Color Selection: Submit manufacturer's complete sample chip set, including pigment number and required dosage rate for each color.

L. Verification Samples: Submit sample chips of specified colors indicating pigment numbers and required dosage rates, for subsequent comparison to installed concrete.

M. Test Reports: Submit report for each test or series of tests specified.

N. Manufacturer's Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.

O. Sustainable Design Submittal: Refer to Division 1 Section - Sustainable Design Requirements.

P. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

Q. Construction Joint Layout: Indicate proposed Construction joints required to construct the structure.
   1. Location of construction joints is subject to approval of the Architect.

R. Minutes of Pre-Installation meetings.
   1. Contractor shall conduct pre-installation meeting on project site prior to commencement of work. Contractor shall conduct the meeting and shall be responsible for the attendance of all required trades and subcontractors including the special inspector.

1.03 QUALITY ASSURANCE

A. Perform work of this section in accordance with **<<ACI 301>>** and **<<ACI 318>>**.
   1. Maintain **<< one copy; or ____ copies>>** of each document on site.

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B. Follow recommendations of **<<ACI 305R>>** when concreting during hot weather.

C. Follow recommendations of **<<ACI 306R>>** when concreting during cold weather.

D. Installer Qualifications:
   1. A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
   2. For foundations and formed structural members, an experienced installer who has completed concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

E. Manufacturers Qualifications: A firm experienced in manufacturing ready-mixed concrete products that complies with ASTM C94 requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

F. Preinstallation Conference: Conduct conference at Project site a minimum of 2 weeks prior to start of concrete work.
   1. After submitting design mixtures, review concrete design mixtures and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including but not limited to the following:
      a. Contractor's superintendent.
      b. Special inspector.
      c. Ready-mix concrete manufacturer.
      d. Concrete subcontractor.
      e. Concrete polishing subcontractor.

G. Quality Control at Epoxy Terrazzo Substrates: Contractor shall establish and provide written quality control concrete slab finishing procedures reviewed by and acceptable to the epoxy terrazzo flooring manufacturer for (slab on grade) slab areas to receive epoxy terrazzo flooring to maintain the tolerance specified. Reduce high spots by approved mechanical means such as shot blast or special grinder. Fill low slab areas with cementitious or epoxy leveling compound acceptable to epoxy terrazzo flooring manufacturer and compatible with epoxy resin to attain level substrate for epoxy terrazzo work. Before concrete slab installation at epoxy terrazzo flooring areas, the General Contractor and installer shall review all screed elevations and spacing, extent of slab pour to help assure quality, and special conditions such as interface to stairs, elevator entrance thresholds and edge of slabs to minimize miscellaneous cracks.

H. For slabs required to include moisture vapor reducing admixture (MVRA), do not proceed with placement unless manufacturer's representative is present for **<< every; first; or _____>>** day of placement.

I. Formwork Designer Qualifications: Design formwork under direct supervision of a Professional Structural Engineer experienced in design of concrete formwork and licensed in the State in which the Project is located.

J. Welders Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.4/D1.4M and no more than 12 months before start of scheduled welding work.

1.04 MOCK-UP

A. Construct and erect mock-up panel for architectural concrete surfaces indicated to receive special treatment or finish as result of formwork.

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1. Panel Size: **<< 6 by 6 feet; or __by __ feet>>** unless otherwise indicated.
2. Number of Panels: **<< Two; Three; ___; or As indicated on drawings>>**.
3. Coordinate location with Architect and Owner.

B. Obtain acceptance of resulting surface finish prior to erecting formwork.

C. Accepted mock-up panel is considered basis of quality for the finished work. Keep mock-up exposed to view for duration of concrete work.

D. Mock-up **<< may; may not; or _____>>** remain as part of the Work.

PART 2 PRODUCTS

2.01 FORMWORK

A. Formwork Design and Construction: Comply with guidelines of **<<ACI 347R>>** to provide formwork that will produce concrete complying with tolerances of **<<ACI 117>>**.

B. Form Materials: **<<Contractor>>**'s choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.

1. Form Facing for Exposed Finish Concrete: **<<Contractor>>**'s choice of materials that will provide smooth, stain-free final appearance. Refer to ACI 301.
2. Form Coating: Release agent that will not adversely affect concrete**<< or interfere with application of coatings; or None - N/A>>**.
3. Form Ties: **<< Cone snap; Taper removable bolt; or _____>>** type that will leave no metal within **<< 1-1/2 inches; or _____ inches>>** of concrete surface, and when removed, will leave no hole larger than 1 inch diameter in concrete surface.

C. Removable Prefabricated Forms

1. Tubular Column Type: Round, spirally wound laminated fiber material, surface treated with release agent, non-reusable, of sizes indicated.

D. Void Forms: Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete mix until initial set.

2.02 REINFORCEMENT MATERIALS

A. Reinforcing Steel: **<<ASTM A615/A615M>>**, Grade **<< 40 (40,000 psi); 60 (60,000 psi); 80 (80,000 psi); 100 (100,000 psi); or ___ (_____ psi)>>**.

1. Type: **<< Plain; Deformed; or ____>>** billet-steel bars.
2. Finish: Unfinished**<< , unless otherwise indicated; as indicated; at _____; _____; or None - N/A>>**.
3. Finish: Galvanized in accordance with **<<ASTM A767/A767M>>**, Class **<< I; or II>><< , unless otherwise indicated; as indicated; at _____; _____; or None - N/A>>**.
4. Finish: Epoxy coated in accordance with **<<ASTM A775/A775M>><< , unless otherwise indicated; as indicated; at _____; _____; or None - N/A>>**.

B. Reinforcing Steel: **<<ASTM A706/A706M>>**, Grade 60 (60,000 psi) (420 MPa).

1. Type: Deformed low-allow steel bars (weldable.)
2. Finish: Unfinished, unless otherwise indicated.

C. Steel Welded Wire Reinforcing (WWR): **<< Plain type, ASTM A1064/A1064M; Galvanized, plain type, ASTM A1064/A1064M; Deformed type, ASTM A1064/A1064M; Class A epoxy coated, deformed type, ASTM A884/A884M; or _____>>**.

1. Form: Flat Sheets.

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2. Finish: Plain, unless otherwise indicated.
3. Finish: Galvanized in accordance with ASTM A767/A767M, Class I, unless otherwise indicated.

D. Reinforcing Accessories:
1. Tie Wire: Annealed, minimum **<< 16 gauge, 0.0508 inch; or __ gauge, __ inch>>**.
2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
a. Manufacture bar supports of steel, wire, plastic or pre-cast concrete of greater compressive strength than concrete being placed.
b. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches (38mm) of weathering surfaces.
c. Welded wire fabric reinforcing shall be supported on continuous bolsters spaced at 2'-6" oc, unless otherwise indicated. Bolsters shall have sand plates or horizontal runners. Solid brick for support of reinforcing in slab is prohibited.
d. For exposed to view concrete surfaces, where legs of bolsters are in contact with forms, provide bolsters with legs that are plastic coated.
e. The use of rebar stakes to holld reinforcement in place shall not be permitted.

E. Coupler Systems: Mechanical devices for splicing reinforcing bars; capable of developing 125% of steel reinforcing yield strength in tension and compression.

F. Dowel Bar Splicer with Dowel-Ins: Mechanical devices for connecting dowels; capable of developing 125% steel reinforcing yield strength in tension and compression.

G. Reinforcing Fabrication:
1. Fabricate concrete reinforcing in accordance with **<<CRSI (DA4)>>** - Manual of Standard Practice.
2. Welding of reinforcing steel is not permitted.
3. Welding of reinforcing steel is permitted only with the specific approval of Architect. Perform welding in accordance with **<<AWS D1.4/D1.4M>>**.
a. Galvanized Reinforcement: Clean surfaces, weld and re-protect welded joints in accordance with **<<CRSI (DA4)>>**.
4. Fabricate and handle epoxy-coated reinforcing in accordance with ASTM D3963/D3963M.
5. Locate reinforcing splices not indicated on drawings at point of minimum stress.

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2.03 CONCRETE MATERIALS

A. Cement: **<<ASTM C150/C150M>>**, Type I / II/ IL Portland Lime type (refer to specific types specified on the contractor drawings). White
1. Acquire cement for entire project from same source.

B. Fine and Coarse Aggregates: **<<ASTM C33/C33M>>**.
1. Acquire aggregates for entire project from same source and within a 500-mile radius of the Project site.

C. Lightweight Aggregate: **<<ASTM C330/C330M>>**.

D. Fly Ash: **<<ASTM C618>>**, Class **<< F; C; C or F; or _____>>**.
1. Use of flyash shall not exceed 25% of cementitious materials by weight.
2. Use of flyash in polished slabs is prohibited.

E. Silica Fume: **<<ASTM C1240>>**, densified amorphous silica fume.
1. Use of silica fume shall not exceed 10% of cementitious materials by weight.

F. Ground Granulated Blast Furnace Slag: ASTM C989, Grade 100 or 120.
   1. Use of blast furnace slag shall not exceed 50% of cementitious materials by weight.

G. Color Additives: Pure, concentrated mineral pigments specifically intended for mixing into concrete and complying with **<<ASTM C979/C979M>>**.
   1. Concentration: Base dosage rates on weight of total cementitious materials, but not aggregate or sand.
   2. Packaging: If pigments are to be added to mix at site, furnish pigments in premeasured disintegrating bags to minimize job site waste.
   3. Color(s): As indicated on drawings.
   4. Color(s): To match **<<Architect>>**'s and Owner sample(s) when incorporated into specified mix design(s).
   5. Color(s): As selected by **<<Architect>>** and Owner from manufacturer's full range.
      a. Allow for **<< ____>>** different pigment colors.
      b. Allow for up to **<< ____>>** percent dosage for each color.
   6. Color: **<< _____>>** at dosage rate of **<< ____>>** percent.

H. Water: **<<ASTM C1602/C1602M>>**; clean, potable, and not detrimental to concrete.

2.04 ADMIXTURES

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

B. Air Entrainment Admixture: **<<ASTM C260/C260M>>**.

C. High Range Water Reducing and Retarding Admixture: **<<ASTM C494/C494M>>** Type G.

D. High Range Water Reducing Admixture: **<<ASTM C494/C494M>>** Type F.

E. Water Reducing and Accelerating Admixture: **<<ASTM C494/C494M>>** Type E.

F. Water Reducing and Retarding Admixture: **<<ASTM C494/C494M>>** Type D.

G. Accelerating Admixture: **<<ASTM C494/C494M>>** Type C.

H. Retarding Admixture: **<<ASTM C494/C494M>>** Type B.

I. Water Reducing Admixture: **<<ASTM C494/C494M>>** Type A.

J. Shrinkage Reducing Admixture: **<<ASTM C494/C494M>>** , Type S.

K. Shrinkage Compensating Admixture: For on site production of concrete with **<<ASTM C845/C845M>>**, **<< Type K; Type M; Type S; or _____>>** cement.

L. Corrosion Inhibiting Admixture:
   1. **<<ASTM C494/C494M>>**, Type C or Type S.
   2. **<<ASTM C1582/C1582M>>**.

M. Porosity Inhibiting Admixture (PIA): Liquid, inorganic admixture free of volatile organic compounds (VOCs) and reactive silicates. Closes capillary systems formed during concrete curing to reduce moisture vapor emission and transmission. Reduces alkali silicate reaction (ASR) and concrete shrinkage with no adverse effect on concrete properties or applied flooring.
   1. Provide admixture in slabs to receive adhesively applied flooring**<< None - N/A; or roofing; or _____>>**.
   2. Hydraulic Conductivity: **<< 6 x 10 exp(-8) fps>>**, minimum, when tested according to **<<ASTM D5084>>**.
   3. Concrete Shrinkage Reduction at 28 Days: 75 percent, minimum, when compared to mix design without PIA and both tested according to **<<ASTM C157/C157M>>**.

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4. ASR Reduction at 28 Days: 78 percent, minimum, when compared to mix design without PIA and both tested according to **<<ASTM C1260>>**.
5. Includes integral biocide.
6. Provide warranty to cover cost of flooring failures due to moisture migration from slabs for life of the concrete.

N. Moisture Vapor Reducing Admixture (MVRA): Liquid, inorganic admixture free of volatile organic compounds (VOCs). Closes capillary systems formed during concrete curing to reduce moisture vapor emission and transmission. Reduces concrete shrinkage with no adverse effect on concrete properties or applied flooring.
1. Provide admixture in slabs to receive adhesively applied flooring**<< None - N/A; or roofing; or _____>>**.
2. Concrete Shrinkage Reduction at 28 Days: 35 percent, minimum, when compared to mix design without MVRA and both tested according to **<<ASTM C157/C157M>>**.
3. VOC Content: Zero.
4. Provide warranty to cover cost of flooring failures due to moisture migration from slabs for life of the concrete.

O. Waterproofing Admixture: Admixture formulated to reduce permeability to liquid water, with no adverse effect on concrete properties.
1. Admixture Composition: Crystalline, functioning by growth of crystals in capillary pores.
2. Admixture Composition: Hydrophobic polymer waterproofing and corrosion inhibitor, functioning by closing concrete pores and chemical bonding.
3. Permeability of Cured Concrete: No measurable leakage when tested in accordance with **<<COE CRD-C 48>>** at **<< 200 psi; or ____ feet>>**; provide test reports.
4. Potable Water Contact Approval: National Science Foundation (NSF) certification for use on structures holding potable water, based on testing in accordance with **<<NSF 61>>** and **<<NSF 372>>**.

2.05 ACCESSORY MATERIALS

A. Underslab Vapor Retarder:
1. Sheet Material: **<<ASTM E1745>>**, **<< Class A; Class B; Class C; or _____>>**; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. Single ply polyethylene is prohibited.
a. Thickness: 15 mils, minimum.
2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.

B. Termite-Resistant Vapor Barrier Sheet: Plastic sheet complying with **<<ASTM E1745>>**, **<< Class C; or _____>>**; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs, and for exclusion of subterranean termites.
1. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, prefabricated boots, etc., for sealing seams and penetrations.

C. Non-Shrink Cementitious Grout: Flowable and low slump, dry pack premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
1. Grout: Comply with **<<ASTM C1107/C1107M>>**.
2. Minimum Compressive Strength at 48 Hours, **<<ASTM C109/C109M>>**: **<< 2,000 pounds per square inch; or ____ pounds per square inch>>**.
3. Minimum Compressive Strength at 28 Days: **<<ASTM C109/C109M>> << 7,000 pounds per square inch; or ____ pounds per square inch>>**.

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4. Products containing aluminum powder are not permitted.

D. Non-Shrink Epoxy Grout: Moisture-insensitive, two-part; consisting of epoxy resin, non-metallic aggregate, and activator.
   1. Minimum Compressive Strength at 7 days, **<<ASTM C579>>**: **<< 12,000 pounds per square inch; 16,000 pounds per square inch; or ____ pounds per square inch>>**.

E. Architectural Concrete Floor Topping and Resurfacer:
   1. Minimum Compressive Strength at 28 Days, **<<ASTM C109/C109M>>**: **<< 6,500 pounds per square inch; 7,000 pounds per square inch; or ____ pounds per square inch>>**.
   2. Minimum Compressive Strength at 28 Days: **<<ASTM C472>>**: **<< 5000 pounds per square inch; or _____ pounds per square inch>>** .
   3. Minimum Compressive Strength at 28 Days: ASTM C1708/C1708M: 5,000 pounds per square inch (48 mPA).

F. Self-Leveling Cementitious Concrete Floor Underlayment:
   1. Minimum Compressive Strength at 28 Days, **<<ASTM C1708/C1708M>>**: **<< 7,000 pounds per square inch; or 5,500 pounds per square inch>>**.

2.06 BONDING AND JOINTING PRODUCTS

A. Latex Bonding Agent: Non-redispersable acrylic latex, complying with **<<ASTM C1059/C1059M>>**, Type II.

B. Epoxy Bonding System:
   1. Complying with **<<ASTM C881/C881M>>** and of Type required for specific application.

C. Acetate Bonding Agent: Non-redispersable polyvinyl acetate.

D. Silane Hybrid Anchoring System:
   1. Complying with **<<ASTM C881/C881M>>** and of Type required for specific application.

E. Waterproofing Admixture Slurry: Slurry coat of Portland cement, sand, and crystalline waterproofing additive, mixed with water in proportions recommended by manufacturer to achieve waterproofing at cold joints in concrete.

F. Waterstops: Bentonite and butyl rubber, complying with **<<NSF 61>>** and **<<NSF 372>>**.
   1. Configuration: As indicated on drawings (3/4"x1" minimum).
   2. Size: As indicated on drawings.

G. Reglets: Formed steel sheet, galvanized, with temporary filler to prevent concrete intrusion during placement.
   1. Size: As indicated on drawings.

H. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

I. Slab Isolation Joint Filler: **<< 1/2 inch; 1/4 inch; or ____ inch>>** thick, unless otherwise indicated, height equal to slab thickness, with removable top section that will form **<< 1/2 inch; or ___ inch>>** deep sealant pocket after removal.
   1. Material: **<<ASTM D1751>>**, **<< cellulose fiber; cork; or _____>>**.
   2. Material: **<<ASTM D1752>>**, **<< sponge rubber (Type I); cork (Type II); self-expanding cork (Type III); recycled PVC (Type IV); or _____>>**.
   3. Material: **<<ASTM D8139>>**, semi-rigid, closed-cell polypropylene foam.
   4. Material: Closed-cell, non-absorbent, compressible polymer foam in sheet form.

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J. Slab Contraction Joint Device: Preformed linear strip intended for pressing into wet concrete to provide straight route for shrinkage cracking.

K. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with **<< rectangular; square; round; or _____>>** knockout holes for conduit or rebar to pass through joint form at **<< 6 inches; or ___ inches>>** on center; ribbed steel stakes for setting.
   1. Provide removable plastic cap strip that forms wedge-shaped joint for sealant installation.
   2. Height: To suit slab thickness.

L. Dowel Sleeves: Plastic sleeve**<< and nailable plastic base; _____; or None - N/A>>** for smooth, round, steel load-transfer dowels.

2.07 CURING MATERIALS

A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.

B. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with **<<ASTM C309>>**.
   1. Product dissipates within **<< 4 to 6 weeks; 30 to 60 days; 7 to 10 days; or _____>>**.
   2. Provide product containing fugitive red dye.

C. Curing Agent, Water-Cure Equivalent Type: Clear, water-based, non-film-forming, liquid-water cure replacement agent.
   1. Comply with **<<ASTM C309>>** standards for water retention.
   2. Compressive Strength of Treated Concrete: Equal to or greater than strength after 28-day water cure when tested according to **<<ASTM C39/C39M>>**.
   3. VOC Content: Zero.

D. Curing and Anti-Spalling Compound: Boiled linseed oil compound.
   1. Application: Use on roadway, bridge deck, parking deck, and ramps.

E. Resin Curing Compound: Solvent-based liquid, white pigmented, membrane-forming.
   1. For use on exterior slabs. When slab will be painted, sealed, topped, or receive other applied finish, completely remove curing compound after curing is complete and before finish coatings are applied.
   2. Comply with **<<ASTM C309>>**, Type 2, Classes A and B.
   3. VOC Content: Less than 350 g/L.
   4. Solids Content: 20 percent, minimum.

F. Low-Solids, Non-Membrane-Forming, Silicate Curing Compound: Water-based, reactive silicate, non-membrane-forming liquid**<< with red fugitive dye; or None - N/A>>**.

G. Curing and Sealing Compound, Moisture Emission-Reducing, Membrane-Forming: Liquid, membrane-forming, clear sealer, for application to newly-placed concrete.
   1. Use this product to cure and seal all slabs to receive adhesively applied flooring or roofing.
   2. Comply with **<<ASTM C309>>** and **<<ASTM C1315>>** Type I Class A.
   3. VOC Content: Less than 100 g/L.
   4. Solids Content: 25 percent, minimum.

H. Curing Compound, Non-dissipating: Liquid, membrane-forming, clear, non-yellowing acrylic; complying with **<<ASTM C309>>**.

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1. Application: Use at **<< _____>>**.
2. Vehicle: **<< Water-based; Solvent-based; or _____>>**.
3. Gloss: **<< Low; High; or ___>>**.
4. Solids by Mass: **<< 10 percent; 15 percent; 18 percent; 25 percent; or _____>>**, minimum.
5. VOC Content: OTC compliant.

I. Curing and Sealing Compound, Low Gloss: Liquid, membrane-forming, clear, non-yellowing acrylic; complying with **<<ASTM C1315>>** Type 1 Class A.

J. Curing and Sealing Compound, High Gloss: Liquid, membrane-forming, clear, non-yellowing acrylic; complying with **<<ASTM C1315>>** Type 1 Class A.

K. Moisture-Retaining Sheet: **<<ASTM C171>>**.
1. Curing paper, **<< regular; white; or _____>>**.
2. Polyethylene film, **<< clear; white opaque; or _____>>**, minimum nominal thickness of **<< 4 mil, 0.004 inch; or ___ mil, ___ inch>>**.

L. Polyethylene Film: **<<ASTM D2103>>**, **<< 4 mil, 0.004 inch; 6 mil, 0.006 inch; or ___ mil, ___ inch>>** thick, **<< clear; white opaque color; or _____>>**.

M. Water: Potable, not detrimental to concrete.

2.08 DENSIFIERS AND HARDENERS

A. Liquid Densifier and Hardener (CONC-LH): Penetrating chemical compound that reacts with concrete, filling the pores and hardening, and dustproofing. ***This section applies to floor slabs indicated by the architect to receive liquid hardener (CONC-LH). Densifiers/hardeners are commonly called out on our projects in spaces that require a more durable and long term treatment than a standard cure & seal product. Liquid hardeners/densifiers are silicate based products that fall under the classification of "penetrating sealers". The other category of penetrating sealer is the water repellant type of penetrating sealer. These are silane and siloxane based products. They would be beneficial on exposed exterior slabs and slabs subjected to water with road salts (parking garages). They are not specified here because they are not as often used on our projects as the hardeners. These types of sealers and other special floor finishes/coatings are specified in 033511 Concrete Floor Finishes.***
1. Composition: Sodium silicate

2.09 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with **<<ACI 211.1>>** recommendations.

B. Proportioning Structural Lightweight Concrete: Comply with **<<ACI PRC-213>>** recommendations.

C. Concrete Strength: Establish required average strength for**<< each type of; or None - N/A>>** concrete on the basis of **<< field experience; trial mixtures; or _____>>**, as specified in **<<ACI 301>>**.
1. For trial mixtures method, employ independent testing agency for preparing and reporting proposed mix designs.

D. Admixtures: Add acceptable admixtures as recommended in **<<ACI 211.1>>** and at rates recommended or required by manufacturer.

E. Normal Weight Concrete:
1. Compressive Strength, when tested in accordance with **<<ASTM C39/C39M>>** at **<< 28; or ____>>** days: **<< 3,000 pounds per square inch; 4,000 pounds per square inch;**

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5,000 pounds per square inch; _____ pounds per square inch; As indicated; As indicated on drawings; or _____>>.

2. Supplementary Cementitious Materials (SCM) Content: As indicated.
3. Water-Cement Ratio: By weight. as indicated.
4. Entrained Air Content: determined in accordance with **<<ASTM C173/C173M>>**. As Indicated.
5. Slump Limits: As indicated.
6. Maximum Aggregate Size: As indicated.
7. Durability Requiements: As indicated.

F. Structural Lightweight Concrete: ***Refer to ACI 213 for detailed information about these properties.***

1. Compressive Strength, when tested in accordance with **<<ASTM C39/C39M>>** at **<< 28; or ____>>** days: **<< 3,000 pounds per square inch; 4,000 pounds per square inch; 5,000 pounds per square inch; _____ pounds per square inch; As indicated; As indicated on drawings; or _____>>**.
2. Water-Cement Ratio: By weight, as indicated.
3. Total Air Content: determined in accordance with **<<ASTM C173/C173M>>**. As Indicated.
4. Maximum Slump: As indicated.
5. Maximum Aggregate Size: As indicated.
6. Calculated Equilibrium Density; Determined in accordance with ASTM C567: As Indicated ***Equilibrium density is generally 3-8 lb/cu ft less than the bulk fresh density and about 3 lb/cu ft more than the oven dry density.***

2.10 MIXING

A. On Project Site: Mix in drum type batch mixer, complying with **<<ASTM C685/C685M>>**. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.

1. Colored Concrete: Add pigments in strict accordance with manufacturer's instructions to achieve consistent color from batch to batch. ***If needed, per project.***
2. Expansive Component: Batch and mix as recommended by manufacturer for specific project conditions. I***f needed, per project.***

B. Transit Mixers: Comply with **<<ASTM C94/C94M>>**.

C. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio. Only add water if withheld from the supplier

1. Batch ticket shall indicate volume of water withheld.

D. Do not use expansive component in same concrete batch with MVRA or PIA. ***MVRA and PIA already contain shrinkage reducers and should not be used with other shrinkage reducing admixtures.***

E. Do not use shrinkage-reducing admixture (SRA) in same concrete batch with MVRA or PIA. ***MVRA and PIA already contain shrinkage reducers and should not be used with other shrinkage reducing.***

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

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3.02 FORMWORK

A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.

B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

C. Obtain approval before framing openings in structural members that are not indicated on drawings.

D. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.

E. Coordinate this section with other sections of work that require attachment of components to formwork.

F. If formwork is placed after reinforcement, resulting in insufficient concrete cover of reinforcement, request instructions from Architect before proceeding.

3.03 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces or untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.04 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

A. Fabricate and handle epoxy-coated reinforcing in accordance with **<<ASTM D3963/D3963M>>**.

B. Comply with requirements of **<<ACI 301>>**. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.

C. Install welded wire reinforcement in maximum possible lengths and offset end laps in both directions. Splice laps with tie wire.

D. Verify that anchors, seats, plates, reinforcing steel and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

E. Wet sticking is not permited.

3.05 INSERTS, EMBEDDED PARTS AND OPENINGS

A. Provide formed openings where required items to be embedded passing through concrete work.

B. Locate and set in place items that will be cast directly into concrete.

C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.

D. Position recessed anchor slots for brick veneer masonry anchors to spacing and intervals specified.

E. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.

F. Install waterstops in accordance with manufacturer's instructions, so they are continuous without displacing reinforcement.

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G. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

H. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.06 FORM CLEANING

A. Clean forms as erection proceeds, to remove foreign matter with forms.

B. Clean formed cavities of debris prior to placing concrete.

1. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
2. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.07 FORMWORK TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 117, unless otherwise indicated.

B. Construct and align formwork for elevator hoistway in accordance with ASME A17.1.

3.08 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 014000 - Quality Requirements.

B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.

3.09 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

C. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.

3.10 PLACING CONCRETE

A. Place concrete in accordance with **<<ACI 304R>>**.

B. Place concrete for floor slabs in accordance with **<<ACI 302.1R>>**.

C. Place concrete with shrinkage-compensating expansive component in accordance with **<<ACI 223R-10>>**.

D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

E. Ensure **<< reinforcement; inserts; waterstops; embedded parts; formed construction joint devices; and _____>>** will not be disturbed during concrete placement.

F. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.

G. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

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3.11 SLAB JOINTING

A. Locate joints as indicated on drawings.

B. Anchor joint fillers and devices to prevent movement during concrete placement.

C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.

1. Install wherever necessary to separate slab from other building members, including columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.

D. Load Transfer Construction and Contraction Joints: Install load transfer devices as indicated; saw cut joint at surface as indicated for contraction joints.

E. Saw Cut Contraction Joints: Saw cut joints in slabs-on-grade as soon as cutting will not ravel, abrade, or otherwise damage the surface, and before random shrinkage cracks begin to develop; generally from **<< 4 to 12 hours; or _____>>** after placing. Use **<< 3/16 inch; or ____ inch>>** thick blade and cut to depth indicated.

F. Contraction Joint Devices: Use preformed joint device, with top set flush with top of slab. ***Only when specifically needed.***

G. Construction Joints: Where not otherwise indicated, use metal combination screed and key form, with removable top section for joint sealant.

H. Terrazzo Coordination: Locate construction joints at terrazzo floor areas to align with joint and divider locations indicated on terrazzo floor pattern drawing, as approved.

3.12 FLOOR FLATNESS AND LEVELNESS TOLERANCES

A. An independent testing agency, as specified in Section **<< 014000>>**, will inspect finished slabs for compliance with specified tolerances.

B. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values: ***Refer to ACI 117-10, section 4.8.4 commentary and ACI 302-15,section 10.15 for detailed info on floor flatness and levelness. Adjust values per project requirements.***

1. Slab-on-grade:
   a. Specified Overall Values: F(F)35/F(L)25 ***Adjust values per project requirements and floor finish.***
   b. Minimum Local Values: F(F)24/F(L) 17 ***Adjust values per project requirements and floor finish***.
2. Elevated Unshored Concrete Floors:
   a. Specified Overall Values: F(F)30
   b. Minimum Local Values: F(F)27
3. Polished Concrete Floors:
   a. Specified Overall Values: F(F)50/F(L)30
   b. Minimum Local Values, F(F)24/F(L) 17
4. Exposed to View and Foot Traffic: F(F) of 20; F(L) of 15**<< , on-grade only; , before removal of shoring; _____; or None - N/A>>**.
5. Under Raised Access Flooring: F(F) of 20; F(L) of 15**<< , on-grade only; , before removal of shoring; _____; or None - N/A>>**.
6. Under Thick-Bed Tile: F(F) of 20; F(L) of 15**<< , on-grade only; , before removal of shoring; _____; or None - N/A>>**.
7. Under Thin Resilient Flooring and Thinset Tile: F(F) of 35; F(L) of 25**<< , on-grade only; , before removal of shoring; _____; or None - N/A>>**.
8. Slabs Supporting Steel Cells: F(F) of 45; F(L) of 35, on grade only.

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C. Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with **<<ASTM E1155/E1155M>>**, within 48 hours after slab installation; report both composite overall values and local values for each measured section.

D. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than F(F) 13/F(L) 10.

E. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process. ***Keep in mind that this is not a desirable corrective measure for polished concrete slabs since it will cause variation in slab appearance.***

F. Slabs to receive specialized flooring such as but not limited to wood planks flooring shall have a maximum surface deviation of 1/8 inch in any direction when checked with a 10 foot straight edge. Use trowelable leveling and patching compounds, according to manufacturer's written instructions to fill cracks, holes, and depressions in substrates.

3.13 CONCRETE FINISHING

A. Repair surface defects,**<< including tie holes,; or None - N/A>>** immediately after removing formwork.

B. Unexposed Form Finish: Rub down or chip off fins or other raised areas **<< 1/4 inch; or ___ inch>>** or more in height.

C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas **<< 1/4 inch; or ___ inch>>** or more in height. Provide finish as follows:

1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.
2. Grout Cleaned Finish: Wet areas to be cleaned and apply grout mixture by brush or spray; scrub immediately to remove excess grout. After drying, rub vigorously with clean burlap, and keep moist for 36 hours.
3. Smooth Skim Finish: Exposed concrete walls shall receive a smooth skim to 1/8" parge finish.

D. Concrete Slabs: Finish to requirements of **<<ACI 302.1R>>**, and as follows:

1. Surfaces to Receive Thick Floor Coverings: "Wood float" as described in **<<ACI 302.1R>>**: thick floor coverings include **<< quarry tile; ceramic tile; Portland cement terrazzo; and _____>>** with full bed setting system.
2. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in **<<ACI 302.1R>>**; thin floor coverings include **<< carpeting; resilient flooring; seamless flooring; resinous matrix terrazzo; thin set quarry tile; thin set ceramic tile; and _____>>**.
3. Decorative Exposed Surfaces: Trowel as described in **<<ACI 302.1R>>**; take measures necessary to avoid black-burnish marks; decorative exposed surfaces include **<< surfaces to be stained or dyed; pigmented concrete; surfaces to receive liquid hardeners; surfaces to receive dry-shake hardeners; surfaces to be polished; all other exposed slab surfaces; and _____>>**.
4. Other Surfaces to Be Left Exposed: Trowel as described in **<<ACI 302.1R>>**, minimizing burnish marks and other appearance defects.
5. Finish lightweight concrete slabs in accordance with submitted procedure. Refer to Section 1.04 Submittals.
6. Concrete: Refer to Section 033543 Concrete Finishing.

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3.14 CURING AND PROTECTION

A. Comply with requirements of **<<ACI 308R>>**. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and for the in-place concrete to develop its minimum design properties.

C. Formed Surfaces: Keep forms in place for full curing period. If wood forms are used, keep moist, especially during hot or dry weather.

D. Surfaces Not in Contact with Forms:

1. Initial/ Intermediate Curing: Start as soon as bleed water has disappeared and before surface is dry for concrete with low bleed rate and when evaporative conditions are aggressive. Maintain until final curing methods begin.
   a. Liquid applied evaporation reducer.
   b. Continuous water-fogging
   c. Environment modification: sunshades, windscreens, enclosures
2. Final Curing:
   a. Continuous water fogging or sprinkling.
   b. Ponding.
   c. Moisture retaining cover.
   d. Liquid membrane-forming curing compound.
      1) Floor slabs to Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.
   e. Plastic Film

3.15 FIELD QUALITY CONTROL

A. The owners approved agent will engage independent testing agency to perform field quality control tests, as specified in Section **<< 014000 - Quality Requirements>>**.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Submit proposed mix design**<< of each class of concrete; or None - N/A>>** to**<< inspection and; or None - N/A>>** testing firm for review prior to commencement of concrete operations.

D. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.

E. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd, but less than 25 cu yds, plus one set for each additional 50 cu. yd. or fraction thereof.

F. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

G. Slump: ASTM C 143; one test at point of placement for each composite sample. Perform additional tests when concrete consistency (flowability) appears to change.

H. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample.

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I. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.

J. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

K. Compression Test Specimens: ASTM C 31.

1. Cast and laboratory cure one set of four 6-inch diameter or five 4-inch diameter cylinder specimens for each composite sample.

L. Compressive Strength Tests: ASTM C 39; test one laboratory-cured specimen at 7 days and one set of two 6-inch or three 4-inch specimens at 28 days. 56 day compression testing will not be deemed acceptable.

M. A compressive-strength test shall be the average compressive strength from a set of two 6-inch or three 4-inch specimens obtained from same composite sample and tested at age indicated.

N. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

O. Slab Testing: Cooperate with manufacturer of specified moisture vapor reducing admixture (MVRA) to allow access for sampling and testing concrete for compliance with warranty requirements.

P. Permeability Test: Test concrete with waterproofing admixture according to **<<COE CRD-C 48>>**.

Q. An independent testing agency, as specified in Section 014000 - Quality Requirements, will inspect installed reinforcement for compliance with contract documents before concrete placement.

R. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.

S. Concrete: Refer to section 033543 Concrete for protection requirements.

3.16 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to **<<Architect>>** and **<<Contractor>>** within 24 hours of test.

B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.

C. Repair or replacement of defective concrete will be determined by the **<<Architect>>**. The cost of additional testing shall be borne by **<<Contractor>>** when defective concrete is identified.

D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of **<<Architect>>** for each individual area.

3.17 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION 033000

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SECTION 033543
POLISHED CONCRETE FINISHING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ANSI/NFSI B101.1 - Test Method for Measuring the Wet SCOF of Hard-Surface Walkways.

B. ANSI/NFSI B101.3 - Test Method for Measuring the Wet DCOF of Hard Surface Walkways.

C. ASTM C1353/C1353M - Standard Test Method for Abrasion Resistance of Dimension Stone Subjected to Foot Traffic Using a Rotary Platform Abraser.

D. ASTM D4039 - Standard Test Method for Reflection Haze of High-Gloss Surfaces.

E. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

F. ASTM D5767 - Standard Test Method for Instrumental Measurement of Distinctness-of-Image (DOI) Gloss of Coated Surfaces.

G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

H. ASTM G154 - Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials.

I. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

J. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.

K. SCAQMD 1113 - Architectural Coatings.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordinate work of this section with concrete floor placement and concrete floor curing.

B. Preinstallation Meeting: Conduct a preinstallation meeting **<< 10 days; or _____>>** prior to start of any concrete work. Preinstallation meeting for this section may be combined with preinstallation meeting for concrete per Section 033000 "Cast-in-Place Concrete." Conduct meeting at the Project site.

1. Items for Review:
    a. Contract document requirements.
    b. Approved submittals and mock-up requirements, including location and timing of test areas/mock-ups.
    c. Physical requirements of concrete slab and slab finish, including specific mix design(s), specified compressive strengths, and floor flatness requirements.
    d. Curing methods.
    e. Polished concrete finish requirements.
    f. Protection of surfaces not scheduled for finish application.
    g. Surface preparation.
    h. Application procedure, including details of each step of grinding, honing, and polishing operations, application of liquid applied products, and quality control.
    i. Procedures for edges and penetrations.
    j. Cleaning, including proper disposal of concrete slurry and concrete dust.

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k. Methods of protection of polished concrete floors during construction and after completion of polishing work, including coordination with all trades to clarify requirements and responsibilities.
l. Coordination with other work.

2. Require attendance of parties directly affecting work of this section, including:
   a. Concrete producer's technical representative.
   b. Concrete installer.
   c. Concrete polishing contractor.
   d. General Contractor's representative.
   e. **<<Contractor>>**'s representative.
   f. **<<Architect>>**.
   g. Structural engineer.
   h. **<<Owner>>**'s representative.
3. Notify parties one week in advance of date and time of meeting.

1.03 SUBMITTALS

A. Product Data:
   1. Submit manufacturers specifications, technical data, test data, and written recommendations for storage, preparation, application and curing for each type of product indicated.
   2. Submit manufacturer's Material Safety Data Sheet (MSDS) and other safety requirement for each type of manufactured material and product indicated.

B. Submit Polishing Contractor’s recommended installation procedures which, when reviewed by the Architect, may become the basis for accepting or rejecting actual installation procedures used on the work.

C. Samples for initial selection, approximately 12-inches x 12-inches x 2-inches, to illustrate finished surfaces of polished concrete.

D. Manufacturer's Certification: Letter of certification from product manufacturer stating that installer is a certified applicator and is familiar with proper procedures and installation requirements required by the manufacturer.

E. Concrete Polishing Contractor Qualifications:
   1. Provide letter of certification from the Concrete Polishing Council (CPC) stating that installer is a certified applicator of special concrete finishes.
   2. Submit a list of previous projects similar to this project in design, extent, and scope.

F. Sustainable Design Submittals: Refer to Division 1 Section “Sustainable Design Requirements.”

1.04 QUALITY ASSURANCE

A. Concrete Polishing Contractor Qualifications:
   1. Shall be a company that has expertise in this type of work, sufficient production capability, successful completion of at least five projects similar to this project in size, and scope.
   2. Shall have an adequate number of personnel trained and experienced in this type of work, and shall have an on-site supervisor who is currently certified as Concrete Polishing Craftsman by the Concrete Polishing Council (CPC).
   3. Shall be approved/certified by the manufacturer for application of the liquid applied products.

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4. Shall be familiar with the specified requirements and the methods needed for proper performance of work of this Section.

1.05 MOCK-UP

A. Construct mock-ups of each type finish, to demonstrate surface finish, color variation, typical joints, and standard of workmanship.

B. Cast concrete slab mock-ups approximately 10 ft x 10 ft in the location indicated or if not indicated, as directed by the Architect.

C. Placement, grinding, and polishing work shall be performed by the same personnel who will be doing this work on the Project.

D. Notify Architect seven days in advance of dates and times when mock-ups will be constructed, when practical.

E. Obtain approval of mock-ups from the Architect before starting actual work. If the Architect determines the mock-ups do not meet requirements, demolish and remove them from the site and cast others until mock-ups are approved.

F. Maintain approved mock-ups during construction in an undisturbed condition as a standard for judging the completed work.

G. When approved by Architect, approved mock-ups may remain as part of the finished work if undamaged and clean at time of Substantial Completion.

1.06 PROTECTION

A. Prevent petroleum or rust stains on concrete slab. No satisfactory chemical or cleaning procedure is available to remove petroleum and rust stains from the concrete surface. Prevention is therefore essential.

B. All equipment shall be diapered to avoid staining of the concrete from petroleum, oil, hydraulic fluid, or other liquid dripping from equipment over concrete surfaces.

C. Do not allow trades to park vehicles on the interior floor slab. If vehicles must be driven on interior slabs, drop cloths shall be placed under vehicles at all times.

D. Do not allow pipe cutting machine to be used or set up on the interior floor slab.

E. Steel, cans, and steel containers shall not be placed on interior slab, to avoid rust staining.

F. All equipment must be equipped with non-marking tires.

G. Equipment with soft rubber tires prone to picking up screws and nails shall be equipped with canvas tire bags.

H. Slabs subject to masonry construction, mortar spoils, pallet movers, forklifts, and scaffolding shall be protected with a breathable product and plywood or OSB until all masonry operations are complete

I. Do not tape protective coverings to concrete.

J. Prohibit use of markers, spray paint and soap stone.

K. Protect from painting activities over interior floor slab.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's sealed packaging, including application instructions.

B. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

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C. Dispense special concrete finish material from factory numbered and sealed containers. Maintain record of container numbers.

1.08 FIELD CONDITIONS

A. Ambient Conditions: Verify that field conditions are within manufacturer's allowable range prior to application.

PART 2 PRODUCTS

2.01 MATERIALS AND MANUFACTURERS

A. Penetrating Liquid Floor Treatment (Densifier and Stain Resistance): Penetrating chemical compound that reacts with concrete, fillng the pores and hardening, and dustproofing. Colorless, odorless, and zero VOC. Breathable treatment which permits moisture transmission through concrete.
   1. Composition: Lithium silicate.
   2. Abrasion Resistance: Greater than 50 percent improvement compared to untreated sample in accordance with **<<ASTM C1353/C1353M>>**.
   3. Treated Material Slip Resistance: High traction range when tested according to **<<ANSI/NFSI B101.1>>** and **<<ANSI/NFSI B101.3>>**.
   4. Adhesion: Greater than 10 percent increase in pull-off strength compared to untreated sample when tested according to **<<ASTM D4541>>**.
   5. Water Vapor Transmission: Zero perms compared to untreated sample when tested according to **<<ASTM E96/E96M>>** Method B.
   6. UV Stability: No degradation or yellowing when tested in accordance with **<<ASTM G154>>**.
   7. Products:
      a. Bomanite Corporation; Stabilizer Pro.
      b. Laticrete International; L&M FGS Hardener Plus.
      c. Sika; Scofield Formula One Lithium Densifier.
      d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Protective Sealer: Provide manufacturer's recommended **<< low-gloss; medium-gloss; or high-gloss>>** solvent-based penetrating clear protective treatment and stain guard.
   1. Sealers/Coatings: Sealers and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet applicable VOC limits of **<<CARB (SCM)>>** or **<<SCAQMD 1113>>**.

2.02 RELATED MATERIALS

A. Water: Clean and potable.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrate, with concrete base slab installer and Concrete Polishing Contractor present, for conditions affecting performance of finish. Correct conditions detrimental to timely and proper work. Do not proceed until unsatisfactory conditions are corrected.

B. Verify that base slab meets requirements of Division 3 Section “Cast-In-Place Concrete.”
   1. Finished floor flatness.

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2. Curing methods.
3. Compressive strength.

3.02 APPLICATION

A. Prepare floor for hardener-sealer application with specified diamond grinding steps, followed by the application of hardener-sealer and final polishing steps.

B. Machine grind floor surfaces to receive polished finishes level and smooth, and to depth required to reveal aggregate to exposure **<< Class A - Cement Fines; cement fines, 85 to 95 percent; fine aggregates, 5 to 15 percent; Class B - Fine Aggregate; fine aggregates, 85 to 95 percent; cement fines and coarse aggregate blend, 5 to 15 percent; Class C - Coarse Aggregate; coarse aggregate and cement fines, 80 percent; fine aggregate and cement fines blend, 10 to 20 percent; or _____>>**; per Concrete Polishing Council aggregate exposure guidelines, and to match approved mockup.

C. Polish interior slabs to **<< Level 4 - Highly Polished, image clarity value 70 to 100 percent; Level 3 - Polished, image clarity value 40 to 69 percent; Level 2 - Satin, image clarity value 10 to 39 percent; Level 1 - Flat, image clarity value 0 to 9 percent; or _____>>** per Concrete Polishing Council appearance guidelines, and to match approved mockup.

1. Image Clarity: Image clarity value per above value shall be measured in accordance with **<<ASTM D5767>>**; prior to application of sealer (if applicable).
2. Haze Index: Haze index average less than 10 shall be measured in accordance with **<<ASTM D4039>>**; prior to application of sealer (if applicable).

D. Hardening and Polishing of Concrete Surface:

1. Concrete must be in place a minimum of 28 days or as directed by the manufacturer before application can begin.
2. Only a certified applicator shall apply hardener. Applicable procedures shall be followed as recommended by the product manufacturer and as required to match approved test sample.
3. Apply hardener for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
4. Achieve waterproofing, hardening, dust-proofing and abrasion resistance of the surface without changing the natural appearance of the concrete, except for the sheen.
5. Finish to within 1/2-inch of vertical surfaces.
6. Properly dispose of collected dry dust from polishing.

3.03 WORKMANSHIP AND CLEANING

A. Maintain polished concrete clean and free of stains and debris

B. Remove spatter from adjoining surfaces.

C. Repair damage to adjacent surfaces caused by cleaning operations.

D. Dispose of materials in accordance with local regulations.

E. Grind and polish in multiple passes with each full pass in direction perpendicular to previous pass.

F. Fill gaps, voids, and pop-outs during grinding operation.

3.04 PROTECTION

A. Final Protection of Polished Concrete:

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1. Protective Sealer:
   a. Stop spreading treatment material when drying begins.
   b. Avoid overlapping treatment material.
   c. Allow to dry tack-free before burnishing slab surface in accordance with manufacturer's recommendations.
   d. Repeat treatment with additional coats as required by manufacturer.
   e. For increased gloss or reduced haze as necessary, allow final coat to dry before burnishing slab surface in accordance with manufacturer's recommendations.
2. Following completion of the final polishing, surface shall be covered to protect from other trades. Cover with breathable product, such as Kraft paper or thin curing blanket. Do not cover with Masonite, plywood, or polyethylene.
3. Do not allow wheeled equipment or vehicles onto concrete after polishing is complete.

B. Clean spills on slab surfaces immediately, with manufacturer's recommended chemicals and absorptive materials.

C. No haze, white residue, streaking, or burnish marks permitted.

END OF SECTION 033543

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SECTION 034500
PRECAST ARCHITECTURAL CONCRETE

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary.

B. ACI SPEC-301 - Specifications for Concrete Construction.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

F. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.

G. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric).

H. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

I. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

J. ASTM C33/C33M - Standard Specification for Concrete Aggregates.

K. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete.

L. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete.

M. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

N. ASTM C642 - Standard Test Method for Density, Absorption, and Voids in Hardened Concrete.

O. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete.

P. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.

Q. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.

R. AWS D1.1/D1.1M - Structural Welding Code - Steel.

S. PCI MNL-117 - Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products.

T. PCI MNL-120 - PCI Design Handbook.

U. PCI MNL-122 - Architectural Precast Concrete.

V. PCI MNL-123 - Connections Manual: Design and Typical Details of Connections for Precast and Prestressed Concrete.

W. PCI MNL-135 - Tolerance Manual for Precast and Prestressed Concrete Construction.

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1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a minimum of two weeks prior to commencing work of this section.

1.03 SUBMITTALS

A. Product Data: Manufacturer's information on accessory products, including pigments, admixtures, inserts, plates, etc.

B. Shop Drawings: Indicate layout, unit locations, configuration, unit identification marks, reinforcement, connection details, support items,**<< location of lifting devices,; or None - N/A>>** dimensions, openings, and relationship to adjacent materials. **<< Provide erection drawings.; or None - N/A>>**

1. Include special details and shapes such as building corners, window sills, keystones, and others as applicable.
2. Include joint and reveal sizes, materials, and styles.
3. Include details of mix designs.
4. Include structural design calculations.

C. Sustainable Design Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

D. Samples: Provide manufacturer's standard size samples illustrating surface finish, color, and texture.

E. Test Reports: Submit test reports by an independent testing agency, for concrete materials, reinforcing, admixtures, and water-absorption testing.

1. When approved by Architect, in lieu of test reports, fabricator may submit signed certificates in writing indicating material compliance with requirements.

F. Designer's Qualification Statement.

G. Welders' Qualification Statement: Welders' certificates in accordance with **<<AWS B2.1/B2.1M>>** and dated no more than 12 months before start of scheduled welding work.

1.04 QUALITY ASSURANCE

A. Design Engineer Qualifications: Design precast concrete units, including concrete mixes, reinforcement, anchorages, and supports, under direct supervision of a Professional Structural Engineer experienced in design of precast concrete and licensed in **<<the State in which the Project is located>>**.

B. Fabricator Qualifications: Comply with at least one of the following:

1. Plant certified under Precast/Prestressed Concrete Institute Plant Certification Program; product group and category A1 - Architectural Precast Concrete.
2. Plant certified under Architectural Precast Association Plant Certification Program for production of architectural precast concrete.

C. Installer Qualifications: Company specializing in performing installation work for architectural precast, including overhead applications; specifically trained or certified by fabricator for installation of architectural precast products.

D. Welder Qualifications: Welding processes and welding operators qualified in accordance with **<<AWS D1.1/D1.1M>>** and no more than 12 months before start of scheduled welding work.

E. Quality Standards: Comply with requirements of the following publications:

1. PCI MNL-120 "PCI Design Handbook - Precast and Prestressed Concrete" for design and fabrication requirements.

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2. PCI MNL-117 "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products" for material, forming, testing, finish, and other quality control requirements.
3. PCI MNL-135 "Tolerance Manual for Precast and Prestressed Concrete Construction" for manufacturing, fabrication, and installation tolerances.

1.05 MOCK-UPS ****VERIFY MOCKUP TYPE ON CASE-BY-CASE BASIS AND KEEP APPLICABLE PARAGRAPH BELOW****

A. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

B. Integrated Exterior Mockup: Attend preinstallation conference and provide precast work for integrated exterior mockup as indicated on Drawings and as specified in Division 1 Section "Quality Requirements."

C. Mockup: Attend masonry preinstallation conference and provide precast work for masonry sample panel indicated in Division 4 Section "Unit Masonry."

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handling: Lift and support precast units only from support points.

B. Blocking and Lateral Support During Transport and Storage: Use materials that are clean, non-staining, and non-harmful to exposed surfaces. Provide temporary lateral support to prevent bowing and warping.

C. Protect units to prevent staining, chipping, or spalling of concrete.

D. Mark units with date of production in location that will be concealed after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Architectural Precast Concrete Fabricators:
1. American Stone Virginia, LLC; Ladysmith, VA.
2. Arban Precast, Ltd.; Dumfries, VA.
3. Cast Stone Systems, Inc.; Warrenton, NC.
4. Gate Precast Company; Oxford, NC.
5. Metromont Corp.; Richmond, VA/Charlotte, NC/Greenville, SC.
6. Seaboard Concrete Products Co.; Richmond VA.
7. Southern Castings, Inc.; Valdosta, GA.
8. Smith Midland; Midland, VA.
9. Tindall Corp.; Petersburg VA/Spartanburg, SC.
10. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.02 PRECAST UNITS, GENERAL

A. Precast Architectural Concrete Units: Comply with **<<PCI MNL-120>>**, **<<PCI MNL-122>>**, **<<PCI MNL-123>>**, **<<PCI MNL-135>>**, and **<<ACI CODE-318>>**.
1. Concrete Face and Backup Mixtures: Minimum 5000 psi, 28 day strength; comply with **<<ACI SPEC-301>>**.
2. Water Absorption: 6% by weight or 14% by volume, when tested according to **<<ASTM C642>>**, except for boiling requirement.

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3. Design Loads: Static loads, anticipated dynamic loading, including positive and negative wind loads, thermal movement loads, and erection forces as defined by applicable code.
4. Calculate structural properties of units in accordance with **<<ACI CODE-318>>**.
5. Accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
6. Provide connections that accommodate building movement and thermal movement and adjust to misalignment of structure without unit distortion or damage.

B. Decorative Precast Architectural Sphere Bollards: Comply with PCI MNL-120, PCI MNL-122, PCI MNL-123, and PCI MNL-135.
1. Manufacturers:
a. Belson Outdoors; Precast Concrete Sphere Bollards. ******MCPS preferred Basis of Design product.******
b. Petersen Manufacturing Co, Inc; BB Bollard Series.
c. Post Guard by Encore Commercial Products, Inc; Concrete Round Ball Sphere Bollard.
d. Wausau Tile; Concrete Sphere Bollard.
2. Size: **<< 12 inches; 18 inches; 24 inches; 30 inches; 36 inches; or <u>As indicated on Drawings</u>>>**.
3. Texture: Smooth.
4. Finish: Stained concrete.
5. Color: As selected by Architect from manufacturer's full range.
6. Anchor Method: Barricade installation.

C. Sustainability: Coordinate with Division 01 Section "Sustainable Design Requirements." Provide reports and/or mix designs indicating amount of Portland cement replaced by fly ash, silica fume or other recycled waste material.
1. Provide information indicating amount of recycled content in steel reinforcing, anchors, inserts, and other metal components.

D. Finish Type: Provide a light sandblast or acid etch finish for a smooth surface texture.
1. Color: Shall be selected from manufacturer's full range.

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2.03 REINFORCEMENT

A. Reinforcing Steel: **<<ASTM A615/A615M>>**, Grade 60 (60,000 psi), deformed billet-steel bars.

B. Steel Welded Wire Reinforcement (WWR): **<<ASTM A1064/A1064M>>**; plain type; galvanized steel wire fabricated into flat sheets.

2.04 CONCRETE MATERIALS

A. Cement: **<<ASTM C150/C150M>>**, Type I - Normal Portland type, or Type III - High Early Strength.

B. Other Cementitious Materials:
1. Fly Ash or Natural Pozzolans: Comply with **<<ASTM C618>>**.

C. Fine and Coarse Structural Aggregates: **<< <u>ASTM C33/C33M</u>; or _____>>**.

D. Lightweight Structural Aggregate: **<< <u>ASTM C330/C330M</u>; or _____>>**.

E. Color Additives: Pure, concentrated mineral pigments specifically intended for mixing into concrete and complying with **<<ASTM C979/C979M>>**.
1. Color(s): As selected by **<<Architect>>** from manufacturer's full range.

F. Water: **<<ASTM C1602/C1602M>>**; clean, potable, and not detrimental to concrete.

G. Air Entrainment Admixture: **<<ASTM C260/C260M>>**.

2.05 MORTAR

A. Mortar and Mortar Mix: Comply with Division 04 Section "Unit Masonry" for mortar materials and mixes.

2.06 SUPPORT DEVICES

A. Connecting and Support Devices; Anchors and Inserts: **<<ASTM A36/A36M>>** steel; hot-dip galvanized in accordance with **<<ASTM A153/A153M>>**.
   1. Clean surfaces of rust, scale, grease, and foreign matter.
   2. Galvanize after fabrication in accordance with requirements of **<<ASTM A123/A123M>>**.

B. Bolts, Nuts, and Washers: **<<ASTM A307>>** heavy hex bolts, Type A, hot-dip galvanized, with matching **<<ASTM A563/A563M>>** nuts and matching washers.

C. Primer: Zinc rich type.

2.07 FABRICATION

A. Fabricate in compliance with **<<PCI MNL-117>>** and **<<PCI MNL-135>>**.

B. Maintain plant records and quality control program during production of precast units. Make records available upon request.

C. Use rigid molds, constructed to maintain precast unit uniform in shape, size, and finish.

D. Use form liners in accordance with manufacturer's instructions.

E. Maintain consistent quality during manufacture.

F. Fabricate connecting devices, plates, angles, items fit to steel framing members, inserts, bolts, and accessories. Fabricate to permit initial placement and final attachment.

G. Embed reinforcing steel, anchors, inserts plates, angles, and other cast-in items.

H. Cure units to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking.

I. Minor patching in plant is acceptable, providing structural adequacy and appearance of units is not impaired.

2.08 FABRICATION TOLERANCES

A. Comply with **<<PCI MNL-117>>** and **<<PCI MNL-135>>**, except as specifically amended below.
   1. Maximum Variation From Nominal Face Dimensions: Plus or minus 3/32 inch.
   2. Maximum Variation From Square or Designated Skew: Plus or minus 1/8 inch in 10 feet.
   3. Maximum Variation from Thickness: Plus or minus 1/8 inch.
   4. Maximum Misalignment of Anchors, Inserts, Openings: Plus or minus 1/8 inch.
   5. Maximum Bowing of Members: Plus or minus length/360.

2.09 SOURCE QUALITY CONTROL

A. Provide testing and analysis of concrete mix. Testing and analysis may be performed by qualified plant personnel or by third party testing agency.

B. Take concrete test cylinders as required to test for compressive strength, water-cement ratio, and other performance requirements indicated.

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C. Take air entrainment test cylinder for each set of exterior concrete test cylinders taken.

D. Take water absorption test in accordance with **<<PCI MNL-117>>**.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building structure, anchors, devices, and openings are ready to receive work of this section.

3.02 PREPARATION

A. Provide for erection procedures and induced loads during erection. Maintain temporary bracing in place until final support is provided.

3.03 ERECTION

A. Erect units without damage to shape or finish. Replace or repair damaged panels.

B. Erect units level and plumb within allowable tolerances.

C. Align and maintain uniform horizontal and vertical joints as erection progresses.

D. Mechanical Fastening: Secure **<< overhead units (such as lintels); copings; large precast panels; and other precast elements, as determined by fabricator's engineer>>**, with mechanical connections or by welding of cast in anchors/studs to supporting structure, in accordance with fabricator's approved erection drawings.

E. Precast Laid in Mortar: Provide full bed joint at sills, water tables, and similar precast elements. Rake bed joint back for pointing mortar, and point joint slightly concave. Coordinate with flashings, weeps, and other cavity wall materials.

F. Joints Between Precast Pieces or Between Precast and Other Materials:

1. Provide sealant head joints where precast is exposed horizontally or protrudes from wall surface (for example, at all copings, sills, water tables, and similar shapes).
2. Provide sealant joints at expansion and control joints, above shelf angles or other pressure-relieving joints, and at other building joints.
3. Where precast is completely flush to adjacent wall surface (precast accent course without protruding from wall surface), all head and bed joints may be pointed with mortar.
4. Prime precast before installation of sealant, as required by manufacturer for proper adhesion.
5. Provide compressible filler/backer rod and sealant per Division 7 Section "Joint Sealants."
6. Tool all precast joints (mortar and sealant) slightly concave.

G. Exposed Joint Dimension: 1/2 inch. Adjust units so that joint dimensions are within tolerances.

3.04 TOLERANCES

A. Erect members level and plumb within allowable tolerances. Comply with **<<PCI MNL-135>>**.

3.05 REPAIR AND CLEANING

A. Repair precast that is damaged during construction to create a uniform match to adjacent precast. If repair is unable to match to the satisfaction of the Owner, remove and replace the damaged piece of precast.

B. Clean precast of soil, mortar, and other stains or markings.

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3.06 PROTECTION

A. Protect installed precast concrete from subsequent construction operations.

END OF SECTION 034500

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SECTION 035400
CAST UNDERLAYMENT

PART 1 GENERAL

PART 2 PRODUCTS

1.01 MANUFACTURERS

A. Cementitious Underlayment:
   1. ARDEX Engineered Cements; ARDEX K 15 with ARDEX P51 Primer.
   2. Custom Building Products; CL-150 Self-Leveling Underlayment with CP-A Acrylic Primer.
   3. Dayton Superior Corporation; EconoLevel with J42 Primer.
   4. Dependable Chemical Co., Inc; SKIMFLOW ES with PRIMER A.
   5. Lambert Corporation; Lambco L-16 Self-Level with Primer L16.
   6. LATICRETE International, Inc; LATICRETE SUPERCAP SC500 with LATICRETE SUPERCAP Primer Plus.
   7. MAPEI Corporation; Ultraplan 1 Plus with Primer T.
   8. Maxxon Corporation; Level-One EZ with Multi-Use Acrylic Primer.

1.02 MATERIALS

A. Cast Underlayments, General:
   1. Comply with applicable code for combustibility or flame spread requirements.
   2. Provide certificate of compliance from authority having jurisdiction indicating approval of underlayment materials in the required fire rated assembly.

B. Cementitious Underlayment: Blended cement mix, producing self-leveling underlayment with the following properties when mixed with water in accordance with manufacturer's directions:
   1. Compressive Strength: Minimum **<< 4000 pounds per square inch; 5000 pounds per square inch; 8000 pounds per square inch; or _____ pounds per square inch>>** after 28 days, tested per **<<ASTM C109/C109M>>**.
   2. Flexural Strength: Minimum **<< 1,000 psi; 1,250 psi; or _____ psi>>** after 28 days, tested in accordance with **<<ASTM C348>>**.
   3. Density: 125 pounds per cubic foot, nominal.
   4. Final Set Time: 1-1/2 to 2 hours, maximum.
   5. Thickness: Capable of thicknesses from feather edge to maximum **<< 3-1/2 inches; or _____ inches>>**.
   6. Surface Burning Characteristics: Flame spread index of 0 and smoke developed index of 0 when tested in accordance with **<<ASTM E84>>**.

C. Aggregate: Dry, well-graded, washed silica aggregate, approximately **<< 1/8 inch; 1/4 inch; or _____ inch>>** in size and acceptable to underlayment manufacturer.

D. Water: **<<ASTM C1602/C1602M>>**; clean, potable, and not detrimental to underlayment mix materials.

E. Joint and Crack Filler: Latex-based filler, as recommended by manufacturer.

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PART 3 EXECUTION

2.01 EXAMINATION

A. Verify substrate surfaces are clean, dry, unfrozen, and do not contain petroleum byproducts or other compounds detrimental to underlayment material bond to substrate.

2.02 PREPARATION

A. Concrete: Mechanically prepare steel troweled concrete to create surface to achieve bond; permitted methods include bead blasting and scarifying. Do not use acid etching.

B. Remove substrate surface irregularities. Fill voids and deck joints with filler. Finish smooth.

C. Vacuum clean surfaces.

D. Prime substrate in accordance with manufacturer's instructions. Allow to dry.

2.03 APPLICATION

A. Apply underlayment in accordance with manufacturer's instructions.

B. Pump or pour material onto substrate. Do not retemper or add water.

1. Pump, move, and screed while material is still highly flowable.
2. Be careful not to create cold joints.
3. Wear spiked shoes while working in wet material to avoid leaving marks.

C. For final thickness over **<< 1-1/2 inches>>**, place underlayment in layers. Allow initial layer to harden to point where material loses evaporative moisture. Immediately prime and begin application of subsequent layer within 24 hours.

D. Where additional aggregate is used, add top layer of mix without aggregate, if needed, to level and smooth surface.

E. If a fine, feathered edge is required for transition, steel trowel the edge after initial set, but before it is completely hard.

2.04 CURING

A. Once underlayment starts to set, prohibit foot traffic until final set is reached.

B. Air cure in accordance with manufacturer's instructions.

2.05 PROTECTION

A. Protect against direct sunlight, heat, and wind; prevent rapid drying to avoid shrinkage and cracking.

B. Do not permit traffic over unprotected floor underlayment surfaces.

END OF SECTION 035400

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SECTION 042000
UNIT MASONRY

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ACI SP-66 - ACI Detailing Manual.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

C. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

D. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

E. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.

F. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement.

G. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

H. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

I. ASTM C33/C33M - Standard Specification for Concrete Aggregates.

J. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale).

K. ASTM C67/C67M - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.

L. ASTM C73 - Standard Specification for Calcium Silicate Brick (Sand-Lime Brick).

M. ASTM C90 - Standard Specification for Dry-Cast Loadbearing Concrete Masonry Units.

N. ASTM C91/C91M - Standard Specification for Masonry Cement.

O. ASTM C97 - Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone.

P. ASTM C99 - Standard Test Method for Modulus of Rupture of Dimension Stone.

Q. ASTM C126 - Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units.

R. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.

S. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.

T. ASTM C151 - Standard Test Method for Autoclave Expansion of Hydraulic Cement.

U. ASTM C170 - Standard Test Method for Compressive Strength of Dimension Stone.

V. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).

W. ASTM C270 - Standard Specification for Mortar for Unit Masonry.

X. ASTM C331/C331M - Standard Specification for Lightweight Aggregates for Concrete Masonry Units.

Y. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.

Z. ASTM C476 - Standard Specification for Grout for Masonry.

AA. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.

BB. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

CC. ASTM C641 - Standard Test Method for Iron Staining Materials in Lightweight Concrete Aggregates.

DD. ASTM C780 - Standard Test Methods for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.

EE. ASTM C887 - Standard Specification for Packaged, Dry, Combined Materials for Surface Bonding Mortar.

FF. ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry.

GG. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength.

HH. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.

II. ASTM C1405 - Standard Specification for Glazed Brick (Single Fired, Brick Units).

JJ. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

KK. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry.

LL. BIA Technical Notes No. 28B - Brick Veneer/Cold-Formed Steel Framed Walls.

MM. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing.

NN. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls.

OO. BIA Technical Notes No. 46 - Maintenance of Brick Masonry.

PP. NCMA TEK 08-02A - Removal of Stains from Concrete Masonry.

QQ. NCMA TEK 10-04 - Crack Control for Concrete Brick and Other Concrete Masonry Veneers.

RR. NCMA TEK 12-01B - Anchors and Ties for Masonry.

SS. NCMA TEK 12-02B - Joint Reinforcement for Concrete Masonry.

TT. PCI MNL-116 - Manual for Quality Control for Plants and Production of Structural Precast Concrete Products.

UU. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting at the Project site at least two weeks before starting work of this section; require attendance by all relevant installers.

1.03 SUBMITTALS

A. Product Data: Provide data for **<< masonry units; fabricated wire reinforcement; mortar; masonry accessories; and _____>>**.

1. Installation Instructions for Cold- and Hot-Weather: Provide a detailed description of the procedures that will be used to comply with **<<TMS 402/602>>** for cold- and hot-weather, including materials and equipment that will be used.

B. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories, for each type of masonry.

1. Provide elevations indicating steel reinforcing bar locations; provide details of reinforcing including bends and cross-sections, in accordance with **<<ACI SP-66>>**.
2. Indicate control and expansion joint locations.
3. Provide flashing details indicating corners, end dams, and other special conditions.
4. Calcium Silicate Masonry Units: For a substitute product meeting **<<ASTM C90>>** to be considered, submit shop drawings of all elevations indicating locations of control, expansion, and other movement joints. ******Keep if using Arriscraft as basis-of-design******

C. Temporary Bracing Plan:
   1. Provide a temporary bracing plan for the information only

D. Sustainability Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

E. Samples: All veneer types and mortar selections will be verified in mock-up panel.
   1. Provide color charts or other printed selection samples for decorative masonry (for example, split face, ground face, glazed brick, as applicable) prior to furnishing for mockup.
   2. Provide color charts or other printed selection samples for exposed accessories and trim requiring color selection.

F. Temporary Bracing Plan:
   1. Provide a temporary bracing plan for the information only of the Architect; plan shall be submitted a minimum of two weeks prior to initiating masonry Work.
   2. The bracing plan shall be based on the Mason Contractors Association of America's "Standard Practice for Bracing Masonry Walls Under Construction" and "Masonry Wall Bracing Design Handbook," or other industry reconginzed standard.
   3. Bracing plan shall be reviewed by a Professional Structural Engineer licensed in the State of Maryland; Professional Structural Engineer shall provide a letter certifying their review of the plan and acknowledgement of its completeness.
   4. The bracing plan and Professional Structural Engineer's letter shall indicate project conditions unique to any referenced standard and provide for the unique bracing required for those conditions.
   5. Maintain one copy of any industry standard referenced within the plan at the Project site.

G. Material Certificates and Test Reports: Provide manufacturer's certificates and test reports for the following:
   1. Masonry Units:
      a. Brick: Size data including fabrication tolerances.
      b. Brick: Efflorescence test, per **<<ASTM C67/C67M>>**.
      c. Masonry Units: Compressive strength test data.
      d. Concrete Masonry: Data indicating aggregates comply with **<<ASTM C33/C33M>>** (normal weight), **<<ASTM C331/C331M>>** (lightweight), and **<<ASTM C618>>** (fly ash).
   2. Mortar and Grout Mixes: Provide description and proportion of materials for each type of mortar and grout.
   3. Provide material certificates for each type of metal accessory, including reinforcing bars, joint reinforcement, veneer ties and anchors, and other indicated accessories, indicating compliance with requirements.

H. Cold- and Hot-Weather Procedures: Provide a detailed description of the procedures that will be used to comply with **<<TMS 402/602>>** for cold- and hot-weather, including materials and equipment that will be used.

I. Masonry Contractor's Qualification Statement.

1.04 QUALITY ASSURANCE

A. Masonry Contractor's Qualifications:
   1. Masonry contractor shall have at least 10 years' experience in masonry construction of type and scope

B. Comply with provisions of **<<TMS 402/602>>**, except where exceeded by requirements of Contract Documents.

C. Fire Rated Assemblies: Provide products that comply with fire-resistance ratings indicated as determined by testing according to **<<ASTM E119>>**, by equivalent testing thickness, or by means acceptable to authorities having jurisdiction.

D. Source Limitations for Masonry: Provide each type of masonry unit from a single manufacturer's plant, sourced through a single supplier. Each type of masonry unit shall maintain consistency of color and texture for all product required on the entire project. The approved mockup/sample panel shall be used to determine acceptable color and texture range.
   1. Source Limitations for Decorative Concrete Masonry: Provide decorative concrete veneers from a manufacturer with a quality control agreement with water repellant manufacturer, certifying that units have been manufactured with integral water repellant to conform to performance requirements indicated. Provide current certificate from water repellant manufacturer confirming conformance.

E. Source Limitations for Mortar: Provide each mortar mix from a single manufacturer, sourced through a single supplier. Each required mortar mix shall maintain consistency of each component, including cementitious materials and aggregate, to provide consistent color and texture for all product required on the entire project. The approved mockup/sample panel shall be used to determine acceptable color and texture range.

F. Aggregate for Concrete Masonry Units: If bottom ash is used as aggregate in the CMU, the Source for the bottom ash shall be a power station that has a minimum of ten (10) years continuous experience as a supplier of quality material as verified by independent certified laboratory testing and no defects in the marketplace.

G. Pre-Construction Testing: Owner shall engage an independent testing agency to perform field quality control tests, in accordance with Section **<< 014000 - Quality Requirements>>**.
   1. Clay Masonry Unit Tests: Testing agency shall test each variety of clay masonry in accordance with **<<ASTM C67/C67M>>** compressive strength requirements.
   2. Concrete Masonry Unit Tests: Testing agency shall test each variety of concrete unit masonry in accordance with **<<ASTM C140/C140M>>** compressive strength requirements.

1.05 MOCK-UPS ******VERIFY USE OF A SAMPLE PANEL VERSUS A FULL INTEGRATED MOCKUP BASED ON PROJECT SIZE AND MCPS REQUIREMENTS******

A. Sample Panel: Build a sample panel approximately 60 inches long by 48 inches high. Include each type of masonry veneer and mortar. Include a sealant filled control joint. **<< Construct sample panel next to existing wall to verify masonry veneer and mortar provide an acceptable match to existing.; or None - N/A>>** ******Sample panel for smaller jobs. Adjust size or language here as needed, depending on number of veneer materials and other components to include******

B. Integrated Exterior Mockups: Attend preinstallation conference and provide masonry work for integrated exterior mockup as indicated on Drawings and as specified in Division 1 Section "Quality Requirements."

1.06 FIELD CONDITIONS

A. Wall Cavity Protection: Provide temporary waterproof sheet coverings over masonry walls at top of walls, sills, parapets, and other horizontal projections. Install coverings at end of each workday, when rain or precipitation is expected, and after masonry work is completed.
   1. Extend coverings down vertically at least 24 inches on each side of masonry wall. At multi-wythe walls where one wythe is more than 24 inches taller than other wythe(s), extend covering as required to fully cover all wythes and cavities.
      a. At roof parapets, extend covering on rear side of parapet full height down to roof deck/membrane, until vertical protection/roof membrane is installed.
   2. Secure all coverings in place with tape or adhesive that does not leave residue, or other securement method that does not penetrate or damage permanent construction.
   3. Provide protective coverings at sills and horizontal projections that can also serve as protection from mortar droppings.
   4. Provide protective coverings over tops of foundation walls containing insulation to protect from exposure to sun and from construction traffic damage.
   5. Do not remove or allow removal of temporary covers until permanent top of wall protection elements (coping, sill, roof surface, waterproof membrane, etc) are underway.

B. Cold- and Hot-Weather Requirements: Comply with requirements of **<<TMS 402/602>>** or applicable building code, whichever is more stringent.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means of that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:
   1. Size: Standard units with nominal face dimensions of **<< 16 by 8 inches>>** and nominal depths as indicated on drawings for specific locations.
   2. Special Shapes: Provide nonstandard blocks configured for corners, lintels, headers, conditions indicated below, and as detailed on Drawings.
      a. Provide bullnose units for outside corners.
      b. Provide solid block with bullnosed top edges at free-standing CMU walls and where top of block is exposed at window sills and similar applications.
   3. Concrete Masonry Units: **<<ASTM C90>>**, lightweight.
      a. Exposed Faces: Manufacturer's standard color and texture.
      b. Aggregates:
         1) Lightweight Aggregates: Lightweight aggregate shall strictly comply with **<<ASTM C331/C331M>>**, **<<ASTM C151>>**, and **<<ASTM C641>>**. Drying shrinkage of aggregate shall not exceed 0.10% at 100 days.
         2) Fly ash, waste concrete, bottom ash, scoria, and aglite shall not be permitted. ******MCPS Standard to not allow fly ash.******
   4. Decorative Concrete Block: **<<ASTM C90>>**, normal weight.
      a. Pattern: Manufacturer's standard **<< ground-face; or split-face>>** pattern.

b. Pattern: Scored **<< ground-face; or split-face>>** with **<< (1); (2); or (3)>>** 3/8-inch vertical rib(s). ******Most common specialty pattern of decorative CMU, other options are available from manufacturer******

c. Wall-Mounted Devices: Where a heavily textured product such as **<< split-face>>** is indicated, provide a smooth textured block (ground-face, cast stone, or similar) in a matching color at all locations where wall-mounted devices are indicated (such as electrical outlets, cameras, light fixtures, etc). Coordinate with M/E/P, communications, electronic security, and door hardware subcontractors as applicable to determine all final mounting locations and heights. ******MCPS request to include - verify need for this on a case-by-case basis if using textured veneer types******

d. Size: Match standard nominal dimensions per "Concrete Block" paragraph above.

e. Color: To be selected by Architect from manufacturer's full range.

f. Provide integral water repellent and companion mortar additive at all exterior decorative CMU.

g. Topcoat: Where recommended by manufacturer of ground-face units, provide clear acrylic top-coat, minimum 20 percent solids content.

h. Integral Water Repellent: Provide all decorative concrete block units as specified in this section with a polymeric liquid or powder admixture added to concrete masonry units at time of manufacture.

1) Performance of Units with Integral Water Repellent:

(a) Water Permeance: When tested per **<<ASTM E514/E514M>>** and for a minimum of 72 hours.

(1) No water visible on back of wall above flashing at the end of 24 hours.

(2) No flow of water from flashing equal to or greater than **<< 0.032 gallons per hour>>** at the end of 24 hours.

(3) No more than 25 percent of wall area above flashing visibly damp at end of test.

(b) Flexural Bond Strength: **<<ASTM C1072>>**; minimum 10 percent increase.

(c) Compressive Strength: **<<ASTM C1314>>**; maximum 5 percent decrease.

2) Use only in combination with mortar that also has integral water repellent admixture.

(a) Use water repellent admixtures for masonry units and mortar by a single manufacturer.

3) Available Products: Provide one of the following or comparable product approved by block manufacturer.

(a) ACM Chemistries; RainBloc.

(b) BASF Aktiengesellschaft; Rheopel Plus.

(c) Grace Construction Products (W.R. Grace & Co.); Dry-Block.

B. Concrete Brick:

1. Actual Size: 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
2. Concrete Building Brick: **<<ASTM C55>>**; lightweight, solid, for interior or concealed use.

2.02 BRICK UNITS

A. Unit Cost Allowance: Face brick shall be furnished via unit cost allowance. Unit cost shall cover purchase of brick and transport to the project site.

1. Face Brick Unit Cost: **<< Five Hundred Dollars ($500); or _____>>** per thousand.
2. The unit cost shall not cover installation, overhead or profit.

3. Bidders and material suppliers are responsible for determining cost to produce special shape units, such as "lipped" brick units.
4. The Contract Sum will be adjusted to reflect the actual cost of selected brick in accordance with the General Conditions. The Contractor shall submit receipts and initiate Change Order process.
5. The Contractor is reminded that unit cost includes all required taxes, less applicable trade discounts, in accordance with the General Conditions.

B. Facing Brick: **<<ASTM C216>>**, Type FBS or FBX, Grade SW.
1. Color and Texture: Match existing, to the approval of Owner and Architect. ******Option for existing buildings that allows Contractor to submit closest matches for review******
2. Color and Texture: Provide Basis-of-Design selection(s) below or comparable product submitted as a substitution and approved by Owner and Architect: ******Option for projects where Architect has already selected acceptable product(s)******
   a. Face Brick 1: **<< _____>>**.
   b. Face Brick 2: **<< _____>>**.
3. Actual Size: 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long (modular).
4. Actual Size: 3-5/8 inches wide by 3-5/8 inches high by 11-5/8 inches long (utility).
5. Actual Size: 3-5/8 inches wide by 2-1/4 inches high by 11-5/8 inches long (norman).
6. Actual Size: 3-5/8 inches wide by 1-5/8 inches high by 11-5/8 inches long (roman).
7. Acutal Size: 3-5/8 inches wide by 2-3/4 inches high by 7-5/8 inches long (engineer/jumbo).
8. Actual Size: 3-5/8 inches wide by 2-3/4 inches high by 11-5/8 inches long (jumbo norman).
9. Special Shapes: Molded units (plant-fabricated) as required by conditions indicated, unless standard units can be sawn to produce equivalent effect. Cut or sawn edges shall not be exposed in the finished work.
10. Efflorescence: Provide brick that has been tested per **<<ASTM C67/C67M>>** and received a rating of "not effloresced."

C. Building (Common) Brick: **<<ASTM C62>>**, Grade SW, except MW may be used in locations acceptable per reference standard; solid units.
1. Actual Size: Match face brick.
2. Locations: May be used in concealed locations in lieu of face brick.

D. Glazed Brick (Single Fired, Brick Units): **<<ASTM C1405>>**, Grade S (Standard), Class Exterior, Division Solid or H40V. ******Glazed brick should only be used in existing conditions with specific approval of MCPS******
1. Provide Type I (single-faced) where only one finished face will be exposed in the completed work, and Type II (double-faced) where both faces will be exposed in the completed work.
2. Color and Texture: **<< _____>>**. ******Fill in Basis-of-Design specific colors or use option below to select from manufacturer's full range******
3. Color and Texture: As selected by Architect from manufacturer's full range.
4. Nominal Size: **<< Modular; and Utility>>**. ******Limited sizes available for glazed brick******
5. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn without chipping glaze to produce equivalent effect.
6. Manufacturers:
   a. Belden Brick.
   b. Elgin Butler.

c. Glen-Gery.

2.03 CALCIUM-SILICATE (SAND-LIME) MASONRY UNITS ******INDUSTRY TERM FOR ARRISCRAFT. INCLUDE CAST STONE ALTERNATE HERE FOR COMPETITIVE BIDDING******

A. Sand-Lime Brick: **<<ASTM C73>>**, Grade **<< SW; MW; SW, except where MW permitted by reference standard; or ____>>**; solid units that have been pressure formed and autoclaved; 3-5/8-inch bed depth..

1. Actual Size: **<< 3-5/8; 7-5/8; and 11-5/8>>** inches high; **<< 3-5/8; 4-5/8; and _____>>** inch depth; 23-5/8 inches long.
   a. Where multiple sizes are indicated, refer to Drawings for layout and location of each size of unit.
   b. Provide special shapes as indicated.
2. Texture: **<< Smooth; and Rocked>>** finish on exposed faces and ends.
3. Corners: Provide **<< quirk mitered corner; 3/8-inch quirk dimension unless otherwise indicated; end return at corners; end finish shall match face texture indicated; and _____>>**.
4. Provide matching dolomitic limestone courses where calcium silicate is indicated at or below grade.
5. Fabrication Tolerances:
   a. Unit Length and Height: Plus or minus 1/16 inch.
   b. Deviation from Square: Plus or minus 1/16 inch, with measurement taken using hte longest edge as the base.
   c. Bed Depth: Plus or minus 1/8 inch.
   d. Custom Unit Dimensions: Plus or minus 1/8 inch.
6. Physical Characteristics:
   a. Average Compressive Strength, Brick Method: 8500 psi; per **<<ASTM C67/C67M>>**
   b. Average Compressive Strength, Dimension Stone Method: 6600 psi; per **<<ASTM C170>>**.
   c. Average Modulus of Rupture: 770 psi; per **<<ASTM C99>>**.
   d. Average Absorption Rate: 8.8 percent; per **<<ASTM C97>>**.
   e. Average Density: 129 lbs/ft^3; per **<<ASTM C97>>**.
7. Products:
   a. Basis-of-Design Product: Arriscraft; Renaissance Stone.
      1) Color A: **<< _____>>**.
      2) Color B: **<< _____>>**.
   b. Subsitutions: Substitutions will be accepted if proper consideration is made by the bidder and contractor to accommodate for the different physical properties of the substitutes in comparison to the base bid material of Calcium Silicate Masonry Units. Any Unit considered for substitution must have tolerances that match Calcium Silicate Masonry Unit Tolerances to be accepted. Products below meet the **<<ASTM C90>>** Concrete Block standard and shall be installed per NCMA TEK Bulletins and Notes, including horizontal joint reinforcement, control joints, and other installation criteria for movement and crack control. Available **<<ASTM C90>>** products:
      1) General Shale Company; Regency Stone.
      2) Indiana Cast Stone; Cast Stone Masonry Units.
      3) Reading Rock, Inc; RockCast.

2.04 MORTAR AND GROUT MATERIALS

A. Masonry Cement: **<<ASTM C91/C91M>>**.
   1. Colored Mortar: Premixed cement as required to match **<<Architect>>**'s color sample.
   2. Available Products:
      a. Argos USA; Magnolia Masonry Cement.
      b. Holcim (US) Inc.; Rainbow Mortamix Custom Color Masonry Cement.
      c. Lehigh Hanson; flamingo Colored Cement.
      d. Roanoke Cement; a division of Titan America; Colored Masonry Cement.
      e. York Building Products, a Stewart Company; Workrite Colored Masonry Cement.

B. Surface Bonding Mortar (Parge Coat): **<<ASTM C887>>**.

C. Mortar Aggregate: **<<ASTM C144>>**.

D. Grout Aggregate: **<<ASTM C404>>**.

E. Water: Clean and potable.

F. Accelerating Admixture: **<<ASTM C494/C494M>>**, Type C; nonchloride, noncorrosive type for use in cold weather; approved by manufacturer for use in masonry mortar.

G. Integral Water Repellent Admixture for Mortar: Polymeric liquid or powder admixture added to mortar at the time of manufacture.
   1. Use only in combination with masonry units manufactured with integral water repellent admixture.
   2. Use only water repellent admixture for mortar from the same manufacturer as water repellent admixture in masonry units.
   3. Meet or exceed performance specified for water repellent admixture used in masonry units.

2.05 DAMPPROOFING

A. General: Refer to and coordinate with Division 7 Section "Bituminous Dampproofing."

2.06 REINFORCEMENT AND ANCHORAGE

A. Reinforcing Steel: **<<ASTM A615/A615M>>**, Grade 60 (60,000 psi), deformed billet bars; uncoated.
   1. Recycled Content: Provide steel with minimum 90 percent total recycled content, including at least 60 percent post-consumer recycled content.
   2. Regional Materials: Provide steel manufactured and of primary raw materials extracted or recovered within 100 mile radius of project site.
   3. At overlapping ends of rebar, provide full contact lap splices at all locations.

B. Joint Reinforcement, Anchorage, and Ties, General: Comply with **<<NCMA TEK 12-02B>>**, **<<NCMA TEK 12-01B>>**, and requirements below.
   1. Use ladder type joint reinforcement, unless otherwise indicated. Truss type reinforcement may be used only when approved by Architect, at walls indicated not to have vertical reinforcing steel and not to be grouted.
   2. Provide prefabricated corner and tee reinforcement, matching design type, wire thickness, and finish of adjacent joint reinforcement. Wire mesh/hardware cloth is not acceptable.
   3. Provide joint reinforcement in minimum 10 foot lengths.

4. At multi-wythe/cavity wall applications, size all anchors, ties, and reinforcement for depths of cavities indicated, including indicated insulation thickness as applicable. Ties shall maintain full adjustability at veneer wythe without affecting insulation.
5. At cavities with space between wythes wider than 4-1/2 inches (air space + insulation depth), provide high strength ties engineered for cavity depths indicated.

C. Single Wythe Joint Reinforcement: **<<ASTM A951/A951M>>**; ladder-type.
1. Material: Mill-galvanized steel for interior walls; hot-dip galvanized steel for exterior walls.
2. Size: **<< 0.1483 inch; 0.1875 inch; or ___ inch>>** side rods with **<< 0.1483 inch; 0.1875 inch; or ___ inch>>** cross rods; width as required to provide not less than **<< 5/8 inch>>** of mortar coverage on each exposure.

D. Multiple Wythe Joint Reinforcement: **<<ASTM A951/A951M>>**; ladder-type. Provide at composite walls and subgrade walls where all wythes are of the same material.
1. Material: **<< ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3; ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M Class B; stainless steel complying with ASTM A580/A580M Type 304; or Mill-galvanized steel for interior walls, hot-dip galvanized steel for exterior walls>>**.
2. Size: **<< 0.1483 inch; 0.1875 inch; or ___ inch>>** side rods with **<< 0.1483 inch; 0.1875 inch; or ___ inch>>** cross rods; width as required to provide not less than 5/8-inch of mortar coverage on each exposure.
   a. Provide two side rods for each wythe that is nominal 6-inch depth or greater, and one side rod for each wythe that is nominal 4-inch depth.

E. Adjustable Multiple Wythe Joint Reinforcement: **<<ASTM A951/A951M>>**. Provide at cavity walls/masonry veneer walls.
1. Type: Ladder, with adjustable ties or tabs spaced at **<< 16 in>>**on center.
2. Material: Hot-dip galvanized steel.
3. Size: **<< 0.1483 inch; 0.1875 inch; or ___ inch>>** side rods with **<< 0.1483 inch; 0.1875 inch; or ___ inch>>** cross rods and adjustable components of **<< 0.1875 inch; or ___ inch>>** wire, width of components as required to extend at least halfway through veneer wythe, but provide not less than 5/8-inch of mortar coverage from each masonry face.
4. Vertical adjustment: Not more than 1-1/4 inches.

F. Rigid Anchors: Bent steel shapes, 1-1/2 inch width, 0.105-inch thick, 24 inch length, with 2 inch **<< 1-1/2 inch; 2 inch; or ___ inch>>** long, 90 degree bend at each end to form a U or Z shape or with cross pins, **<< hot dip galvanized to ASTM A153/A153M Class B; mill galvanized; stainless steel; epoxy coated; or _____>>**.

G. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than **<< 5/8 inch>>** of mortar coverage from masonry face.
1. For Anchorage to Structural Steel Framing: Crimped wire anchors for welding to frame, **<< 0.25 inch; or ___ inch>>** thick, with triangular/trapezoidal wire ties **<< 0.1875 inch; 0.25 inch; or ___ inch>>** thick, **<< hot dip galvanized to ASTM A 153/A 153M, Class B; or _____>>**.

H. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, **<< hot dip galvanized to ASTM A 153/A 153M, Class B; mill galvanized; stainless steel; or _____>>**. Provide at masonry veneer walls with metal framing backup. At cavity walls with CMU backup and masonry veneer, masonry veneer

anchors may be used in conjunction with standard horizontal joint reinforcing, at Contractor's option, in lieu of adjustable multiple wythe joint reinforcement.

1. Anchor Plates: Not less than **<< 0.075 inch; 0.105 inch; or ___ inch>>** thick, designed for fastening to structural backup through sheathing by two fasteners.
2. Wire Ties: **<< Triangular; Trapezoidal; Rectangular; Manufacturer's standard; or _____>>** shape, **<< 0.1875 inch; 0.25 inch; or ___ inch>>** thick.
   a. Size wire ties to extend at least halfway through veneer wythe, but provide not less than 5/8 inch of mortar coverage from masonry face.
3. Vertical Adjustment: Not less than **<< 2 inches; 3-1/2 inches; 5-1/2 inches; or _____ inches>>**.
4. Products:
   a. Construction Tie Products; CTP-16.
   b. Heckmann Building Products; 213 + 263.
   c. Hohmann & Barnard; HB-213-2x.
   d. Wire Bond; RJ-711.
   e. 3GEN Masonry Products; H-13-H or H-13-V.

I. Metal-to-Metal Fasteners (for Steel Studs): Self-drilling, self-tapping #10 hex screws; fabricated of either 304 stainless steel or of steel with corrosion resistant polymer coating tested to **<<ASTM B117>>**. Fasteners shall include integral neoprene or EPDM washer.
   1. Products:
      a. ELCO Construction Products; Dril-Flex with Stalgard Finish.
      b. Heckmann Building Products; #668 TEK Self-Drilling Steel Stud Screw.
      c. ITW Commercial Construction North America; Teks Maxiseal with Climaseal Finish, or Scots Long Life Teks (stainless steel).

2.07 FLASHINGS

A. Combination Non-Asphaltic Flashing Materials - Stainless Steel:
   1. Stainless Steel/Polymer Fabric Flashing: **<<ASTM A240/A240M>>**; minimum 2 mil type 304 stainless steel sheet bonded on one side to one sheet of polymer fabric.
      a. Manufacturers:
         1) York Flashings; Multi-Flash SS (basis-of-design).
         2) Hohmann & Barnard, Inc; Mighty-Flash Stainless Flashing.
         3) Prosoco; R-Guard SS ThruWall.
         4) STS Coatings; Wall Guardian Stainless Steel TWF.
         5) WIRE-BOND; 4160 Bond-N-Flash.
   2. Stainless Steel/Polymer Fabric Drainage Plane Flashing: **<<ASTM A240/A240M>>**; **<< 2 mil; 3 mil; or _____ mil>>** type **<< 304; 316; or ____>>** stainless steel sheet bonded **<< between one sheet of polymer fabric and one sheet of non-woven drainage material; or _____>>**.
      a. Manufacturers:
         1) York Flashings; Flash-Vent SS (basis-of-design).
         2) 3GEN Masonry Products; Genflash SS.
         3) STS Coatings, Inc; Wall Guardian Venting Stainless Steel TWF.

B. Flashing Corners and End Dams: Provide minimum 26 gauge stainless steel; factory-fabricated corner and end dam components or field formed by folding in line with the flashing material.

C. Termination Bars: One-inch wide, fabricated of 0.090-inch extruded aluminum or 0.075-inch stainless steel; compatible with membrane and adhesives.

D. Drip Edge: **<< Stainless steel; Copper; or _____>>**; angled drip with hemmed edge; compatible with membrane and adhesives. Provide a 1/2-inch hemmed edge extension. ******1/2-inch hemmed edge extension per MCPS request. Stainless steel should be standard, copper may still be preferred at some aesthetic conditions (for example, with certain colors of decorative cmu)******

E. Flashing Sealant/Adhesive/Liquid Seam Tape: Polyether-based, 100% solids, moisture-curing elastomeric products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates; and that are compatible with asphalt-free flashing materials and air barrier materials. Traditional mastic is not acceptable.
   1. Available Products:
      a. Master Builders Solutions; MasterSeal NP150.
      b. STS Coatings; GreatSeal LT-100 Liquid Tape.
      c. York Flashings; UniverSeal US-100 Liquid Tape.

2.08 ACCESSORIES

A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
   1. Provide nominal 2.5-inch "standard" and "tee" configurations to suit application unless indicated otherwise.

B. Joint Filler: Closed cell polypropylene or non-chlorinated polyethylene foam; oversized 50 percent to joint width; self expanding; in maximum lengths available.

C. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
   1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations. Provide in depth matching cavity depth without gap at front or back of mesh. Fabricate approximately 10 inches high with minimum 6 inch high dovetail shape projections.
      a. Available Products:
         1) 3GEN Masonry Products; Mortar Clear.
         2) Advanced Building Products, Inc; Mortar Break DT.
         3) Heckmann Building Products; WallDefender.
         4) Hohmann & Barnard, Inc.; Mortar Trap.
         5) Mortar Net Solutions; MortarNet.
         6) Wire-Bond; Cavity Net DT (3611D).
         7) York Flashings; Weep-Net.
      b. At cavities with air space greater than 2 inches, provide companion drainage product by one of the manufacturers above; nominal 1/2-inch thickness by 20 inches wide, to be field inserted into cavity in a "U" configuration. **<< Basis-of-Design is "Mortar Catch 352" by Advanced Building Products, Inc.; or None - N/A>>**

D. Bond Break: **<<ASTM D226/D226M>>**, Type I ("No.15") asphalt felt or polyethylene tape.

E. Weeps/Cavity Vents:
   1. Cellular Type: **<< Preformed aluminum vents with sloping louvers; Molded PVC grilles, insect resistant; Extruded propylene with honeycomb design; Polyester mesh; or _____>>**.

a. Color(s): To be selected by Architect from manufacturer's standard range.
b. Available Products:
1) 3Gen Masonry Products; Cell Vent.
2) Advanced Building Products, Inc.; Mortar Break weep mesh.
3) Blok-Lok Limited; Cell-Vent.
4) CavClear/Archovations, Inc.; CavClear Weep Vent.
5) Heckmann Building Products Inc.; No. 85 Cell Vent.
6) Hohmann & Barnard, Inc.; Quadro-Vent.
7) Mortar Net Solutions; WeepVent.
8) Wire-Bond; Cell Vent.

2. Bed Joint Weep System: Corrugated plastic drainage system incorporating continuous drainage strip within cavity portion of wall with integral weephole extensions at 9-1/2 inches on center located above flashing in the bed joint of the veneer masonry. Provide at masonry units over 32 inches long, and as indicated.
a. Available Products:
1) Heckmann Building Products; Core/Cavity Vent Weep System #367.
2) Masonry Technology Incorporated (MTI); Cavity Weep CV 5010.

F. Reinforcing Positioners: Provide wire positioners in bed joints to keep steel reinforcing bars centered in cells, fabricated of 0.1483-inch hot-dip galvanized steel wire.
1. Available Products:
a. Heckmann Building Products, Inc.; No. 376 Rebar Positioner.
b. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
c. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

G. Cleaning Solution: Manufacturer's proprietary standard-strength acidic cleaner intended specifically for removal of efflorescence, mortar or grout stains, and other discoloration and staining of masonry due to construction soiling and residue. Cleaner shall not be harmful to masonry work or adjacent materials; verify cleaner is acceptable for masonry colors and textures indicated.
1. Manufacturers:
a. Diedrich Technologies, Inc.
b. EaCo Chem, Inc.
c. Prosoco, Inc.

2.09 LINTELS

A. Lintels, General: Coordinate with Structural Drawings for lintel information at each opening.

B. Masonry Lintels: Fabricated of bond beam CMUs, with texture matching adjacent standard CMU. Provide reinforcing bars and grout in accordance with structural requirements. Provide temporary supports until cured.

C. Precast Concrete Lintels: Comply with structural requirements for concrete strength and reinforcing. Precast U-lintels fabricated in accordance with performance standards of **<<PCI MNL-116>>** with 3500 psi concrete for standard lintels and 6000 psi concrete for prestressed lintels as manufactured by Cast-Crete are acceptable in lieu of rectangular section lintels.

D. Steel Lintels: Refer to Section **<< 055000 - Metal Fabrications; or _____>>**.

2.10 MORTAR AND GROUT MIXING

A. Mortar for Unit Masonry: **<<ASTM C270>>**, using the Proportion Specification.

1. Masonry below grade and in contact with earth: Type S.
2. Reinforced masonry: Type S.
3. Mortar parge coats: Type S.
4. Exterior, loadbearing and non-loadbearing, and interior, loadbearing and non-loadbearing: Type N, except as indicated above.
    a. Interior, non-loadbearing masonry may use Type O at Contractor's option.

B. Colored Mortar: Proportion selected pigments and other ingredients to match **<<Architect>>**'s sample, without exceeding manufacturer's recommended pigment-to-cement ratio.
    1. Use colored mortar for all veneer masonry. Separate colors shall be required for each type and color of veneer.

C. Grout: **<<ASTM C476>>**; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

D. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.

E. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COLD AND HOT WEATHER REQUIREMENTS

A. For installation in cold or hot weather, comply with requirements of **<<TMS 402/602>>** or applicable building code, whichever is more stringent.

3.04 GENERAL INSTALLATION REQUIREMENTS

A. **<< Existing Masonry:>>** Refer to Division 1 for procedures for cutting and patching of existing masonry; and refer to Division 2 Demolition section for procedures for selective demolition of existing masonry.

B. Establish lines, levels, and coursing indicated. Protect from displacement.

C. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
    1. CMU Coursing: One unit and one mortar joint equal 8 inches, unless otherwise indicated.
    2. Brick Coursing: Either two or three units with accompanying mortar joints shall equal 8 inches, based on basis-of-design brick size(s) indicated above. ******Verify brick coursing with basis-of-design brick size******

D. Provide running bond for all masonry units unless otherwise indicated. ******Verify specialty bonding other than running bond on case-by-case basis******

E. Tool all mortar joints slightly concave both above and below grade, and where they will be exposed, unless otherwise indicated.
   1. Provide flush joints where they will be concealed by surface-applied treatments or finishes other than paint; including but not limited to wall tile, wall coverings, fluid-applied or SPF air barriers, or membranes.

F. Calcium Silicate Masonry Units: If substituting for the Basis-of-Design product with a concrete based product meeting **<<ASTM C90>>**, installation must meet the following requirements in addition to general installation requirements of this section: ******Keep if using Arriscraft as a basis-of-design product******
   1. Provide additional control, expansion, and movement joints to comply with requirements of **<<NCMA TEK 10-04>>**.
   2. Horizontal joint reinforcement shall be spaced at no more than 16 inches O.C. vertically per **<<NCMA TEK 10-04>>**.
   3. Provide continuous bond breaker material between clay masonry and units meeting **<<ASTM C90>>** standard.
   4. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.05 PLACING AND BONDING

A. Remove broken, cracked, chipped, or otherwise damaged masonry units from pallets and set aside. Do not use unless they may be field cut to remove damaged section, for installation where special shape is required to fit construction.

B. Create a consistent blend for each type of veneer masonry by mixing units from a minimum of three pallets.

C. Provide asphalt felt or polyethylene tape bond-breaker between clay masonry and concrete or other masonry types. Rake back joints for sealant.

D. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

E. Lay hollow masonry units with face shell bedding on head and bed joints.

F. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

G. Remove excess mortar and mortar smears as work progresses.

H. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.

I. Interlock intersections and external corners.

J. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

K. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
   1. Do not cut masonry unless it is required for certain shapes, such as rowlock sills, or unless it is unavoidable due to fitting around other construction, such as wall penetrations.
   2. Cut masonry edges shall not be visible in the final work. Where special shapes are required that would expose cut edges, they shall be plant-fabricated.

3.06 DAMPPROOFING (FOUNDATION WALLS)

A. Coordinate with Division 7 Section "Bituminous Dampproofing." Verify locations to receive dampproofing on the drawings and schedule masonry work to coordinate with installation of dampproofing.

3.07 WEEPS/CAVITY VENTS

A. Install weeps in veneer and cavity walls at maximum 24 inches on center for brick (8- and 12-inch wide veneers) and maximum 32 inches on center for decorative CMU (16-inch wide veneers); install horizontally on top of through-wall flashing, above shelf angles and lintels, at bottom of walls, and as indicated on Drawings.

3.08 CAVITY MORTAR CONTROL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.

B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.

C. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.09 REINFORCEMENT AND ANCHORAGE - << GENERAL; SINGLE WYTHE MASONRY; AND CAVITY WALL MASONRY>>

A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.

C. Place continuous joint reinforcement in first and second joint below top of walls.

D. At parapets and below-grade/foundations, provide joint reinforcement at 8 inches o.c. vertically.

E. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8-inch mortar cover on each side.

F. Lap joint reinforcement ends minimum 6 inches.

G. Do not extend reinforcement across control, expansion, and other building movement joints.

H. Reinforce corners and intersections with prefabricated T- or L-shaped reinforcing.

I. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches horizontally and 24 inches vertically.

J. Embed ties and anchors in mortar joint and extend at least halfway through masonry veneer unit; with at least 5/8-inch mortar cover to the outside face of the anchor.

3.10 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

A. Masonry and/or Metal Framing Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

3.11 REINFORCEMENT AND ANCHORAGES - COMPOSITE UNIT MASONRY

A. Install continuous horizontal joint reinforcement at 16 inches o.c. vertically, except at below grade foundation walls install at 8 inches o.c. vertically.

B. Where concrete foundations are indicated, tie below-grade masonry to concrete with rigid anchors spaced at maximum 8 inches o.c. vertically.

C. Coordinate with parging/dampproofing and with installation of insulation, where indicated.

3.12 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
   1. Extend flashings full width at such interruptions, and at head flashings extend at least 4 inches, minimum, into adjacent masonry at each end. Turn up flashing at head and sill not less than 2 inches to form end dams.
   2. Remove or cover protrusions or sharp edges that could puncture flashings.
   3. Seal lapped ends and penetrations of flashing before covering with mortar.

B. Terminate flashing up 16 inches minimum on vertical surface of backing:
   1. Install vertical leg of flashing over air barrier transition membrane and behind the primary air barrier (fluid-applied/SPF), unless otherwise indicated on Drawings.
   2. Anchor vertical leg of flashing into backing with a termination bar and continuous sealant at top of termination bar.

C. Extend metal flashings to within 1/2-inch of exterior face of masonry and adhere to top of drip edge/drip plate.
   1. Notch and hem exterior corners of drip edges to eliminate sharp, exposed cut metal edges at locations below 6' - 0" above grade.

D. Support flexible flashings across gaps and openings.

E. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

F. Retrofit Through-Wall Flashing: Where flashing is being provided in an existing cavity wall, remove and reinstall masonry to suit through-wall flashing as indicated. ******Provide this for existing walls where flashing needs to be added. Make sure it is well detailed on Drawings******
   1. Remove veneer brick in alternating sections for access to wall cavity. Save removed masonry units for reinstallation.
   2. Provide embedded through-wall flashing with snap-lock receiver on exterior face where indicated to receive counterflashing. Coordinate receiver with counterflashing. Secure concealed flashing to face of existing back-up wythe with termination bar and sealant bead at top.
   3. Infill sections as work progresses with reinstalled or matching veneer masonry and weeps at 16 inches on center. Match existing coursing and bond. Provide flashing end dams at lateral terminations of cavity.
   4. Repeat process with alternate sections of veneer masonry. Lap and seal flashing material sections for continuous installation.

3.13 LINTELS

A. Comply with requirements on Structural Drawings for type of lintel at each opening, additional lintel sizing, reinforcement, and installation requirements.

B. Install loose steel or precast lintels over openings where indicated.

C. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.
   1. Allow masonry lintels to attain specified strength before removing temporary supports.

D. Maintain minimum 8 inch bearing on each side of opening, unless otherwise indicated.

3.14 GROUTED COMPONENTS

A. Comply with requirements on Structural Drawings for locations of structural grouted components and accessories, including but not limited to, grouted bond beams, reinforced unit masonry walls, (including locations and sizing of vertical steel bar reinforcing), grouted solid CMU, and composite wall collar joints.

B. Lap splices minimum 24 bar diameters.

C. Support and secure reinforcing bars from displacement. Maintain position within 1/2-inch of dimensioned position.

D. Place and consolidate grout fill without displacing reinforcing.

3.15 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control or expansion joints.

B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

C. Provide control and expansion joints at locations indicated on Drawings, and as follows:

1. At changes in wall height.
2. At changes in wall thickness
3. At change in support (eg: transition from foundation support to floor slab support).
4. Adjacent to corners of walls within a distance equal to no more than half the maximum control joint spacing.
5. Wall intersections.
6. Do not place control joints closer than 16 inches to edge of wall openings (doors, windows, louvers, ducts).
7. Distance between joints shall not exceed a length to height ratio of 1.5:1.
8. Distance between joints shall not exceed 25 feet where no openings occur between joints.
9. Distance between joints shall not exceed 20 feet where openings occur between joints.

3.16 BUILT-IN WORK

A. As work progresses, install built-in metal door frames, anchor bolts, plates, and other items to be built into the work and furnished under other sections.

B. Install built-in items plumb, level, and true to line.

C. Bed anchors of metal door frames in adjacent mortar joints. Fill frame voids solid with grout.

1. Mix mortar (or grout) to a 4-inch maximum slump consistency and hand trowel into place in accordance with Steel Door Institute (SDI-100).
2. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.

D. Do not build into masonry construction organic materials that are subject to deterioration.

3.17 TOLERANCES

A. Install masonry within the site tolerances found in **<<TMS 402/602>>**.

B. Maximum Variation from Unit to Adjacent Unit: 1/16-inch.

C. Maximum Variation from Plane of Wall: 1/4-inch in 10 feet and 1/2-inch in 20 feet or more.

D. Maximum Variation from Plumb: 1/4-inch per story non-cumulative; 1/2-inch in two stories or more.

E. Maximum Variation from Level Coursing: 1/8-inch in 3 feet, 1/4-inch in 10 feet, and 1/2-inch in 30 feet.

F. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/8-inch, plus 1/8-inch.

G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4-inch.

3.18 CUTTING AND FITTING

A. Cut and fit for chases, pipes, conduit, sleeves, and other penetrations. Coordinate with other sections of work to provide correct size, shape, and location.

B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.19 FIELD QUALITY CONTROL

A. Field Inspections and Tests, General: Except where indicated below, Montgomery County shall provide independent special inspector to perform field quality control inspections and tests and prepare field reports. Refer to Statement and Schedule of Special Inspections included in the Contract Documents and to the Montgomery County Special Inspection Program available from the Montgomery County Department of Permitting Services.

1. The Contractor shall alert MCPS and Montgomery County Special Inspector a minimum of two weeks prior to expected delivery date of masonry products and start of installation.
2. The Contractor shall permit full access to inspectors in order to perform inspections, including use of temporary facilities and equipment such as scaffolding or lifts.
3. Do not enclose cavities or spaces to be grouted solid until inspections have approved grout and reinforcement for material properties, size, and installation locations.

B. Field Testing by Special Inspector: Montgomery County shall provide independent special inspector to perform field quality control tests, as specified in Section **<< 014000 - Quality Requirements>>** and per Statement and Schedule of Special Inspections. Unless otherwise indicated, for each type of masonry unit, 5 randomly chosen units shall be sampled for every 50,000 installed, or portion thereof.

1. Clay Masonry Unit Tests: Testing agency shall test each variety of clay masonry in accordance with **<<ASTM C67/C67M>>** requirements.
2. Concrete Masonry Unit Tests: Testing agency shall test each variety of concrete unit masonry, of each load-bearing size indicated, in accordance with **<<ASTM C140/C140M>>** requirements.
3. Masonry Prism Testing: Test masonry prism per **<<ASTM C1314>>** at beginning of masonry work and for every 7,500 square feet of wall or portion thereof.
4. Mortar Tests: Testing agency shall test each type of mortar in accordance with **<<ASTM C780>>**. Mortar shall be tested on each of the first 3 days. Alert testing agency if mortar mix is altered during construction to allow for retesting.
5. Grout Test: Testing agency shall test each type of grout in accordance with **<<ASTM C1019>>**. Grout shall be tested on each of the first 3 days. Alert testing agency if grout mix is altered during construction to allow for retesting.

C. Field Weep Testing by Contractor: Contractor shall test 10% of weeps (approximately one every 20 linear feet of wall) for proper drainage. Once the veneer has been installed to a height approximately 8- to 16-inches above the top of cavity drainage material, slowly pour approximately 2 cups of clean water into the cavity to observe drainage.

3.20 REPAIR AND CLEANING

A. Remove masonry units that have become damaged or stained, or that do not display acceptable blend of color and texture matching mockup/sample panel. Remove as whole units, do not cut. Replace with new units with fresh mortar joints.

B. Immediately remove excess mortar and mortar droppings.

C. Replace defective mortar and repoint. Enlarge holes or voids at defective mortar, and remove enough adjacent mortar to allow for repointing. Install fresh mortar joint and match to adjacent work.

D. Cleaning, General:

1. Where expansion/control joints and sealant joints are indicated, clean joints and leave them clear and ready for installation of joint or sealant materials.
2. To prevent freezing of cleaners and rinse water, do not clean when masonry surface temperature will drop below 40 degrees F.
3. Test cleaning methods and materials on one half of mockup/sample panel; leave the other half uncleaned. Obtain approval of Architect before cleaning the finished work.
4. Protect adjacent non-masonry surfaces from cleaning materials and processes with temporary sheeting or masking.
5. Pre-wet masonry surfaces and clean with specified cleaning solution. Rinse surfaces immediately after cleaning; do not allow cleaning solution to dry or set into the masonry.
6. Use non-metallic tools in cleaning operations.

E. In-Progress Cleaning:

1. As the work progresses, and prior to mortar curing, dry brush to remove mortar fins and smears before tooling joints.

F. Final Cleaning:

1. As soon as possible after mortar has fully cured, provide final cleaning of masonry in each area (approximately 7 to 28 days; coordinate with manufacturer's recommendations for each mortar type specified). Field test a small area to ensure mortar curing is complete prior to large-scale cleaning.
2. Remove staining of concrete masonry in accordance with NCMA TEK 08-02A.
3. Clean concrete masonry in accordance with **<<NCMA TEK 08-04A>>** using bucket-and-brush hand cleaning methods.
4. Clean clay masonry in accordance with **<<BIA Technical Notes No. 20>>**. using bucket-and-brush hand cleaning methods.
5. Clean masonry with a proprietary acidic cleaner in accordance with manufacturer's written instructions.
6. Remove cleaners promptly after cleaning with low-pressure rinse.

G. Project Closeout Cleaning (prior to Substantial Completion): Provide cleaning of masonry as follows:

1. Remove construction dust with a very low pressure rinse.
2. Perform a visual inspection and spot clean to remove efflorescence, staining, or organic growth, in accordance with recommendations of BIA and NCMA technical notes.

3.21 PROTECTION

A. Provide temporary protective waterproof sheet coverings over tops of walls, parapets, sills, and other horizontal projections as the work progresses, in accordance with FIELD CONDITIONS article in Part 1 above.

B. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

C. Provide protective vertical boards and horizontal sheeting at grade level base of walls to prevent staining or splashing from rain, mud, or mortar droppings.

3.22 MASONRY WASTE

A. Fill Material: Clean masonry waste may be used as fill material. Break up masonry waste into small pieces no greater than 4 inches any direction. Mix with Division 31 engineered fill material so that masonry waste is no more than 33% of the fill (1 part masonry waste, 2 parts engineered fill). Fill containing masonry waste shall be at least 18 inches below grade level.

1. Excess waste shall be removed and disposed of or recycled in accordance with Division 1 waste disposal requirements.

END OF SECTION 042000

SECTION 051200
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AISC (MAN) - Steel Construction Manual.

B. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges.

C. AISC 325 - Steel Construction Manual.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

F. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.

G. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

H. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.

I. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

J. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.

K. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.

L. ASTM A992/A992M - Standard Specification for Structural Steel Shapes.

M. ASTM A1085/A1085M - Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).

N. ASTM E94/E94M - Standard Guide for Radiographic Examination Using Industrial Radiographic Film.

O. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments.

P. ASTM E165/E165M - Standard Practice for Liquid Penetrant Testing for General Industry.

Q. ASTM E709 - Standard Guide for Magnetic Particle Testing.

R. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.

S. ASTM F959/F959M - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series.

T. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

U. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi, 144 ksi, and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.

V. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.

W. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.

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X. AWS D1.1/D1.1M - Structural Welding Code - Steel.

Y. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections.

Z. SSPC V1 (PM1) - Good Painting Practice: Painting Manual Volume 1.

AA. SSPC V2 (PM2) - Systems and Specifications: Steel Structures Painting Manual Volume 2.

BB. SSPC-SP 2 - Hand Tool Cleaning.

1.02 SUBMITTALS

A. Shop Drawings:

1. Indicate **<< profiles; sizes; spacing; locations of structural members; openings, cuts; attachments; fasteners; _____; camber, splices; and other relevant data>>**.
2. **<< Connections; Connections not detailed; or _____>>**.
3. Include anchor bolt placement and other embedment drawings.
4. Indicate welded connections with **<<AWS A2.4>>** welding symbols. Indicate weld lengths, type, size, and field or shop.
5. Indicate bolted connections with type, size, and length of bolts. Indicate pre-tensioned and slip critical bolts.
6. Calculations and background data for connections indicated as delegated connection design, signed and sealed by the fabricator's connection design engineer licensed in the state where the project is located. ***Clearly indicate on the drawings (or here) which connections are delegated to the fabricator and which connection design option is to be utilized.***
   a. Calculations need not be performed for pre-designed connections taken from the tables in the AISC manuals and publications provided job conditions precisely match conditions presumed in the tables. Calculations shall be provided for all variations from the conditions presumed in the tables All information used from such tables shall be clearly identified with the table number and all such connections shall be indicated in the calculations submitted.
   b. Submit calculations concurrently with the shop drawings. Shop drawings will not be reviewed without calculations submitted.

B. Product Data/Certification: Certify that **<< products; or _____>>** meet or exceed **<< specified requirements; or _____>>**.

C. Mill Test Reports: Include chemical and mechanical/physical properties of the structural steel. Submit only if requested.

D. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint.

E. Welders' Qualification Statement: Welders' certificates in accordance with **<<AWS B2.1/B2.1M>>**.

F. Connection Design Engineer's Qualification Statement.

G. Fabricator's Qualification Statement.

H. Erectors Qualification Statement

I. Sustainable Design Submittals: Refer to Division 1 Section - Sustainable Design Requirements

J. Product data/test reports for:

1. Direct-tension indicators.

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2. Tension-control, high-strength, bolt-nut-washer assemblies.
3. Shop primers.
4. Non-shrink grout.

1.03 DOMESTIC ORIGIN

A. Consistent with the Maryland Annotatee Code, Article 78A known as the "Buy American Steel" Act of the General Assembly of Maryland, Acts of 1978, all steel used in th eproject shall be manufactured in the United States of America.

B. Structural fasteners shall comply with the requirements of ASTM F3125, Grade A325 or A490 . Steel used on this project shall be manufactured in the United States of America.

1.04 QUALITY ASSURANCE

A. Fabricate structural steel members in accordance with **<<AISC (MAN)>>** "Steel Construction Manual."

B. Fabricator: Company specializing in performing the work of this section and accredited or certified by one of the following, or another comprehensive quality assurance program acceptable to the Architect and the AHJ.
   1. The International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.
   2. AISC Quality Certification Program

C. Welder Qualifications: Welding processes and welding operators qualified in accordance with **<<AWS D1.1/D1.1M>>**.

D. Erector: Company specializing in performing the work of this section with a verifiable record of experience completing work similar in materials, size, and complexity to this Project.

E. Connection Design Engineer Qualifications: A Professional Engineer with connection design expertise, and experience with this type of work, licensed in the State in which the Project is located.

1.05 PREINSTALLATION CONFERENCE:

A. Conduct the conference at the Project site a minimum of 2 weeks prior to the comensing of steel work. Require the following representatives to attend.
   1. Project superintendent
   2. Special Inspector
   3. Structural steel erector

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store steel members off the ground on pallets, dunnage, or other supports and spacers. Storage of materials shall not cause distortion, damage, or overload to members or supporting structures.

B. Protect steel members and packaged materials from corrosion and deterioration.

C. Repair or replace damaged members as directed.

D. Fasteners shall be stored in a protected place in sealed containers with manufacturer's labels intact. Repackaging is permissible provided the testing and inspecting agency observes the repackaging and sealing of containers.

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PART 2 PRODUCTS

2.01 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content not less than 75 percent.

B. Channels and Miscellaneous Channel Shapes, : **<<ASTM A992/A992M>>** Grade 50.

C. S and M Shapes and T: **<<ASTM A572/A572M>>** Grade 50.

D. Angles: **<<ASTM A572/A572M>>** Grade 50 or **<<ASTM A36/A36M>>** Grade 36.

E. Steel Plate:
   1. **<<ASTM A572/A572M>>** : Less than 4" thick.
   2. **<<ASTM A36/A36M>>** : 4" and thicker.

F. Structural Bars:
   1. **<<ASTM A572/A572M>>** : Less than 4" thick.
   2. **<<ASTM A36/A36M>>** : 4" and thicker.

G. Steel W Shapes and Tees: **<<ASTM A992/A992M>>** Grade 50.

H. HP Shapes: ASTM A572 Grade 50.

I. Rectangular (and square) HSS: **<<ASTM A500/A500M>>** Grade C.

J. Round HSS:**<<ASTM A500/A500M>>** Grade C.

K. Steel Sheet: ASTM A1011/A1011M, Designation SS, Grade 30, or ASTM A1008/A1008M, Designation SS, Grade 30.

L. Steel; Pipe: **<<ASTM A53/A53M>>**, Grade B, Finish **<< black; galvanized; black and galvanized, as indicated; or _____>>**, unless indicated galvanized. ***Try to avoid specifying pipe. Use HSS Round shapes.***

M. Shear Stud Connectors: AWS D1.1 Clause 7, Type B.

N. Raised Pattern Floor Plate: **<<ASTM A786/A786M>>** (33 ksi)commercial grade. ***Yield strength of A786 plate is 33 ksi. Use A786 when possible but, if necessary, can be ordered to a defined plate spec – ASTM A36, A572***

O. Common Structural Bolts and Nuts: Carbon steel, **<<ASTM A307>>**, Grade A.
   1. Galvanizing shall be in compliance with ASTM A153/A153M or ASTM F2329.

P. High-Strength Structural Bolts, Nuts, and Washers: **<<ASTM F3125/F3125M>>**,**<< Type 1,; Type 3,; _____,; or None - N/A>>** Grade A325 with matching compatible **<<ASTM A563>>** or **<<ASTM A563M>>** nuts and **<<ASTM F436/F436M>>** washers. Substitute Grade A490 if needed.

Q. Tension Control Bolts: Twist-off type; **<<ASTM F3125/F3125M>>**. Substitute Type 2280 when using A490 bolts.

R. Headed Anchor Rods and Threaded Rod: **<<ASTM F1554>>**, **<< Grade 36; Grade 55; Grade 105; or _____>>**, with supplement S1, **<< plain; zinc coated; or _____>>**, straight, with matching **<<ASTM A563>>** or **<<ASTM A563M>>** nuts and **<<ASTM F436/F436M>>** Type 1 washers (where hole diameter permits) or ASTM F844. Hooked anchor rods are not permitted.

S. Direct Tension Indicator Washers: **<<ASTM F959/F959M>>** Type S325 or Type A490 as applied.

T. Threaded Rods: **<<ASTM A36/A36M>>**

U. Shear Stud Connectors:**<<AWS D1.1/D1.1M>>** Clause 9, with material as required in Clause 9.2.6, Type B.

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V. Welding Materials: **<<AWS D1.1/D1.1M>>**; type required for materials being welded.

W. Sliding Bearing Plates: **<< Teflon coated; or _____>>**.

X. Grout: **<< ASTM C1107/C1107M; ; or None - N/A>>**Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.

1. Minimum Compressive Strength at 48 Hours: **<< 2,000 pounds per square inch; or ____ pounds per square inch>>**.
2. Minimum Compressive Strength at 28 Days: **<< 7,000 pounds per square inch; or 5,000 pounds per square inch>>**.

Y. Shop and Touch-Up Primer: **<< Fabricator's standard; SSPC-Paint 15; or _____>>**, complying with VOC limitations of authorities having jurisdiction.

Z. Touch-Up Primer for Galvanized Surfaces: **<< Fabricator's standard; SSPC-Paint 20 Type I - Inorganic; SSPC-Paint 20 Type II - Organic; or _____>>**, complying with VOC limitations of authorities having jurisdiction.

AA. Factory-Fabricated Fire-Resistant Steel Columns: Load-bearing structural steel members encased in manufacturer's standard fire-resistant insulating material and covered with non-load-bearing steel shell.

1. Structural Steel: Comply with **<<ASTM A36/A36M>>**, **<<ASTM A572/A572M>>**, and **<<ASTM A992/A992M>>**.
2. Steel Bolts: Comply with **<<ASTM F3125/F3125M>>**,
3. Column Fill: Portland cement with manufacturer's standard aggregates, additives, and fire-resistant coating.
4. Steel Flanges and Casings: **<<AISC 325>>**.
5. Configuration: As shown on drawings.
6. Fire-Resistance: **<< As shown on drawings; UL assembly _____; or _____>>**.

2.02 FABRICATION

A. Shop fabricate to greatest extent possible.

B. Fabricate structural steel designated as AESS in accordance with requirements of AISC “Code of Standard Practice for Steel Buildings and Bridges”.

C. Thermal cutting shall be done by machine to greatest extent possible.

D. Continuously seal weld members exposed to weather in the final work by **<< intermittent welds and plastic filler; continuous welds; or _____>>**.

E. Complete shop fabrication, including welding of assemblies, before shop priming.

F. Mill or sawcut column bearing surfaces.

G. Develop required camber for members .

2.03 FINISH

A. Prepare structural component surfaces that are to remain unpainted, in accordance with **<< SSPC-SP 1; SSPC-SP 2; SSPC-SP 3; SSPC-SP 5; SSPC-SP 6; SSPC-SP 7; SSPC-SP 10; SSPC-SP 11; SSPC-SP 13; or _____>>**.

B. Prepare structural component surfaces which are to be painted, as follows:

1. Concealed Steel: SSPC-SP 2 “Hand Tool Cleaning” or SP 3 “Power Tool Cleaning”.
2. Exposed Steel (Exterior and Interior): SSPC-SP 6, “Commercial Blast Cleaning”.

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C. Shop prime structural steel members, unless otherwise indicated. Do not prime surfaces that will be **<< fireproofed; field welded; in contact with concrete; high strength bolted; or faying surfaces of slip-critical bolted connections>>**.

D. Coordinate shop primers for compatibility with topcoats to be applied over them.

E. Leave structural steel members un-primed. ***Keep d, or B & C.***

F. Bolt holes shall be cut, drilled or punched perpendicular to metal surfaces. Do not thermally cut bolt holes or enlarge holes by burning in the field.

G. Primer for Exposed Steel at Swimming Pool (Natatorium): Shop primer that complies with Division 9, “High Performance Coatings”.

H. Structural steel members requiring galvanizing shall be hot dip galvanized in accordance with ASTM A123/A123M

I. Galvanize steel lintels and shelf angles located in exterior walls.

J. Galvanize structural steel and fasteners permanently exposed to exterior conditions.

2.04 CONNECTION DESIGN

A. Design connections not detailed on drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

B. All connections shall be designed using **<< Allowable Stress Design (ASD); or Load and Resistance Factor Design (LRFD)>>** with loads given at service load level.

C. Simple shear connections shall be selected and completed using schematic details indicated and AISC 360. Simple Shear connections completed by the structural-steel fabricator shall withstand loads indicated and comply with other information and restrictions indicated.

D. Moment Connections shall be Fully Restrained (Type FR).

2.05 SOURCE QUALITY CONTROL

A. High-Strength Bolts: Provide inspection and verification that all shop-bolted connections in comply with requirements of **<<RCSC (HSBOLT)>>** "Specification for Structural Joints Using High-Strength Bolts," .

B. Welded Connections: Visually inspect all shop-welded connections in accordance with AWS D1.1 and test using one of the visual inspection indicate a possible deficiency of welds using**<< one of; or None - N/A>>** the following:

1. Radiographic testing performed in accordance with **<<ASTM E94/E94M>>**.
2. Ultrasonic testing performed in accordance with **<<ASTM E164>>**.
3. Liquid penetrant inspection performed in accordance with **<<ASTM E165/E165M>>**.
4. Magnetic particle inspection performed in accordance with **<<ASTM E709>>**.

C. In addition to visual inspection, shop welded shear connectors shall be tested and inspected in accordance with requirements of AWS D1.1 and as follows:

1. Perform bend tests if visual inspection reveals a less than 360 degree flash.
2. If weld fracture occurs on stud being tested, additional studs shall be tested.

2.06 PREFABRICATED BUILDING COLUMNS

A. Prefabricated building columns consisting of load bearing structural steel members protected by concrete fireproofing encased in an outer non-load bearing steel shell.

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B. Fire Resistance Rating: Provide prefabricated building columns listed and labeled by a testing and inspection agency acceptable to authorities having jurisdiction, for ratings indicated, based on testing according to ASTM E119.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.02 ERECTION

A. Erect structural steel in compliance with **<<AISC 303>>**.

B. Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.

C. The deck layout and jointing will be finalized in the shop drawings and may require shoring of some composite deck. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

D. Do not field cut or alter structural members without approval of **<<Architect>>**. Unfair holes that require enlarging shall be reamed. Enlargement of unfair holes shall not be done using burning or drift pin.

E. After erection, prime welds, abrasions, and surfaces not **<< shop primed; galvanized; or _____>>**, which are intended to receive primer. Re-prime all field weld.s

F. Grout solidly between column base plates and bearing surfaces, filling all voids. Comply with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

G. Shear Connectors: Prepare steel surfaces as required by shear connector manufacturer. Fasten headed stud shear connectors in accordance with AWS D1.1 and manufacturer’s written instructions, using automatic end welding.

1. Remove ceramic ferules from the deck prior to concrete operations.

3.03 PREFABRICATED BUILDING COLUMNS

A. Install prefabricated building columns to comply with AISC 360, manufacturer’s written instructions, and requirements of testing and inspection agency that apply to fire-resistance rating indicated.

3.04 TOLERANCES

A. Comply with tolerance requirements per AISC 303 for structural steel and architecturally exposed structural steel.

3.05 FIELD QUALITY CONTROL

A. The owners approved agent will engage an independent testing agency to perform field quality control tests, inspections, and reports, as specified in Section 014000 - Quality Requirements, and as indicated in the Statement of Special Inspections.

B. High-Strength Bolts: Field-bolted connections will be tested and inspected in accordance with **<<RCSC (HSBOLT)>>** "Specification for Structural Joints Using High-Strength Bolts,".

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C. Welded Connections: Field-welded connections will be visually inspected in accordance with AWS D1.1. and tested using one of the following methods when results of visual inspection indicate a possible deficiency:
   1. Radiographic testing performed in accordance with **<<ASTM E94/E94M>>**.
   2. Ultrasonic testing performed in accordance with **<<ASTM E164>>**.
   3. Liquid penetrant inspection performed in accordance with **<<ASTM E165/E165M>>**.
   4. Magnetic particle inspection performed in accordance with **<<ASTM E709>>**.

D. Remove slag and backing bars, back gouge, and grind smooth to facilitate visual inspection of field welds.

E. Complete Joint Penetration Groove Welds shall have ultrasonic testing performed on 10% of CJP weld for Risk Category II structures and all welds for Risk Category III or IV structures with butt, T- and corner joints subject to transversely applied tension loading, in material 5/16 inches or greater.

3.06 TOUCH-UP

A. Shop Primed Steel: Immediately following erection, apply primer to exposed areas using same material as shop coating.

B. Galvanized Steel: Immediately following erection, apply galvanizing repair paint to exposed areas in accordance with ASTM A780.

END OF SECTION 051200

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SECTION 051213
ARCHITECTURALLY-EXPOSED STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Additional requirements for structural steel members designated as architecturally-exposed structural steel (AESS).

1.02 REFERENCE STANDARDS

A. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges.

B. AISC 360 - Specification for Structural Steel Buildings.

C. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.

D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

F. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

G. ASTM A1085/A1085M - Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).

H. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi, 144 ksi, and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.

I. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.

J. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.

K. AWS D1.1/D1.1M - Structural Welding Code - Steel.

L. SSPC-SP 1 - Solvent Cleaning.

M. SSPC-SP 6 - Commercial Blast Cleaning.

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1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Schedule and conduct a preinstallation meeting at project site minimum of 2 weeks prior to start of work of this section; require attendance by all affected installers. Coordinate requirements for shipping, special handling, storage, attachment of safety cables and temporary erection bracing, final coating, touch-up painting, mock-up coordination, **<<Architect>>**'s observations, and other requirements for AESS.

1.04 SUBMITTALS

A. Product data for each type of product specified. Submit paint systems in accordance with Section **<< 099113; 099123; 099600; and _____>>**.

B. Sustainable Design Submittals: Refer to Division 1 Section - Sustainable Design Requirements

C. Shop Drawings: Detailing for fabrication of AESS components.

1. Provide erection documents clearly indicating which members are AESS members and the AESS category of each part.
2. Include details that clearly identify AESS requirements found in this specification. Provide connections for AESS consistent with concepts shown on drawings.
3. Indicate welds by **<<AWS A2.4>>** symbols, distinguishing between shop and field welds, and show size, length and type of each weld. Identify grinding, finish and profile of welds as defined by the designated AESS category.
4. Indicate orientation of hollow structural section (HSS) seams and mill marks (where applicable).
5. Indicate type, size, finish and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tensioned shear/bearing connections. Indicate orientation of bolt heads.
6. Indicate which surfaces or edges are exposed and what class of surface preparation is being used.
7. Indicate special tolerances and erection requirements as noted on drawings or defined by the designated AESS category.
8. Indicate vent or drainage holes for HSS members.

D. **<< AESS 1; AESS 2; AESS 3; AESS 4; and AESS C>>** Samples: Provide samples of specific AESS characteristics. Samples may be small size samples or components of conventional structural steel demonstrating specific AESS characteristics, including **<< surface preparation; sharp edges ground smooth; continuous weld appearance; weld show through; fabrication mark removal; and _____>>**.

E. Welders' Qualification Statement: Welders' certificates in accordance with **<<AWS B2.1/B2.1M>>** and dated no more than **<< 12 months; or ____>>** before start of scheduled welding work.

F. Qualification data for fabricator and erector to demonstrate their capabilities and experience. Include **<< lists of completed projects names and address; names and addresses of architects and owners; photographs showing detail of installed AESS; other information specified; and _____>>**.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: In addition to those qualifications listed in Section **<< 051200>>**, engage an AISC Certified Fabricator, experienced in fabricating AESS similar to that indicated for this project with a record of successful in-service performance, as well as sufficient production capacity to fabricate AESS without delaying the work.

B. Erector Qualifications: In addition to those qualifications listed in Section **<< 051200>>**, engage an AISC Certified Erector, experienced in erecting AESS work similar in material, design, and extent to that indicated for this project and with a record of successful in-service performance.

C. Welder Qualifications: Welding processes and welding operators qualified within previous **<< 12 months; or ____>>** in accordance with **<<AWS D1.1/D1.1M>>** and dated no more than **<< 12 months; or ____>>** before start of scheduled welding work..

D. Comply with applicable provisions of **<<AISC 303>>**, Section 10 for the designated AESS category.

E. **<<Owner>>** to engage a quality assurance agency per requirements of **<<AISC 360>>**, Chapter N and **<<AISC 303>>**, Section 10.

F. **<<Contractor>>** to engage a quality assurance agency per requirements of **<<AISC 360>>**, Chapter N and **<<AISC 303>>**, Section 10.

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1.06 DELIVERY, STORAGE, AND HANDLING

A. Handle finished pieces in accordance with Section 10 of **<<AISC 303>>**, using nylon-type slings, or chains with softeners, or wire ropes with softeners such that they are not damaged.

B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration. Use special care in handling to prevent twisting or warping of AESS members.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Comply with Section **<< 051200>>**, except as amended in this section for aesthetic purposes.

B. Comply with **<<AISC 303>>**, Section 10 for specific AESS category designated on drawings.

C. Comply with **<<AISC 303>>**, Section 10 for specific AESS as follows:

1. **<< _____>>**: **<< AESS 1; AESS 2; AESS 3; AESS 4; AESS C; or _____>>**

2.02 FABRICATION

A. Fabricate and assemble AESS in shop to greatest extent possible. Locate field joints in AESS assemblies at concealed locations or as approved by **<<Architect>>**. Detail AESS assemblies to minimize field handling and expedite erection.

B. Permissible tolerances for member depth, width, out of square, and camber and sweep to be as specified in **<<ASTM A6/A6M>>**, **<<ASTM A500/A500M>>**, and **<<ASTM A1085/A1085M>>**.

C. For curved structural members, whether composed of a single standard structural shape or built-up, the as-fabricated variation from theoretical curvature to be equal to or less than standard camber and sweep tolerances permitted for straight members in applicable ASTM standard.

D. Use special care in handling and shipping of AESS both before and after shop painting to minimize damage to any shop finish. Use nylon-type slings or softeners when using chains or wire rope slings.

E. Bolted Connections:

1. Make in accordance with Section **<< 051200>>**. Provide bolt type and finish as noted herein.

F. Welded Connections:

1. Comply with **<<AWS D1.1/D1.1M>>** and Section **<< 051200>>**.
2. Assemble and weld built-up sections by methods that will maintain alignment of members without warp exceeding tolerances of this section.

G. Surface Preparation:

1. Remove blemishes or unsightly surfaces resulting from temporary braces or fixtures.
2. Remove backing and run out tabs.

H. Fabricate AESS in accordance with categories defined in **<<AISC 303>>**, as follows:

1. AESS 1: Basic elements.
2. AESS 2: Feature elements viewed at a distance greater than **<< 20 feet>>** (feature elements not in close view).
3. AESS 3: Feature elements viewed at a distance less than **<< 20 feet>>** (feature elements in close view).

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4. AESS 4: Showcase elements with special surface and edge treatment beyond fabrication (showcase elements).
5. ----------
6. Add modifications to characteristics included in **<<AISC 303>>** matrix in order to modify one or more of the defined AESS categories and create a custom AESS C.
7. ----------
8. AESS C: Custom elements; fabricate to requirements of **<< AESS 1; AESS 2; AESS 3; AESS 4; or _____>>** and the following characteristics:
   a. C.1: **<< _____>>**.
   b. C.2: **<< _____>>**.
   c. C.3: **<< _____>>**.

2.03 PAINT SYSTEM

A. Compatibility: All components/procedures of AESS paint system to comply with coating system specified, submitted, and approved per **<< Section; or Sections>><< 099113; 099123; 099600; and _____>>**. As a minimum, identify required surface preparation, primer, intermediate coat (if applicable), and finish coat. Primer, intermediate coating, and finish coating to be from a single manufacturer combined in a system documented by manufacturer with adequate guidance for fabricator to procure and execute.

B. Primer: As specified in **<< Section; or Sections>><< 099113; 099123; 099600; and _____>>**. Primer to comply with all federal standards for VOC, lead and chromate levels.

C. Primer: **<< Acrylic water-soluble shop coat with good resistance to normal atmospheric corrosion.; Fast curing two-part epoxy.; Organic, epoxy/zinc rich meeting class B surface requirements for slip critical connections, as found in AISC 360.; Inorganic zinc rich meeting class B surface requirements for slip critical connections, as found in AISC 360.; or _____>>** Primer to comply with all federal standards for VOC, lead and chromate levels.

D. Finish Coating: Field apply intermediate and top coats per **<< Section; or Sections>><< 099113; 099123; 099600; and _____>>**.

2.04 SHOP PRIMING

A. Surface Preparation:
   1. Provide surface preparations to meet **<<SSPC-SP 6>>**.
   2. Coordinate required surface profile with approved paint submittal prior to beginning surface preparation.
   3. Prior to blasting, remove any grease and oil using solvent cleaning to meet **<<SSPC-SP 1>>**.
   4. Remove weld spatter, slivers and similar surface discontinuities.
   5. Ease sharp corners resulting from shearing, flame cutting or grinding.

B. Shop prime structural steel members. Do not prime surfaces that will be **<< fireproofed; field welded; in contact with concrete; high strength bolted with slip-critical connections; or _____>>**.
   1. Extend priming of members partially embedded in concrete or mortar to a depth of **<< 2 inches>>**.

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions to provide a dry film thickness of not less than **<< 1.5 mils>>**. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

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1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop primer to surfaces that are inaccessible after assembly or erection.

2.05 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by hot-dip process to AESS indicated for galvanizing according to **<<ASTM A123/A123M>>**. Fabricate such that all connections of assemblies are made in the field with bolted connections where possible.

2.06 MATERIALS

A. General: Meet requirements of **<< 051200>>** as amended below.

B. Tension Control, High-Strength Bolts, Nuts, and Washers: Per section **<< 051200>>**, Tension Control Bolts. Provide **<< standard carbon steel; cadmium plated; mechanically galvanized; or _____>>** finish **<< rounded bolt heads with twist off bolts; heavy hex bolt heads with twist off bolts; or _____>>**; **<<ASTM F3125/F3125M>>**.

PART 3 EXECUTION

3.01 EXAMINATION

A. Erector to check all AESS members upon delivery for twist, kinks, gouges or other imperfections which may result in rejection of appearance of member. Coordinate remedial action with fabricator prior to erecting steel.

3.02 PREPARATION

A. Provide connections for temporary shoring, bracing and supports only where noted on approved fabrication documents. Temporary connections not shown are to be made at locations not exposed to view in final structure or as approved by **<<Architect>>**.

B. Handle, lift and align pieces using nylon straps or chains with softeners required to maintain appearance of AESS through process of erection.

3.03 ERECTION

A. AESS 1 and 2: Basic elements; feature elements not in close view:

1. Employ special care to handle and erect AESS. Erect finished pieces using nylon straps or chains with softeners such that they are not damaged.
2. Place weld tabs for temporary bracing and safety cabling at points concealed from view in completed structure or where approved by **<<Architect>>** during pre-installation meeting. Obtain **<<Architect>>** approval of methods for removing temporary devices and finishing AESS members prior to erection.
3. AESS Erection Tolerances: Erect to standard frame tolerances for structural steel per Chapter 7 of **<<AISC 303>>**.
4. Set AESS accurately in locations and to elevations indicated and according to **<<AISC 303>>** and **<<AISC 360>>**.
5. Remove blemishes or unsightly surfaces resulting from temporary braces or fixtures.
6. Remove all backing and run out tabs.
7. When temporary braces or fixtures are required to facilitate erection, take care to avoid any blemishes, holes or unsightly surfaces resulting from use or removal of such temporary elements.

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8. Bolted Connections: Align bolt heads on same side of connection as indicated on approved fabrication or erection documents.
9. Welded Connections: Comply with **<<AWS D1.1/D1.1M>>** and Section **<< 051200>>**. Appearance and quality of welds to be consistent. Employ methods that will maintain alignment of members without warp exceeding tolerance of this section.
10. Remove weld spatter exposed to view.
11. Grind off projections larger than **<< 1/16 inch>>** at field butt and plug welds.
12. Continuous Welds: Where continuous welding is noted on drawings, provide continuous welds of a uniform size and profile.
13. Do not enlarge holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts. Replace connection plates that are misaligned where holes cannot be aligned with acceptable final appearance.
14. Splice members only where indicated.
15. Obtain permission for any torch cutting or field fabrication from **<<Architect>>**. Finish sections thermally cut during erection to a surface appearance consistent with mock-up.

B. AESS 3: Feature elements in close view:
1. Erect to requirements of AESS 1 and 2 and as follows:
2. Field Welding: Weld profile, quality, and finish to be consistent with mock-ups approved prior to fabrication.
3. Provide a continuous appearance to all welded joints including tack welds. Provide joint filler at intermittent welds.

C. AESS 4: Showcase elements:
1. Erect to requirements of AESS 3 and as follows:
2. Grind welds smooth.
3. Minimize Weld Show Through: At locations where welding on far side of an exposed connection creates distortion, grind distortion and marking of steel to a smooth profile with adjacent material.
4. Filling of Weld Access Holes: Where holes must be cut in web at intersection with flanges on W shapes and structural tees to permit field welding of flanges, fill holes with joint filler.
5. Where welds are indicated to be ground, contoured, or blended, oversize welds as required and grind to provide a smooth transition and match profile on approved mock-up.

D. ----------

E. Add modifications to characteristics included in **<<AISC 303>>** matrix in order to modify one of the defined AESS categories and create a custom AESS C.

F. ----------

G. AESS C: Custom elements:
1. Erect to requirements of **<< AESS 1 and 2; AESS 3; or AESS 4>>** and as follows:
a. **<< _____>>**.
b. **<< _____>>**.

3.04 FIELD QUALITY CONTROL

A. The owners approved agent will engage an independent testing agency to perform field quality control tests, inspections, and reports, as specified in Section 014000 - Quality Requirements, and as indicated in the Statement of Special Inspections.

B. Structural Requirements:

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1. Comply with quality control requirements per **<<AISC 360>>**, Chapter N and **<<AISC 303>>**, Section 10. Refer to Section **<< 051200>>** for additional requirements.
2. Quality assurance agency to review work for compliance with requirements of **<<AISC 360>>**, Chapter N and **<<AISC 303>>**, Section 10.

C. AESS 1 and 2 Acceptance: **<<Architect>>** to observe AESS in place and determine acceptability based on qualification data and submittals. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.

D. AESS 3,4, and C Acceptance: **<<Architect>>** to observe AESS in place and determine acceptability based on qualification data and submittals as well as on approved mock- up. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.

3.05 CLEANING

A. Touch-up Painting: Complete cleaning and touch-up painting of field welds, bolted connections, and abraded areas of shop paint to blend with adjacent surfaces of AESS. Perform touch-up work in accordance with manufacturer's instructions and as specified in Section **<< 099113; 099123; 099600; and _____>>**.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas. Repair galvanized surfaces in accordance with **<<ASTM A780/A780M>>**.

C. See Section **<< 017419 - Construction Waste Management and Disposal>>**, for additional requirements.

END OF SECTION 051213

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SECTION 052100
STEEL JOIST FRAMING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

B. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

D. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric).

E. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

F. ASTM E94/E94M - Standard Guide for Radiographic Examination Using Industrial Radiographic Film.

G. ASTM E165/E165M - Standard Practice for Liquid Penetrant Testing for General Industry.

H. ASTM E709 - Standard Guide for Magnetic Particle Testing.

I. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.

J. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi, 144 ksi, and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.

K. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.

L. AWS D1.1/D1.1M - Structural Welding Code - Steel.

M. CSA A123.24 - Standard Test Method for Wind Resistance of Vegetated Roof Assembly.

N. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172.

O. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections.

P. SJI 100 - Standard Specifications for K-Series, LH-Series, and DLH-Series Open Web Steel Joists, and for Joist Girders.

Q. SJI Technical Digest No. 9 - Handling and Erection of Steel Joists and Joist Girders.

R. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.

S. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).

T. SSPC-SP 2 - Hand Tool Cleaning.

1.02 SUBMITTALS

A. Shop Drawings: Indicate **<< standard designations; joist coding; configurations; sizes; spacings; cambers; locations of joists; joist chord extensions; bridging; connections; attachments; and splice and connection locations and details>>**.

B. Calculations and analysis data for Special Joists: (Special Joists “SJ” are those which have special loading conditions and/or non-standard configuration, not in compliance with SJI

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Standard Specifications and Load Tables, requiring special design and detailing.) Calculations and analysis data shall be signed and sealed by a professional engineer licensed in the state in which the project is located.

C. Welders' Qualification Statement: Welders' certificates in accordance with **<<AWS B2.1/B2.1M>>**.

D. Joist Design Engineer's Qualification Statement.

E. Manufacturer's Qualification Statement.

F. Erector's Qualification Statement.

G. Sustainable Design Submittals: Refer to Division 1 section - Sustainable Design Requirements.

1.03 QUALITY ASSURANCE

A. Perform Work**<< , including that for headers and other supplementary framing,; or None - N/A>>** in accordance with **<<SJI 100>>** Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders.

1. Maintain **<< one copy; or ____ copies>>** of document on site.

B. Manufacturer Qualifications: Company specializing in performing the work of this section, with a record of successful performance on projects of similar size and scope as this Project. Manufacturer shall be certified by SJI.

C. Welder Qualifications: Welding processes and welding operators qualified in accordance with **<<AWS D1.1/D1.1M>>**.

D. Erector Qualifications: Company specializing in performing the work of this section with a record of successful performance on projects of similar size and scope as this Project.

E. Joist Design Engineer Qualifications: A Professional Engineer with joist design expertise, and experience with this type of work, licensed in the State in which the Project is located.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Transport, handle, store, and protect products in accordance with SJI requirements.

B. Joists shall be protected from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide joists, joist substitutes (where indicated), special joists and connections capable of withstanding design loads indicated.

1. Use ASD. Data is given at service-load level.
2. Design special joists to withstand design loads with live-load deflections no greater than the following:
   a. Floor Joists: Vertical deflection of 1/360 of the span.
   b. Roof Joists: Vertical deflection of 1/240 of the span.

B. Recycled Content: Provide products with a minimum post-consumer recycled content of 60%.

2.02 MATERIALS

A. Joist Components: Minimum yield strength, Fy=50 ksi.

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B. High-Strength Structural Bolts, Nuts, and Washers: **<<ASTM F3125/F3125M>>**,**<< Type 1,; Type 3,; _____ ,; or None - N/A>>** with matching compatible **<<ASTM A563/A563M>>** nuts and **<<ASTM F436/F436M>>** washers.

C. Tension Control Bolts: Twist-off type; **<<ASTM F3125/F3125M>>**.

D. Shear Stud Connectors: **<< Made from ASTM A108 Grade 1015 bars; Made from ASTM A108 Grade ____ bars; Forged steel, headed, uncoated; or _____>>**.

E. Structural Steel For Supplementary Framing. Minimum yield strength, Fy=36 ksi, unless otherwise indicated.

F. Welding Materials: **<<AWS D1.1/D1.1M>>**; type required for materials being welded.

G. Shop and Touch-Up Primer: **<< SSPC-Paint 15; complying with VOC limitations of authorities having jurisdiction.; Not required except at the following locations:; and _____>>**.

H. Touch-Up Primer for Galvanized Surfaces: **<< SSPC-Paint 20 Type I - Inorganic; SSPC-Paint 20 Type II - Organic; or _____>>**, complying with VOC limitations of authorities having jurisdiction.

2.03 FABRICATION

A. Manufacture steel joists and related components in conformance with SJI 100, Standard Specification for K-Series, LH-Series and DLH-Series Open Web Steel Joists and Joist Girders, with steel angle chords, and chord slope/configuration as indicated.

B. Manufacture composite steel joists and related components in conformance with SJI 200, Standard Specification for CJ-Series Composite Steel Joists, with steel angle chords.

C. Manufacture joist substitutes in accordance with SJI 100.

D. Perform welding in accordance with AWS D1.1 and D1.3 procedures and requirements.

E. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per foot.

F. Provide special sized openings in joist web framing as indicated.

G. Supply bottom chord ceiling extensions as required to support ceilings.

H. S

I. **<< Do not camber roof joists.; Camber joists per SJI recommendations.; Do not camber K, KCS, and LH joists. Camber DLH and Joist Girders per SJI recommendations.; or _____>>**

2.04 FINISH

A. **<< Shop prime joists with SSPC Paint 15, or manufacturer's standard shop primer complying with performance requirements of SSPC Paint 15, unless otherwise indicated.; Leave joists unprimed; Galvanize joists; or _____>>**

1. If fireproofing is specified, omit primer, or verify that primer is compatible with fireproofing materials and will allow adhesion.

B. Prepare surfaces to be finished in accordance with SSPC-SP 1 and **<< SSPC-SP 2; SSPC-SP 3; or ____>>**.

C. Primer for Exposed Joists at Swimming Pool (Natatorium): Shop primer that complies with Division 9, "High Performance Coatings".

D. Joist requiring galvanizing shall receive hot dipped galvanizing coating in accordance with **<<ASTM A123/A123M>>**.

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2.05 ACCESSORIES

A. Provide horizontal and diagonal bridging in accordance with SJI standards for size, type and spacing.

B. Provide ceiling extensions adequate to support ceiling construction that is intended to be installed directly to the bottom of the joists (suspended ceiling are not intended), with ends within ½ inch from face of wall, unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing and in field conditions, with Installer present, prior to beginning work to ensure compliance with the requirements for installation tolerances and other conditions affecting performance.

3.02 ERECTION

A. Erect joists with correct bearing length on supports.

B. Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment.

C. Coordinate the placement of anchors for securing loose bearing members furnished as part of the work of this section.

D. After joist alignment and installation of framing, field weld joist seats to steel bearing surfaces.

E. Position and field weld joist chord extensions and wall attachments**<< as detailed; or None - N/A>>**. Do not weld bottom chord extensions to columns or other support until dead load is in place.

F. Install supplementary framing for **<< floor; roof; and _____>>** openings greater than as indicated.

G. Do not permit erection of decking until joists are braced**<< , bridged,; or None - N/A>>** and secured or until completion of erection and installation of permanent bridging and bracing.

H. Do not field cut or alter joists without approval of joist manufacturer.

I. After erection, prime **<< welds; damaged shop primer; damaged galvanizing ; surfaces not shop primed; and ___>> << , except surfaces specified not to be primed; or None - N/A>>**.

3.03 TOLERANCES

A. Maximum Variation From Plumb: **<< 1/4 inch; or ____ inch>>**.

B. Maximum Offset From True Alignment: **<< 1/4 inch; or ____ inch>>**.

3.04 FIELD QUALITY CONTROL

A. The owners approved agent will engage an independent testing agency to perform field quality control tests, inspections, and reports, as specified in Section 014000 - Quality Requirements, and as indicated in the Statement of Special Inspections.

B. High-Strength Bolts: Field-bolted connections will be tested and inspected in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts".

C. Welded Connections: Field-welded connections will be visually inspected in accordance with AWS D1.1 and tested using one of the following methods when results of visual inspection

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indicate a possible deficiency. Test at least **<< 10>>** percent of welds using**<< one of; or None - N/A>>** the following:

1. Radiographic testing performed in accordance with **<<ASTM E94/E94M>>**.
2. Ultrasonic testing performed in accordance with **<<ASTM E164>>**.
3. Liquid penetrant inspection performed in accordance with **<<ASTM E165/E165M>>**.
4. Magnetic particle inspection performed in accordance with **<<ASTM E709>>**.

3.05 FIELD TOUCH UP

A. Shop Primed Joists: Immediately following erection, apply primer to abraded areas using same material as shop coating.

B. Galvanized Joists: Immediately following erection, apply galvanizing repair paint to abraded areas in accordance with **<<ASTM A780/A780M>>**.

C. Repair of damaged joists shall be per manufacturers recommendations and detailing.

END OF SECTION 052100

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SECTION 053100
STEEL DECKING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

B. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

C. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.

D. AWS D1.1/D1.1M - Structural Welding Code - Steel.

E. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel.

F. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172.

G. ICC-ES AC43 - Acceptance Criteria for Steel Deck Roof and Floor Systems.

H. ICC-ES AC70 - Acceptance Criteria for Power-Actuated Fasteners Driven into Concrete, Steel and Masonry Elements.

I. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks.

J. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.

K. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).

1.02 SUBMITTALS

A. Product Data: Provide for each type: **<< deck profile characteristics; dimensions; structural properties; finishes; _____; and fasteners>>**.

1. Test reports for acoustic roof deck verifying acoustical performance according to ASTM C423 and ASTM E795.

B. Shop Drawings: Indicate deck plan, **<< support locations; projections; openings; reinforcement; pertinent details; accessories; and fastening>>**. Reproductions of the structural steel drawings or any portion of are prohibited without the strict permission of the Architect.

C. Certificates: Certify that products furnished meet or exceed **<< specified requirements; or _____>>**.

D. Welders' Qualification Statement: Welders' certificates in accordance with **<<AWS B2.1/B2.1M>>**.

E. Designer's Qualification Statement.

F. Fabricator's Qualification Statement.

G. Sustainable Design Submittals: Refer to Division 01 Section “Sustainable Design Requirements.”

1.03 DOMESTIC ORIGIN

A. Consistent with Maryland Annotated Code, Article 78A known as “Buy American Steel” Act of the General Assembly of Maryland, Acts of 1978, steel used on this project shall be manufactured in the United States of America.

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1.04 QUALITY ASSURANCE

A. Welder Qualifications: Welding processes and welding operators qualified in accordance with **<<AWS D1.1/D1.1M>>** and **<<AWS D1.3/D1.3M>>**.

B. Fabricator Qualifications: A qualified steel deck fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with **<<IAS AC172>>**, or other comprehensive quality assurance program acceptable to the Architect and the AHJ.

C. Installer Qualifications: An experienced installer who has completed steel deck work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect deck from damage and corrosion during delivery, storage, and placement.

B. Store deck on dry wood sleepers; slope for positive drainage; provide ventilation.

1. Keep factory installed insulation dry in acoustic cellular deck.

PART 2 PRODUCTS

2.01 STEEL DECK

A. All decks shall have a minimum recycled content of 75 percent post-consumer material.

B. Roof Deck: Fabricate deck panels in accordance with ANSI/SDI Standard for Steel Roof Deck, and the following:

1. Galvanized Steel Sheet: **<<ASTM A653/A653M>>** with G60/Z180 galvanized coating.
   a. Grade as indicated.
2. Galvanized and Shop Primed Steel Sheet: **<<ASTM A653/A653M>>**, with G60 galvanized coating. Pre-treat, clean, and prime with specified primer. Applies to deck surfaces indicated to receive finish paint.
   a. Grade as indicated.
3. Profile: As indicated.
4. Attachment: Puddle weld only. The use of mechanical fasteners at the roof deck is prohibited.

C. Acoustical Roof Deck: Fabricate deck panels in accordance with ANSI/SDI Standard for Steel Roof Deck, and the following:

1. Galvanized Steel Sheet: **<<ASTM A653/A653M>>** with **<< G40/Z120; G60/Z180; G90/Z275; G115/Z350; or ____>>** galvanized coating.
   a. Grade: As indicated.
2. Galvanized and Shop Primed Steel Sheet: ASTM A653, with G60 galvanized coating. Pre-Treate, clean, and prime with specified primer. Applies to deck surfaces indicated to receive finish paint.
   a. Grade: As indicated.
3. Sound Attenuation material: Pre-formed glass fiber strips. Shop installed in cellular deck.
4. Acoustical Performance: Minimum NRC rating = ____, tested in accordance with ASTM C423
5. Profile: As indicated , with perforated vertical ribs.
6. Profile: As indicated, with perforated bottom plate ***(If cellular deck profile).***

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7. Attachment: Puddle weld only. The use of mechanical fasteners at the roof deck is prohibited.

D. Composite Floor Deck: Fabricate deck panels in accordance with ANSI/SDI Standard for Steel Floor Deck-Slabs, and the following:
   1. Galvanized Steel Sheet: **<<ASTM A653/A653M>>** with **<< G40/Z120; G60/Z180; G90/Z275; G115/Z350; or ____>>** galvanized coating.
      a. Grade: As indicated.
   2. Profile: As indicated.

E. Acoustical Cellular Floor Deck: Fabricate deck panels in accordance with ANSI/SDI Standard for Steel Floor Deck-Slabs, and the following:
   1. Galvanized Steel Sheet: **<<ASTM A653/A653M>>** with **<< G60/Z180; G90/Z275; G115/Z350; or ____>>** galvanized coating.
      a. Grade: As indicated.
   2. Profile: As indicated.
   3. Sound attenuation material: Pre-formed glass fiber strips. Shop install in cellular deck.
   4. Acoustical Performance: Minimum NRC rating = ____, tested in accordance with ASTM C423.

F. Non-composite Form Deck: Fabricate deck panels in accordance with ANSI/SDI Standard for Non-composite Steel Floor, and the following:
   1. Galvanized Steel Sheet: **<<ASTM A653/A653M>>** with **<< G40/Z120; G60/Z180; G90/Z275; G115/Z350; or ____>>** galvanized coating.
      a. Grade: As indicated.
   2. Profile: As indicated.

G. Natatorium Roof Deck: Fabricate deck panels in accordance with ANSI/SDI Standard for Steel Roof Deck, and the following: **This is set up as a generic spec utilizing standard roof deck (generally 3" deep). It requires galvanized steel deck, with two field coats of a high-performance coating system to be specified in DIV 9. We have had good luck using Tnemec products for those coatings. This approach was used on 582386 – Henrico Aquatic Center. The spec can also be written around a specific manufacturer. Refer to 510022 - PWC 12th High School for a natatorium deck spec written around the Toris-A acoustic deck with Natacoat, by Epic Metals Corp.**
   1. Galvanized Steel Sheet: ASTM A653, with G90 galvanized coating, pre-treated and cleaned in accordance with surface prep requirements for specified coating system.
      a. Grade: As indicated
   2. Profile: As indicated.
   3. Refer to Division 9 "High Performance Coatings" for field-applied two-coat system.

2.02 ACCESSORY MATERIALS

A. Welding Materials: **<<AWS D1.1/D1.1M>>**.

B. Fasteners: **<< Stainless; Galvanized hardened; or _____>>** steel, self tapping.

C. Fasteners at Natatorium: Bi-metal, self drilling, self-tapping stainless steel screws with hardened carbon steel point.

D. Powder Actuated Mechanical Fasteners: Steel; with knurled shank and forged ballistic point. Comply with applicable requirements of **<<ICC-ES AC70>>**. ***Not to be used at roof deck.***
   1. Fasteners shall have an ICC ES evaluation report and shall have been tested in accordance with ICC ES AC70

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2. Delegated Design of steel deck fastening system: Refer to Part I of this specification.
3. Installation of steel deck fastening system: Powder Actuated Fasteners shall be installed by qualified persons trained and certified by the fastener manufacturer. Installation shall be in accordance with the manufacturer's recommendations and the Delegated Design submittal.

E. Mechanical Screw Fasteners: Steel; hex washer head, self-drilling, self-tapping. ***To be used as the sidelap connections only.***
1. Fasteners shall have an ICC ES evaluation report and shall have been tested in accordance with ICC ES AC43.
2. When part of delegated design using powder actuated fasteners screw sizes and pattern shall be included in the delegated design (refer to Part I of this specification), else as indicated.
3. Installation of steel deck fastening system: Screw fasteners shall be installed by qualified persons experienced in the use of these fasteners and installation tools on similar previous work. Installation shall be in accordance with the manufacturer's recommendations and the Delegated Design submittal.

F. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

G. Weld Washers: Mild steel, uncoated, **<< 3/4 inch; or ____ inch>>** outside diameter, **<< 1/8 inch; or ____ inch>>** thick.

H. Shop and Touch-Up Primer: **<< SSPC-Paint 15; or _____>>**, complying with VOC limitations of authorities having jurisdiction.

I. Touch-Up Primer for Galvanized Surfaces: **<< SSPC-Paint 20; SSPC-Paint 20 Type I - Inorganic; SSPC-Paint 20 Type II - Organic; or _____>>**, complying with VOC limitations of authorities having jurisdiction.

J. Flute Closures: Closed cell **<< foam rubber; or _____>>**, **<< 1 inch; or ____ inch>>** thick; profiled to fit tight to the deck.

2.03 FABRICATED DECK ACCESSORIES

A. Sheet Metal Deck Accessories: Metal **<< closure strips; wet concrete stops; cover plates; and other standard sheet metal accessories>>**, 22 guage (0.0299 inch) thick sheet steel unless otherwise indicated; of profile and size as indicated; **<< finished same as deck; galvanized; or primed>>**.

B. Pour Stops: Same material, profile and finish as deck, with thickness according to Steel Deck Institute (SDI) recommendations based on overhang dimension and slab thickness, unless otherwise noted.

C. Roof **<< Sump Pans; Drain Pans; Sump Plates; or _____>>**: Formed sheet steel, **<< 14 gauge, 0.0747 inch; or ___ gauge, ___ inch>>** minimum thickness, flat bottom, sloped sides, recessed **<< 1-1/2 inches>>** below roof deck surface, bearing flange **<< 3 inches>>** wide, sealed watertight.

D. Floor Drain Pans: Formed sheet steel, **<< 14 gauge, 0.0747 inch; or ___ gauge, ___ inch>>** minimum thickness, flat bottom, sloped sides, recessed **<< 1-1/2 inches>>** below floor deck surface, bearing flange **<< 3 inches>>** wide, sealed watertight.

E. Hips and Valleys: Same material and finish as deck. Fasten as per edge fastening requirements on roof plan.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions are suitable for deck installation prior to beginning work.

3.02 INSTALLATION

A. Erect metal deck in accordance with **<< SDI Manual of Construction of Steel Deck; manufacturer's instructions; and _____>>**. Align and level.

B. On **<< concrete; masonry; and ____>>** surfaces provide bearing length as indicated, and **<< 4 inch; 6 inch; or ___ inch>>** minimum.

C. On steel supports provide bearing length as indicated, and **<< 1-1/2 inch; 3 inch; or _____>>** minimum bearing or per manufacturers requirements for interior supports, heavy reactions and for deep deck.

D. Fasten deck to steel support members at ends and intermediate supports as indicated.

E. Fasten side laps: **<< As indicated; or #10 Galv Screws at 18" o.c. unless otherwise noted>>** As indicated or #10 Galc Screws at 18" oc unless otherwise noted.

F. Drive mechanical sidelap connectors completely through adjacent lapped sheets; positively engage adjacent sheets with minimum three-thread penetration.

G. Deck Welding in accordance with **<<AWS D1.3/D1.3M>>**.

1. Weld washers: Uncoated sheet steel, fabricated to fit in deck rib; thickness and hole diameter as recommended by deck manufacturer, but no less than 16 ga thick x 3/8 inch diameter hole.

H. Where deck changes direction, install **<< 6 inch>>** minimum wide sheet steel cover plates, of same thickness as deck. Fusion weld **<< 12 inches; or ____ inches>>** on center maximum.

I. At floor edges, install concrete stops upturned to top surface of slab, to contain wet concrete, unless otherwise indicated. Provide stops of sufficient strength to remain stationary without distortion.

J. At openings between deck and walls, columns, and other penetrations, provide sheet steel closures and angle flashings to close openings.

K. Close openings **<< above walls and partitions perpendicular to deck flutes; and _____>>** with **<< single; double; or _____>>** row of foam cell closures.

L. Position roof drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.

M. Position floor drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.

N. Immediately after fastening deck and other metal components in position, wire brush clean and coat welds, burned areas, and damaged surface coating, with touch-up primer per manufacturer's instructions. Patch and close all holes in deck created by welding, prior to touch-up.

O. Where indicated, shore composite deck before concrete placement.

P. Sound Absorbing Insulation: Where indicated, install premolded roll or strip sound absorbing insulation according to deck manufacturer's instructions.

Q. Natatorium Roof Deck Installation

1. Apply first coat of two coat system before deck is installed.

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2. Before permanent fastening adjust deck panels into final position with ends aligned and with adequate bearing on the supporting frame.
3. Fasten to supporting structure with mechanical fasteners, as indicated. Welding is not permitted, unless approved by architect.
4. Fasten sidelaps: As indicated.

3.03 FIELD QUALITY CONTROL

A. The owners approved agent shall engage a qualified independent testing and inspection agency to perform field quality control tests, as specified in Section 014000 - Quality Requirements and as follows:
   1. Inspect deck attachments are in accordance with construction documents and shop drawings.
   2. Prior to placement of concrete inspect steel headed stud anchors
      a. Break and remove ceramic ferules from deck prior to concrete operations.

END OF SECTION 053100

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SECTION 054000
COLD-FORMED STEEL FRAMING - STRUCTURAL (CFSF-S)

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members.

B. AISI S200 - North American Standard for Cold-Formed Steel Framing - General Provisions.

C. AISI S201 - North American Standard for Cold-Formed Steel Framing - Product Data.

D. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing.

E. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing.

F. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing.

G. AISI S400 - North American Standard for Seismic Design of Cold-Formed Steel Structural Systems.

H. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

I. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

J. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

K. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.

L. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.

M. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel.

N. ICC (IBC) - International Building Code.

O. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).

1.02 DOMESTIC ORIGIN

A. Consistent with Maryland Annotated Code, Article 78A known as “Buy American Steel” Act of the General Assembly of Maryland, Acts of 1978, steel used on this project shall be manufactured in the United States of America.

1.03 SUBMITTALS

A. Refer Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Sustainable Design Submittal: Refer to Division 01 Section “Sustainable Design Requirements.”

C. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, limitations**<< and accessories; or None - N/A>>**.

D. Product Data: For lateral-force resisting systems, provide product data sheets on hold-down, showing compliance with requirements.

E. Shop Drawings: Provide signed and sealed shop drawings and calculations by a Registered Professional Engineer licensed in the Commonwealth of Marlyand. Shop drawings shall ndicate component details, **<< framed openings; bearing; anchorage; loading; welds;**

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type and location of fasteners; and _____>>, and accessories or items required of related work.

1. Indicate **<< stud; floor joist; ceiling joist; roof joist; roof rafter; roof truss; and _____>>** layout.
2. Describe method for securing **<< studs; or _____>>** to tracks and for **<< bolted; welded; or _____>>** framing connections.

F. Product test reports for steel sheet, Power-actuated anchors, mechanical fasteners, vertical deflection clips, and miscellaneous structural clips and accessories.

1.04 QUALITY ASSURANCE

A. Designer Qualifications: Design framing system under direct supervision of a professional structural engineer experienced in designing this work and licensed in **<<the State in which the Project is located>>**.

B. Welder Qualifications: Welding processes and welding operators qualified in accordance with **<<AWS D1.1/D1.1M>>** and **<<AWS D1.3/D1.3M>>** and dated no more than **<< 12 months; or ____>>** before start of scheduled welding work.

1.05 PRE-INTSALLATION CONFERENCE:

A. Conduct the conference at the project site a minimum of 2 weeks prior to the comensing of cold form steel work.

1.06 DELIVERY, STORAGE AND HANDLING

A. Protect cold-formed steel framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed steel framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Design Requirements: Design cold-formed framing systems, components and connectors to withstand specified design loads in compliance with **<< ICC (IBC); ASCE 7; applicable building code; AISI S100; AISI S240; AISI S400; and _____>>**.

B. Regulatory Requirements: Comply with **<< applicable building code; or _____>>** criteria for loads, including seismic loads.

1. Design Loads: **<< In accordance with applicable codes.; As indicated on the drawings.; As follows:; or _____ .>>**
2. Framing shall be designed to resist design loads with deflections not greater than the followings:
   a. Exterior Load Bearing and Non-Load Bearing Wall shall have a horizontal deflection not greater than L/240 or L/600 for brick veneer.
   b. Interior Load Bearing and Non-Load Bearing Wall horizontal deflection shall have a horizontal deflection not greater than L/240 under a horizontal load of 5 psf (ASD) or 8 PSF (LRFD).
   c. Floor Joist, Roof Rafter, and Ceiling Joist framing shall have a vertical deflection not greater than L/240 for total load and L/360 for live loads.
3. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic

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day/night temperature ranges subject to a maximum ambient temperature change of 120 deg F.

4. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings with an upward and downward movement of 1 inch.

2.02 MATERIALS

A. Steel Sheet: **<<ASTM A1003/A1003M>>**, subject to the ductility limitations indicated in **<<AISI S240>>**.

2.03 STRUCTURAL FRAMING COMPONENTS

A. Wall Studs and Track Sections: **<<AISI S240>>**; c-shaped studs and u-shaped track sections in stud-matching nominal width and compatible height.

B. Studs and Track: **<<ASTM C955>>**; studs formed to channel, C- or Sigma-shaped with punched web; U-shaped track in matching nominal width and compatible height.

1. Stud: 1-5/8 inch flange width; load bearing - 0.0428 in (18 gage) minimum and non-load bearing - 0.0329 inch (20 gage).
2. Track: 1-1/4 inch flange width; thickness to match stud thickness.
3. Galvanized in accordance with **<<ASTM A653/A653M>>**, **<< G90/Z275; G60/Z180; or ____>>** coating.

C. Steel Box or Back to Back headers studs formed to C- or Sigma-shaped with unpunched web, with stiffeners, U-shaped track in matching nominal width and compatible height.

D. Steel Single or Double L headers formed to L shapes used to form header beams of web depths indicated.

E. Jamb Studs: **<<AISI S240>>**; manufactured, engineered, c-shaped with wide flanges, designed to replace conventional double-stud framing at openings.

F. Headers: **<<AISI S240>>**; manufactured, engineered **<< one-member; two-member; or _____>>** assemblies, with wide flanges, designed to replace conventional box or nested header framing at openings.

1. Jamb Mounting Clips: Manufacturer's standard.
2. Cripple Stud Clips: Manufacturer's standard.

G. Joists and Purlins: Fabricated from **<<ASTM A653/A653M>>** steel sheet, with **<< G90/Z275; G60/Z180; or _____>>** hot dipped galvanized coating.

1. Base Metal: **<< Structural Steel (SS), Grade 33/230; Structural Steel (SS), Grade 37/255; Structural Steel (SS), Grade 50/340, Class 1; or _____>>**.
2. Flange width of 1 5/8 inches, with depths as indicated on plans.
3. Mil thickness: As required to meet specified performance levels.

2.04 MISCELLANEOUS CONNECTIONS

A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot-dip galvanized per **<<ASTM A153/A153M>>**.

B. Welding: Comply with **<< AWS D1.1/D1.1M; AWS D1.3/D1.3M; and _____>>**.

2.05 ACCESSORIES

A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.

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B. Plates, Gussets, Clips: **<< Formed ; or None - N/A>>**Sheet Steel, thickness determined for conditions encountered; finish to match framing components.

C. Galvanizing Repair: Touch up bare steel with zinc-rich paint in compliance with **<<ASTM A780/A780M>>**.

D. Shop and Touch-Up Primer: **<< SSPC-Paint 15; or _____>>**, complying with VOC limitations of authorities having jurisdiction.

E. Touch-Up Primer for Galvanized Surfaces: **<< SSPC-Paint 20 Type I - Inorganic; SSPC-Paint 20 Type II - Organic; or _____>>**, complying with VOC limitations of authorities having jurisdiction.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that **<< substrate surfaces; abutting building framing components; or _____>>** are ready to receive work.

B. Verify field measurements and adjust installation as required.

3.02 INSTALLATION - GENERAL

A. Install structural members and connections in compliance with **<<ASTM C1007>>**.

3.03 INSTALLATION OF STUDS

A. Install non load bearing or load-bearing studs; brace, and reinforce to develop full strength and achieve design requirements.

B. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.

C. Install intermediate studs above and below openings to align with wall stud spacing.

D. Provide deflection allowance in stud track, directly below horizontal building framing at non-loadbearing framing.

E. Attach **<< cross studs; furring channels; or _____>>** to studs for attachment of fixtures anchored to walls.

F. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.

G. Touch-up field welds and damaged **<< corrosion protected; primed; or _____>>** surfaces with primer.

3.04 INSTALLATION OF << JOISTS; PURLINS; AND _____>>

A. Install framing components in accordance with manufacturer's instructions.

B. Place **<< joists; purlins; or _____>>** at a maximum of **<< 12 inches; 16 inches; 24 inches; or ____ inches>>** on center; not more than **<< 2 inches; or ____ inches>>** from abutting walls and connect joists to supports using **<< fastener; welding; or _____>>** method.

C. Set **<< floor; ceiling; and _____>><< joists; or _____>>** parallel and level, with lateral bracing and bridging.

D. Locate joist end bearing directly over load-bearing studs or provide load distribution on top of stud track.

E. Provide web stiffeners at **<< reaction points; or _____>>**.

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F. Touch-up field welds and damaged **<< galvanized; primed; or _____>>** surfaces with primer.

3.05 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Provide inspections for **<< welding; mechanical fastening; cold-formed steel light-frame construction; lateral force-resisting systems; and _____>>** in accordance with requirements of **<<AISI S240>>**.

END OF SECTION 054000

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SECTION 054003.13
CONTINUOUS INSULATION (CI) FRAMING SYSTEM - BRACKET

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

C. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

D. ASTM A1046/A1046M - Standard Specification for Steel Sheet, Zinc-Aluminum-Magnesium Alloy-Coated by the Hot-Dip Process.

E. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

G. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

H. ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing Members.

I. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.

J. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

K. ASTM F594 - Standard Specification for Stainless Steel Nuts.

L. ASTM F1941/F1941M - Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric.

M. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).

1.02 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting: Conduct pre-installation meeting at Project site before starting work of this section to verify project requirements, coordinate with installers of other work, establish condition and completeness of building substrate, and review manufacturers' installation instructions and warranty requirements.

B. Coordinate with work of other sections that is to be installed over, or anchored to, the continuous insulation (CI) framing system, including but not limited to structural anchors, claddings and cladding anchors, utilities, insulation, and firestopping.

1.03 DEFINITIONS

A. Clipped Continuous Insulation (CI) Framing System: An engineered “fixing” system of framing designed to support building veneers on metal girts, transmitting all structural loads through insulation to the wall substrate via intermittent, thermally-isolated clips while maintaining required thermal performance of the wall.

1.04 SUBMITTALS

A. Product Data: Provide product data for factory fabricated continuous insulation (CI) framing members and each accessory product.

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B. Shop Drawings: Indicate component details, including sizes, depths, and thicknesses of clips, girts, rails, and accessories or items required of related work.
   1. Indicate cladding joint layout, with CI framing system clip and girt layout and spacing coordinated for proper anchorage and support.
   2. Indicate anchorage details including mechanical fasteners for securing CI framing system to primary structural wall element.
      a. Indicate supplemental framing and reinforcing as required due to structural calculations.
   3. Design Data: Include calculations for loadings and stresses of factory fabricated CI framing for project specific claddings and loadings, signed and sealed by a professional structural engineer.

C. Thermal Modeling Report: Provide test data indicating reduction of R-value of continuous insulation due to framing penetrations. Test data shall demonstrate, at minimum, compliance with **<<ASHRAE Std 90.1 I-P>>** U-factor requirement for walls of construction indicated.

D. Test Reports: Provide test reports performed by a qualified testing agency, for structural anchors, mechanical fasteners, framing clips, and accessories.

E. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

F. Designer's Qualification Statement.

G. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design CI framing system under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in **<<the State in which the Project is located>>**.

B. Installer Qualifications: Company specializing in exterior/envelope wall systems installation, experienced in the erection and installation of CI framing systems with a history of successful in-service use.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in factory-provided protective coverings and packaging.

B. Protect materials against damage during transit, delivery, storage, and installation at site.

C. Prior to installation, store materials and components under cover in a dry, clean location.

D. Protect CI framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

1.07 WARRANTY

A. Warranty: Installer's warranty against failures in materials, fabrication, finishes, and installation commencing on Date of Substantial Completion. Failures include structural cracks or punctures, material deterioration, and workmanship.
   1. Warranty Period: Two years beginning at the date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

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A. Continuous Insulation (CI) Framing Systems: Provide complete system including manufacturer's supplementary girts/rails and other required accessories with bracket system indicated.
   1. Aluminum Systems:
      a. ECO Cladding; Sigma Bracket.
      b. GIP GmbH; VECO-A.
      c. Hilti; FOX VI.
      d. SFS intec Ltd. / NVELOPE Rainscreen Systems Ltd.; NV1 Bracket.
   2. Steel Systems:
      a. Exo-Tec Manufacturing, Inc; Stand-Off MPV Bracket.
      b. GIP GmbH; VECO-G.
      c. Knight Wall Systems; MFI D-Series.
      d. Northern Facades; ISO Clip.
   3. Substitutions: Refer to Section 016000 - Product Requirements.

2.02 CONTINUOUS INSULATION (CI) FRAMING SYSTEM

A. Provide primary and secondary framing members (girts and rails), bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.

B. Design Requirements: Provide complete CI framing system, capable of supporting indicated exterior finish cladding(s) in a "rainscreen" design when anchored to indicated structural substrates. System shall consist of thermally isolated brackets supporting vertical girts. Where necessary due to cladding orientation or engineered design, vertical girts shall support horizontal rails. Design shall have the following characteristics:
   1. Structural Performance: Design, engineer, fabricate, and erect to withstand specified design loads for project conditions within required limits.
   2. Design Loads: Refer to Structural Drawings for wind and live loads.
   3. Spacing and types of girts and rails shall be as required by cladding manufacturer to support each indicated type of cladding.
      a. Coordinate with cladding manufacturer(s) for dead loads of cladding system(s).
      b. Coordinate with indicated joint layouts to ensure secondary girts are spaced to provide appropriate structural attachment for cladding(s).
      c. The primary material of the bracket and girt components shall be steel or aluminum. Products fabricated of fiberglass or a composite material are not acceptable.
   4. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
   5. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

C. Thermal Performance: System shall obtain effective R-value or U-factor indicated.
   1. Continuous framing profiles fully penetrating insulation are not allowed. Metal framing shall not thermally bridge exterior and interior except for fasteners.
   2. Framing assembly shall not reduce continuous insulation nominal R-value to less than 90% effective R-value.
   3. Continuous insulation framing system shall be thermally modeled to demonstrate, at minimum, compliance with **<<ASHRAE Std 90.1 I-P>>** maximum U-factor for walls.

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D. Flatness: Installed system and components shall be flat within the tolerances allowable by cladding manufacturer; with no noticeable warping, buckling, deflections, or other surface irregularities that distort cladding.

E. Heat Resistance: All components that will come into contact with spray foam insulation shall be capable of exposure to the heat generated by spray foam installation without damage, including plastic washers and thermal spacers. Plastics and resins shall be rated for exposure to temperatures of 300 degrees Fahrenheit or more intermittently without loss of structural capacity or integrity.

F. Ventilation: System design shall allow for movement of air in the cavity behind the cladding, including compartmentalization and/or cross-ventilation for a pressure-equalized system where indicated.

G. Drainage: System design shall allow for drainage of moisture from the cavity behind the cladding.

H. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with Code of Standard Practice.

I. Shop fabricate framing system to the greatest extent possible.

J. Deliver to project site in largest practical sections.

2.03 CONTINUOUS INSULATION FRAMING MATERIALS

A. Steel Framing: Either **<<ASTM A792/A792M>>** aluminum-alloy coated steel or **<<ASTM A1046/A1046M>>** zinc-aluminum-magnesium alloy coated steel.

B. Aluminum Framing: **<<ASTM B209/B209M>>**, Alloy 6061-T6 for plate and sheet and **<<ASTM B221>>**, Alloy 6063-T6 for extrusions.

C. Brackets: To suit girts and cladding system loads, and providing for field adjustment of girts to maintain plane of cladding. Provide fixed or floating type as required to accommodate expansion. Provide brackets of depths required for total wall thickness and cavity sizes indicated on Drawings, including adjustable or custom brackets as required.

D. Girts: As required to suit anchoring of perpendicular rails. Provide either vertical or horizontal girts as required due to indicated orientation of cladding.

1. Perpendicular Rails: Subframing rails mounted to girts, to meet the requirements of cladding manufacturer for support and attachment at cladding ends and joints, and for regular spacing for attachment of claddings.

E. Thermal-Break Pads / Spacers: Minimum 1/8-inch thick; fabricated of stable polymer or resin material that is suitable for loading and for heat resistance indicated, including but not limited to polyoxymethylene (POM) or fiberglass (epoxy- or vinyl ester-based). Polymer pad shall be for thermal break properties only and shall not bear structural loading of cladding materials.

2.04 FASTENERS

A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Type 304 stainless-steel or zinc-plated with electrodeposition coating per **<<ASTM B633>>** or **<<ASTM F1941/F1941M>>**.

B. Anchorage Devices: **<< Powder actuated; Drilled expansion bolts; Screws with sleeves; and _____>>** or chemical anchors; Alloy Group 1 stainless steel per **<<ASTM F593>>** for bolts and **<<ASTM F594>>** for nuts.

2.05 ACCESSORIES

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A. Touch-Up Primer for Galvanized Surfaces: **<< SSPC-Paint 20 Type I - Inorganic; SSPC-Paint 20 Type II - Organic; or _____>>**, complying with VOC limitations of authorities having jurisdiction.

B. Protective Coating: Provide corrosion protection coating on concealed aluminum surfaces in contact with cementitious materials or dissimilar metals.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that **<< substrate surfaces; building framing components; or _____>>** are ready to receive work.

B. Verify field measurements and adjust installation as required.

3.02 INSTALLATION

A. Install components in accordance with **<< manufacturers' instructions; ASTM C1007 requirements; and _____>>**.

B. Attach primary brackets prior to application of spray foam insulation/air barrier. Install brackets true to line with secure connections to primary structural components, at spacing required by load calculations and as indicated on Shop Drawings.

C. After installation of spray foam insulation/air barrier, remove only amount needed for attachment of secondary girts/rails and cladding support anchors. Notify spray foam installer if amount of material removed affects wall's insulating or air/vapor barrier performance, or if touch up is required.

D. Install framing girts/rails plumb, square, and true to line, with securely fastened connections.
   1. If cutting is required, cut by sawing or shearing, do not torch cut. Protect adjacent surfaces from sparks.
   2. Fasten CI framing members by screw fastening. Locate all mechanical fasteners as indicated on Shop Drawings.
   3. Locate screws at slotted holes to allow for expansion and contraction in the CI framing system design.
   4. Each girt shall be supported by at least two primary support brackets.
   5. Do not bridge building expansion joints with CI framing. Independently frame both sides of joints.

3.03 TOLERANCES

A. Maximum Variation from True Position: **<< 1/8 inch>>**.

B. Maximum Variation of any Member from Plane: **<< 1/8 inch>>**, unless otherwise indicated by cladding manufacturer.

3.04 REPAIR AND PROTECTION

A. Touch up shop-applied coatings as required if damaged during handling or installation.

B. After installation of primary support brackets, inspect substrates for damage and repair substrate flashings or membranes as required.

C. Provide fine adjustments to CI framing as required immediately prior to cladding installation to verify that tolerances are maintained. Prepare CI framing in a timely manner to avoid excessive UV exposure to substrate membranes, air barriers, and other materials.

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D. Provide final protection of CI framing as required to ensure that CI framing system is without damage or deterioration prior to installation of cladding.

END OF SECTION 054003.13

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SECTION 054003.14
CONTINUOUS INSULATION (CI) FRAMING SYSTEM - GIRT

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

C. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

D. ASTM A1046/A1046M - Standard Specification for Steel Sheet, Zinc-Aluminum-Magnesium Alloy-Coated by the Hot-Dip Process.

E. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

G. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

H. ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing Members.

I. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.

J. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

K. ASTM F594 - Standard Specification for Stainless Steel Nuts.

L. ASTM F1941/F1941M - Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric.

M. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).

1.02 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting: Conduct pre-installation meeting at Project site before starting work of this section to verify project requirements, coordinate with installers of other work, establish condition and completeness of building substrate, and review manufacturers' installation instructions and warranty requirements.

B. Coordinate with work of other sections that is to be installed over, or anchored to, the continuous insulation (CI) framing system, including but not limited to structural anchors, claddings and cladding anchors, utilities, insulation, and firestopping.

1.03 DEFINITIONS

A. Floating Continuous Insulation (CI) Framing System: An engineered “fixing” system of framing designed to support building veneers on metal girts, transmitting all structural loads through insulation to the wall substrate solely via fasteners and the compressive strength of indicated board insulation, while maintaining required thermal performance of the wall.

1.04 SUBMITTALS

A. Product Data: Provide product data for factory fabricated continuous insulation (CI) framing members and each accessory product.

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B. Shop Drawings: Indicate component details, including sizes, depths, and thicknesses of clips, girts, rails, and accessories or items required of related work.
   1. Indicate cladding joint layout, with CI framing system clip and girt layout and spacing coordinated for proper anchorage and support.
   2. Indicate anchorage details including mechanical fasteners for securing CI framing system to primary structural wall element.
      a. Indicate supplemental framing and reinforcing as required due to structural calculations.
   3. Design Data: Include calculations for loadings and stresses of factory fabricated CI framing for project specific claddings and loadings, signed and sealed by a professional structural engineer.

C. Thermal Modeling Report: Provide test data indicating reduction of R-value of continuous insulation due to framing penetrations. Test data shall demonstrate, at minimum, compliance with **<<ASHRAE Std 90.1 I-P>>** U-factor requirement for walls of construction indicated.

D. Test Reports: Provide test reports performed by a qualified testing agency, for structural anchors, mechanical fasteners, framing clips, and accessories.

E. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

F. Designer's Qualification Statement.

G. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design CI framing system under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in **<<the State in which the Project is located>>**.

B. Installer Qualifications: Company specializing in exterior/envelope wall systems installation, experienced in the erection and installation of CI framing systems with a history of successful in-service use.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in factory-provided protective coverings and packaging.

B. Protect materials against damage during transit, delivery, storage, and installation at site.

C. Prior to installation, store materials and components under cover in a dry, clean location.

D. Protect CI framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

1.07 WARRANTY

A. Warranty: Installer's warranty against failures in materials, fabrication, finishes, and installation commencing on Date of Substantial Completion. Failures include structural cracks or punctures, material deterioration, and workmanship.
   1. Warranty Period: Two years beginning at the date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Continuous Insulation (CI) Framing Systems: Provide complete system including girts/rails and other required accessories with framing system indicated.

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1. Aluminum Systems:
   a. IMETCO; IntelliFrame.
   b. MOTO Cladding; SL / DL System.
   c. Universe Facade Solutions; Universe "U" Series System.
2. Steel Systems:
   a. Clark Dietrich; ProChannel CI System.
   b. Knight Wall Systems; **<< CI System; or HCI System>>**.
3. Substitutions: Refer to Section 016000 - Product Requirements.

2.02 CONTINUOUS INSULATION (CI) FRAMING SYSTEM

A. Provide primary and secondary framing members (girts and rails), bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.

B. Design Requirements: Provide completed CI framing system, capable of supporting indicated exterior finish cladding(s) in a "rainscreen" design when anchored to indicated structural substrates. System shall consist of girts or clips supported by indicated insulation and anchored through insulation to substrate only via fasteners. Where necessary due to cladding orientation or engineered design, girts or clips shall support secondary framing rails. Design shall have the following characteristics:
   1. Structural Performance: Design, engineer, fabricate, and erect to withstand specified design loads for project conditions within required limits.
   2. Design Loads: Refer to Structural Drawings for wind and live loads.
   3. Spacing and types of girts and rails shall be as required by cladding manufacturer to support each indicated type of cladding.
      a. Coordinate with cladding manufacturer(s) for dead loads of cladding system(s).
      b. Coordinate with indicated joint layouts to ensure secondary girts are spaced to provide appropriate structural attachment for cladding(s).
      c. The primary material of the girt components shall be steel or aluminum. Products fabricated of fiberglass or a composite material are not acceptable.
   4. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
   5. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

C. Thermal Performance: System shall obtain effective R-value or U-factor indicated.
   1. Continuous framing profiles fully penetrating insulation are not allowed. Metal framing shall not thermally bridge exterior and interior except for fasteners.
   2. Framing assembly shall not reduce continuous insulation nominal R-value to less than 90% effective R-value.
   3. Continuous insulation framing system shall be thermally modeled to demonstrate, at minimum, compliance with **<<ASHRAE Std 90.1 I-P>>** maximum U-factor for walls.

D. Flatness: Installed system and components shall be flat within the tolerances allowable by cladding manufacturer; with no noticeable warping, buckling, deflections, or other surface irregularities that distort cladding.

E. Heat Resistance: All components that will come into contact with spray foam insulation shall be capable of exposure to the heat generated by spray foam installation without damage, including plastic washers and thermal spacers. Plastics and resins shall be rated for exposure to

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temperatures of 300 degrees Fahrenheit or more intermittently without loss of structural capacity or integrity.

F. Ventilation: System design shall allow for movement of air in the cavity behind the cladding, including compartmentalization and/or cross-ventilation for a pressure-equalized system where indicated.

G. Drainage: System design shall allow for drainage of moisture from the cavity behind the cladding.

H. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with Code of Standard Practice.

I. Shop fabricate framing system to the greatest extent possible.

J. Deliver to project site in largest practical sections.

2.03 CONTINUOUS INSULATION FRAMING MATERIALS

A. Steel Framing: Either **<<ASTM A792/A792M>>** aluminum-alloy coated steel or **<<ASTM A1046/A1046M>>** zinc-aluminum-magnesium alloy coated steel.

B. Aluminum Framing: **<<ASTM B209/B209M>>**, Alloy 6061-T6 for plate and sheet and **<<ASTM B221>>**, Alloy 6063-T6 for extrusions.

C. Primary Girts/Clips: As required to suit anchoring of cladding or perpendicular rails as necessary. Provide either vertical or horizontal girts as required due to indicated orientation of cladding.

1. Perpendicular Rails: Subframing rails mounted to girts, to meet the requirements of cladding manufacturer for support and attachment at cladding ends and joints, and for regular spacing for attachment of claddings.

2.04 FASTENERS

A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Type 304 stainless-steel or zinc-plated with electrodeposition coating per **<<ASTM B633>>** or **<<ASTM F1941/F1941M>>**.

B. Anchorage Devices: **<< Powder actuated; Drilled expansion bolts; Screws with sleeves; and _____>>** or chemical anchors; Alloy Group 1 stainless steel per **<<ASTM F593>>** for bolts and **<<ASTM F594>>** for nuts.

2.05 ACCESSORIES

A. Touch-Up Primer for Galvanized Surfaces: **<< SSPC-Paint 20 Type I - Inorganic; SSPC-Paint 20 Type II - Organic; or _____>>**, complying with VOC limitations of authorities having jurisdiction.

B. Protective Coating: Provide corrosion protection coating on concealed aluminum surfaces in contact with cementitious materials or dissimilar metals.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that **<< substrate surfaces; building framing components; or _____>>** are ready to receive work.

B. Verify field measurements and adjust installation as required.

C. Verify that installation of primary air barrier, air barrier transition materials, flashings, and other materials is complete.

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3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions.

B. Where individual clips are used, mount clips plumb, square, and true to line, at intervals and locations indicated on approved Shop Drawings.

C. Install framing girts/rails plumb, square, and true to line, with securely fastened connections.
   1. Do not use shims between girts and insulation.
   2. If cutting is required, cut by sawing or shearing, do not torch cut. Protect adjacent surfaces from sparks.
   3. Fasten CI framing members by screw fastening. Locate all mechanical fasteners as indicated on Shop Drawings.
   4. Locate screws at slotted holes, and maintain gaps between ends of multiple girt components, to allow for expansion and contraction in the CI framing system design.
   5. Where individual clips are used, each girt shall be supported by at least two primary support clips.
   6. Do not bridge building expansion joints with CI framing. Independently frame both sides of joints.

D. Anchor Fastening: Tighten anchor screws to a snug tight condition; do not strip screws and do not over-torque beyond manufacturer's recommendations. Do not over-compress insulation. If installed using hand tools, verify for each installer at beginning of the work using snug-tight criteria.
   1. Do not use stripped holes. If fastener must be removed, patch all holes, including holes in insulation, air barrier membranes, transition membranes, and flashings, as applicable.

3.03 TOLERANCES

A. Maximum Variation from True Position: **<< 1/8 inch>>**.

B. Maximum Variation of any Member from Plane: **<< 1/8 inch>>**, unless otherwise indicated by cladding manufacturer.

3.04 REPAIR AND PROTECTION

A. Touch up shop-applied coatings as required if damaged during handling or installation.

B. After installation of primary support brackets, inspect substrates for damage and repair substrate flashings or membranes as required.

C. Provide fine adjustments to CI framing as required immediately prior to cladding installation to verify that tolerances are maintained. Prepare CI framing in a timely manner to avoid excessive UV exposure to substrate membranes, air barriers, and other materials.

D. Provide final protection of CI framing as required to ensure that CI framing system is without damage or deterioration prior to installation of cladding.

END OF SECTION 054003.14

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SECTION 055000
METAL FABRICATIONS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

C. ASTM A48/A48M - Standard Specification for Gray Iron Castings.

D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.

G. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.

H. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

I. ASTM A536 - Standard Specification for Ductile Iron Castings.

J. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

K. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

L. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.

M. AWS D1.1/D1.1M - Structural Welding Code - Steel.

N. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.

O. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172.

P. NAAMM MBG 531 - Metal Bar Grating Manual.

Q. SCAQMD 1113 - Architectural Coatings.

R. SCAQMD 1168 - Adhesive and Sealant Applications.

S. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.

T. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).

U. SSPC-SP 3 - Power Tool Cleaning.

V. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning.

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1.02 SUBMITTALS

A. Product Data: Provide product data for each factory fabricated product and accessory material. Include product data for the following:
   1. Nonshrink grout.
   2. Shop primer paint products.
      a. Coordinate with Division 9 Painting topcoat manufacturer and provide compatibility certificates from topcoat manufacturer that shop primers are acceptable substrate for specified topcoats.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Include field measurements, and indicate where field measurements differ from documents.
   2. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.

C. Welders' Qualification Statement: Welders' certificates in accordance with **<<AWS B2.1/B2.1M>>** and dated no more than 12 months before start of scheduled welding work.

D. Designer's Qualification Statement.

E. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under **<<IAS AC172>>**.

1.03 QUALITY ASSURANCE

A. Design mechanical supports and miscellaneous steel shapes under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Maryland.

B. Welder Qualifications: Welding processes and welding operators qualified in accordance with **<<AWS D1.1/D1.1M>>** and dated no more than 12 months before start of scheduled welding work.

C. Field Measurements: Take field measurements prior to fabrication and verify that dimensions and tolerances are acceptable for fabricated products to fit the space. Indicate field measurements on shop drawings.

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PART 2 PRODUCTS

2.01 GENERAL

A. Materials, General: Provide metal fabrications and components with finished surfaces that are smooth and flat. Metal fabrications and components shall not have labels, stickers, engraved or rolled manufacturer names, seams, or blemishes that are exposed in the finished work.

B. Sustainability:
   1. Provide steel fabrications with a minimum 25 percent postconsumer plus 1/2 of preconsumer recycled content.
   2. Provide factory fabricated components that contribute to project's building product disclosure requirements, per Division 01 Section "Sustainable Design Requirements."
   3. Low-Emitting Materials:
      a. Paints and Coatings: Paints, touch-up primers, and other coatings field-applied inside the weatherproofing system shall meet applicable VOC limits of **<<CARB (SCM)>>** or **<<SCAQMD 1113>>**.

b. Adhesives and Sealants: Adhesives and sealants shall meet the chemical content requirements of **<<SCAQMD 1168>>**.

2.02 MATERIALS - STEEL

A. Steel Sections: **<< ASTM A36/A36M; or _____>>**.

B. Steel Tubing: **<< ASTM A500/A500M Grade B cold-formed; ASTM A501/A501M hot-formed; or _____>>** structural tubing.

C. Plates: **<< ASTM A283/A283M; or _____>>**.

D. Pipe: **<< ASTM A53/A53M, Grade B Schedule 40; ASTM A53/A53M Grade B Schedule 80; ASTM A53/A53M Grade ____ Schedule 40; ASTM A53/A53M Grade ____ Schedule ____; or _____>>**.

E. Slotted Channel Fittings: **<<ASTM A1011/A1011M>>**, Grade 33.

F. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.

1. Provide stainless steel fasteners for all exterior construction and for fastening stainless steel fabrications.
2. Provide stainless steel fasteners at areas subject to moisture or steam, including mechanical rooms, janitor/custodial rooms with floor sinks, and similar spaces.
3. Provide zinc-plated fasteners for interior construction except where stainless steel is indicated.

G. Bolts, Nuts, and Washers: **<<ASTM A307>><< , Grade A; , Grade B; , _____; or None - N/A>><< , plain; , galvanized to ASTM A153/A153M where connecting galvanized components; or None - N/A>>**.

H. Welding Materials: **<<AWS D1.1/D1.1M>>**; type required for materials being welded.

I. Shop and Touch-Up Primer: **<< SSPC-Paint 15; or _____>>**, universal shop primer, complying with VOC limitations of authorities having jurisdiction.

J. Touch-Up Primer for Galvanized Surfaces: **<< SSPC-Paint 20, Type I - Inorganic; SSPC-Paint 20 Type II - Organic; or _____>>**, complying with VOC limitations of authorities having jurisdiction.

2.03 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 FABRICATED ITEMS

A. Metal Ladders: Refer to Division 5 Section "Metal Ladders".

B. Bollards:

1. Fixed Bollards (Utility Bollard for Service Areas): 6-inch diameter Schedule 40 steel pipe, concrete filled, with prefabricated finial cap, as detailed; manufacturer's standard polyester factory-powder coat finish. ******Architect/designer coordinate with MCPS bollard detail (refer to Adtek Civil details) for custom detail******

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a. Basis-of-Design: Calpipe Security Bollards IBF06040 with custom finial cap.
b. Finial Cap: 6 inch diameter by 6 inch high; as detailed; with rebar pigtails for embedding into concrete-filled bollard.
c. Total Exposed Height Including Cap: 48 inches, unless otherwise indicated.
d. Provide roofing felt wrapped around subgrade embedded bollard to serve as bond break between bollard and concrete footing.

2. Removable Bollards: 5-3/4 inch diameter ductile cast iron per **<<ASTM A536>>**; fixed cast-in anchor for casting into new concrete; manufacturer's standard factory polyester powder-coat finish.
   a. Basis-of-Design Product: Reliance Foundry; Model R-7576.
   b. Finial Cap Design: Three (3) decorative annular rings, with rounded cap; matching Basis-of-Design.
   c. Total Exposed Height Including Cap: 34 inches, unless otherwise indicated.
   d. Mounting Method: Manufacturer's standard cast-in anchor. Base is secured to anchor with a full-height 1-inch diameter threaded bar; 3-1/2 inch outside diameter washer and 1-inch nut (sized to threaded bar).
      1) Cap shall install to top of bollard base with three (3) 3/8-inch set screws with plastic plugs.
3. **<< Precast Concrete Bollards: >>**Refer to Division 3 "Precast Architectural Concrete" for decorative precast bollards.

C. **<< Catwalk:>>**Fabricate steel plate and other components specified in Division 05 Section "Structural Steel Framing" for catwalk assembly.

D. **<< Ledge Angles; Shelf Angles; Channels; Plates; and _____>>** Not Attached to Structural Framing: For support of **<< metal decking; joists; masonry; and _____>>**; prime paint finish for field finishing.

E. Lintels: As detailed; prime paint finish for field finishing.

F. Door Frames for **<< Overhead Door Openings; Wall Openings; and _____>>**: Channel or bent plate sections; prime paint finish for field finishing.

G. **<< Operable Partition Support:>>** Provide steel beam or other shape as acceptable to operable partition manufacturer, along length of operable partition; coordinate with manufacturer to size beam to prevent sag.

H. **<< Elevator >>** Hoist and Fall-Protection Beams: Provide beam sections as required by manufacturer; prime paint finish.

I. **<< Elevator >>** Sills: Provide angle shapes for slab edge locations and elevator sill supports; size in coordination with elevator manufacturer's requirements.

J. Slotted Channel Framing: Fabricate channels and fittings from **<<ASTM A1011/A1011M>>**, Grade 33 structural steel complying with the referenced standards; with **<< factory-applied, rust-inhibiting thermoset acrylic enamel; factory-applied, polyester powder-coat; electro-galvanized per ASTM B633 Type III, SC 1; hot-dipped galvanized per ASTM A653, Grade G90; hot-dipped galvanized per ASTM A1 Grade G65.; or _____>>** finish.
   1. Provide 1-5/8 inch by 1-5/8 inch channel unless otherwise indicated.

K. Bar Gratings: **<<NAAMM MBG 531>>**, welded or pressure-locked galvanized steel type. For all gratings, unless otherwise indicated, provide manufacturer's standard galvanized cross rods or bars spaced at 4 inches o.c.
   1. **<< Elevator>>** Sump Grating: Removable; type W-19-4 or P-19-4 per **<<NAAMM MBG 531>>**; minimum 1-inch high by 1/8-inch thick galvanized steel bearing bars, spaced approximately 1-3/16-inch o.c; with cross bars at 4 inches o.c.

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2. Provide welded frames for bar gratings, fabricated of galvanized steel shapes, with integral anchors/lugs for casting into concrete.

L. Miscellaneous Steel Shapes: Provide steel shapes for miscellaneous applications indicated on drawings, including but not limited to, reinforcing steel shapes at low partitions/knee walls, concrete slab edge angles, and metal corner guards.

2.05 ENCLOSURES AND GATES

A. Enclosures and Gates: Fabricate gate assembly, including steel gate posts, gate leaves, infill panels, and hardware, in configuration indicated. Galvanize all steel components.

1. Gate Posts: Provide Schedule 80 steel pipe gate posts, unless indicated otherwise. Close tops of posts with cap plates, welded and ground smooth.
2. Gate Framing: Provide 3-inch by 3-inch steel angle or bent plate for perimeter and intermediate framing of gates. Fabricate framing by welding; grind joints smooth.
3. Provide all necessary bracing and reinforcement as required for square, level, and flush operable gates.
4. Provide all fasteners, accessories, and hardware for a complete and operable gate assembly, unless indicated otherwise.
5. Infill: Vertically oriented, composite plastic lumber fabricated from a mixture of cellulose fiber and polyethylene or polypropylene; 1 inch by 5-1/2 inches actual dimension, with square edge. Provide with manufacturer's standard wood grain texture, with color selected from manufacturer's full range.
    a. Manufacturers:
        1) Fiberon LLC; Protect Advantage 1-inch Square Edge (Basis-of-Design)
        2) TimberTech.
        3) Trex Company, Inc.
6. Infill Panels: Provide prefabricated galvanized steel vision screen assembly for 100% visual screening. Infill panels may be secured to gate framing by welding or by mechanical attachments. If using fasteners, fasteners shall be concealed along sides of framing, with smooth exposed heads. Do not fasten to front faces of frame.
    a. Products:
        1) Ametco Manufacturing Corporation; Shadow 100.
        2) Barnett Bates; Orsogril Talia 100.
7. Hardware: Provide the following:
    a. Barrel Hinges: Exterior grade, weld-on type with grease fitting, of mild steel with stainless steel pin. Size to suit weight of gate, but rated not less than 600 pounds per hinge. Provide a minimum of two per gate leaf, unless indicated otherwise.
    b. Pulls: Bent, 1/4-inch by 1-inch galvanized steel bar stock, welded to frame. Minimum 6-inch high by 2-inch deep pull. Provide one at each gate leaf, vertically mounted.
    c. Staple and Hasp: To suit a standard padlock. Padlock is NIC.
    d. Cane Bolts: Minimum 30 inch length, with attachment hangers/brackets that hold bolts in retracted position, and with a weld pin positioned to prevent cane bolt from being accidentally removed from lower bracket. Provide one per gate leaf. Provide receiver cups for each gate leaf in both the closed and 90 degree open positions, to allow for gates to be held open. Fill spaces around receiver cups with non-shrink grout.

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2.06 NON-PENETRATING ROOF EDGE PROTECTION RAILING ****USE THIS RAILING PRODUCT ONLY IF NEEDED - DESIGNER SHALL TRY TO AVOID CONDITIONS THAT WOULD REQUIRE THIS RAILING (ROOF EQUIPMENT OR WALK PADS CLOSER THAN 10 FT TO ROOF EDGE)****

A. Roof Edge Protection Railing: Freestanding pedestrian barrier system, including pipe railings, upright posts, bases, and fittings. Provide with corrosion-resistant powdercoat finish complying with AAMA 2604.

1. Standards: Provide a railing system with horizontal top and mid rails, tested for a minimum structural load of 200 lb in any direction, in accordance with OSHA Regulation 29 CFR 1910.28, 1910.29, and 1926.502.
2. Height: Installed height of 42 inches from roof surface to top of top rail. Midrail height 20 inches from roof surface to top of midrail.
3. Mounting Bases: Manufacturer's standard, powdercoated, 90 lb cast iron, galvanized steel, or concrete filled PVC, with protective pads on bottom to protect roof surface.
4. Posts and Rails: Minimum 1-1/2 inch diameter, 16 gauge steel, powdercoated or galvanized.
5. Fittings: Provide manufacturer's standard fittings for a complete assembly. Post to base fitting shall have positive locking system that allows posts to be mounted in any direction. Friction locking is not permitted.
6. Hardware: Provide manufacturer's standard securing carbon steel pins, zinc plated and yellow chromate dipped, consisting of collared pin and lanyard that connects to lynch pin.
7. Accessories:
   a. Toe Board Brackets: Provide system of adjustable metal brackets to secure LP-2 treated lumber toe boards to railing system. Include LP-2 PPTW toeboards in modular length to suit railing system.
   b. Step-Rail: Variable height railing enables a continuous run of railing system when the roof steps up or down.
   c. Raised Mid-Rail: Railing to fit over duct work for continuous run of railing system.
   d. LP Outrigger: Supports placed under ducting or conduit to continue run of railing system when rail section cannot be used.
   e. Gates: Provide railing systems manufacturer’s fabricated pipe rail swinging or sliding gate assembly of opening size indicated. Include hinges, locking coupler, and accessories.
   f. Finishing Rail: D-shaped railing extension for ladder landings, length of rail section and D-loop as indicated on the Drawings.
8. Manufacturers:
   a. BlueWater Manufacturing; SafetyRail 2000.
   b. Garlock Safety Systems; Railguard 200 Railing System.
   c. Kee Safety, Inc.; KeeGuard Contractor.

2.07 DOWNSPOUT BOOTS

A. Downspout Boots: Refer to Division 22 Section "Storm Drainage Piping Specialties."

2.08 FINISHES - STEEL

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Prime paint steel items.

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1. Exceptions: Galvanize and do not prime items to be embedded in concrete, masonry, or spray-applied fireproofing. Do not prime items where field welding is required, or provide for field removal of shop primer with a grinder or wire wheel prior to field welding.

C. Prepare interior items to be primed in accordance with **<<SSPC-SP 3>>** Power Tool Cleaning.

D. Prepare exterior items to be primed, and interior items to receive specialty protective coating such as zinc-rich primer, in accordance with **<<SSPC-SP 6/NACE No.3>>** Commercial Blast Cleaning.

E. Galvanizing: Galvanize after fabrication to **<<ASTM A123/A123M>>** requirements.

F. Slotted Channel Framing: **<<ASTM A1011/A1011M>>** Grade 33; coated with manufacturer's standard rust-inhibitive acrylic enamel.

G. Factory Powder Coating: **<<AAMA 2604>>** multiple coat, thermally cured fluoropolymer system; **<< color as indicated; color as selected from manufacturer's standard colors; custom color to match approved sample; or color no. ____ , manufactured by _____>>**.

2.09 FABRICATION TOLERANCES

A. Squareness: 1/8-inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16-inch.

C. Maximum Misalignment of Adjacent Members: 1/16-inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16-inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Furnish setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components as indicated on shop drawings.

1. Perform field welding in accordance with **<<AWS D1.1/D1.1M>>**.

D. Obtain approval prior to site cutting or making adjustments not scheduled.

E. After erection, provide touch-up primer on all field welds and areas that have been damaged during installation. Do not prime surfaces to be in contact with concrete. Clean and prepare the surfaces in accordance with manufacturer requirements and ensure that touch-up primer is compatible with shop primer. Coordinate with Division 9 "Painting" for field priming of materials that were not shop-primed and for top coats.

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F. Installation of Bollards: Coordinate with bollard details on Drawings. ******Designer shall coordinate installation details with MCPS standards and with Civil drawing details and notes******
   1. Embedded Bollards: Install bond break material around embedded base of bollards, and anchor bollards in concrete footings to a minimum depth of 36 inches with minimum of 6 inches of concrete below bottom and around all sides of bollards, unless otherwise indicated. Fill bollards with concrete and install decorative finial cap into concrete.
   2. Removable Bollards: Coordinate with concrete installer to cast permanent base anchor into concrete. Install bollards into base anchor and secure tightly in accordance with manufacturer requirements.

G. Installation of Enclosures and Gates: Anchor posts in concrete footings, to a minimum depth of 36 inches with 6 inches of concrete below bottom and around all sides of posts, unless otherwise indicated.
   1. Install gate leaf assemblies to smoothly operate without sagging or binding.
   2. Install all hardware for proper operation. Drill cores into concrete apron and install cane bolt receiver sleeves into cores flush with grade. Fill spaces around gate posts and cane bolt receivers with non-shrink grout.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4-inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4-inch.

C. Maximum Out-of-Position: 1/4-inch.

END OF SECTION 055000

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SECTION 055100
METAL STAIRS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency.

B. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.

G. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

H. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

I. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

J. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable.

K. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

L. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

M. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi, 144 ksi, and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.

N. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.

O. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.

P. AWS D1.1/D1.1M - Structural Welding Code - Steel.

Q. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

R. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.

1.02 SUBMITTALS

A. Product Data: Provide manufacturer's product data for metal stairs.

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1. Provide data for shop primer and for nonshrink grout.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
   1. Indicate welded connections using standard **<<AWS A2.4>>** welding symbols. Indicate net weld lengths.
   2. Design Data: Include delegated-design shop drawings, including structural calculations and details for loadings and stresses, and anchors and connections.
   3. Include the design engineer's seal and signature on each sheet of shop drawings.

C. Welders' Qualification Statement: Welders' certificates in accordance with **<<AWS B2.1/B2.1M>>** and dated no more than **<< 12 months; or ____>>** before start of scheduled welding work.

D. Designer's Qualification Statement.

1.03 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in **<<the State in which the Project is located>>**, or personnel under direct supervision of such an engineer.

B. Welder Qualifications: Welding processes and welding operators qualified in accordance with **<<AWS D1.1/D1.1M>>** and dated no more than **<< 12 months; or ____>>** before start of scheduled welding work.

C. Indoor Emissions: For each type of paint and coating, comply with the emissions requirements of California Department of Public Health **<<CAL (CDPH SM)>>**.

D. VOC Content: For each type of paint and coating, comply with VOC content restrictions as required by **<<40 CFR 59, Subpart D>>**.

PART 2 PRODUCTS

2.01 METAL STAIRS - GENERAL

A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
   1. Regulatory Requirements: Provide stairs and railings that comply with most stringent requirements of local, state, and federal regulations; where requirements of Contract Documents exceed those of regulations, comply with Contract Documents.
      a. Head Clearance: Maintain a minimum of 80 inches head clearance along all paths of travel (the "walk line") as measured above stair noses or finished walking surfaces.
   2. Structural Design: Provide complete stair and railing assemblies that comply with the following:
      a. Stair Capacity: Uniform live load of 100 lb/sq ft and a concentrated load of 300 lb with deflection of stringer or landing framing not to exceed 1/360 of span.
         1) Deflection shall not exceed 1/720 of span where brittle finish materials such as stone, ceramic tile, or terrazzo are indicated.
      b. Railing Assemblies: Refer to Division 5 "Pipe and Tube Railings."
   3. Dimensions: As indicated on drawings.
   4. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
   5. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.

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6. Separate dissimilar metals using paint or permanent tape.

B. Metal Jointing and Finish Quality Levels, per **<<NAAMM AMP 510>>** "Metal Stairs Manual": ******Commercial should be standard - use Architectural for decorative/monumental stairs and Industrial for service/mech yard type spaces******
   1. Architectural: All joints as inconspicuous as possible, whether welded or mechanical.
      a. Welded Joints: Continuously welded and ground smooth and flush.
      b. Mechanical Joints: Butted tight, flush, and hairline; concealed fastenings only.
      c. Exposed Edges and Corners: Eased to small uniform radius.
      d. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for highest quality gloss finish.
   2. Commercial: Exposed joints as inconspicuous as possible, whether welded or mechanical; underside of stair not covered by soffit IS considered exposed to view.
      a. Welded Joints: Intermittently welded on back side, filled with body putty, and sanded smooth and flush.
      b. Welds Exposed to View: Ground smooth and flush.
      c. Mechanical Joints: Butted tight, flush, and hairline.
      d. Bolts Exposed to View: Countersunk flat or oval head bolts; no exposed nuts.
      e. Exposed Edges and Corners: Eased to small uniform radius.
      f. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for satin or matte finish.
   3. Industrial: All joints made neatly.
      a. Welded Joints: Welded on back side wherever possible.
      b. Welds Exposed to Touch: Ground smooth.
      c. Bolts Exposed to Touch in Travel Area: No nuts or screw threads exposed to touch.

C. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.

D. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

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2.02 METAL STAIRS WITH CONCRETE TREADS

A. Jointing and Finish Quality Level: **<< Industrial; Service; Commercial; Architectural; or _____>>**, as defined above. ******Coordinate choice selection with types listed above******

B. Risers: Closed.

C. Treads: Metal pan with field-installed concrete fill.
   1. Concrete Depth: 1-1/2 inches, minimum.
   2. Tread Pan Material: Steel sheet.
   3. Tread Pan Thickness: As required by design; 14 gauge, 0.075-inch minimum.
   4. Concrete Reinforcement: Welded wire **<< Welded wire mesh; or _____>>**.
   5. Concrete Finish: Coordinate with Division 9 and design stair treads to prepare for **<< resinous flooring; terrazzo; or resilient stair tread>>**, as indicated. ******Verify finish on case-by-case basis with MCPS******

D. Risers: Same material and thickness as tread pans.
   1. Nosing Depth: Not more than 1-1/2 inch overhang.
   2. Nosing Return: Flush with top of concrete fill, not more than 1/2-inch wide.

E. Stringers: Rolled steel channels.
   1. Stringer Depth: 12 inches, unless otherwise required by Structural Designer.
   2. End Closure Plates: Sheet steel of same thickness as risers welded across ends.
   3. Top Closure Plates: Where excessive gap between wall and stringer occurs (3/8-inch or wider), provide a cover plate of 1/8-inch thick flat steel plate or bar; width to cover full width of stringer and open gap. Field weld top closures to stringers.

F. Landings: Same construction as treads, supported by steel framing members and reinforced as required to achieve design load capacity.

G. Railings: Refer to Division 5 Section "Pipe and Tube Railings."

2.03 METAL STAIRS WITH PRECAST EPOXY TERRAZZO TREADS/RISERS ***FOR DECORATIVE/MONUMENTAL STAIR ONLY***

A. Precast Terrazzo Treads/Risers: Fabricate metal stairs to the same specifications as for cast concrete treads above, except provide vertical steel risers instead of sloped. Design tread pan dimensions to account for terrazzo tread thickness to maintain standard rise and run stair dimensions.
   1. Refer to Division 9 Section "Resinous Matrix Terrazzo Flooring" for precast terrazzo treads/risers.

2.04 HANDRAILS AND GUARDS

A. Handrails and Guards: Refer to Division 5 Section "Pipe and Tube Railings."

2.05 MATERIALS

A. Steel Sections: **<< ASTM A36/A36M; or _____>>**.

B. Steel Tubing: **<<ASTM A500/A500M>>** or **<<ASTM A501/A501M>>** structural tubing, round and shapes as indicated.

C. Steel Plates: **<<ASTM A6/A6M>>** or **<<ASTM A283/A283M>>**.

D. Pipe: **<< ASTM A53/A53M Grade B Schedule 40; ASTM A53/A53M Grade B Schedule 80; ASTM A53/A53M Grade ____ Schedule 40; ASTM A53/A53M Grade ____ Schedule ____; or _____>>**, **<< black finish; galvanized finish; black and galvanized finish, as indicated; or _____>>**.

E. Ungalvanized Steel Sheet: **<< Hot- or cold-rolled, unless otherwise indicated; Cold-rolled only; Hot- or cold-rolled, except use cold-rolled where finished work will be exposed to view; or _____>>**.
   1. Hot-Rolled Steel Sheet: **<<ASTM A1011/A1011M>>**, Designation **<< CS (commercial steel); SS (structural steel), Grade 33; or _____>>**.
   2. Cold-Rolled Steel Sheet: **<<ASTM A1008/A1008M>>**, Designation **<< CS (commercial steel); SS (structural steel), Grade 33, Type 1; or _____>>**.

F. Galvanized Steel Sheet: **<<ASTM A653/A653M>>**, Structural Steel (SS) Grade **<< 33/230; 37/255; 50/340; or ____>>** with **<< G40/Z120; G60/Z180; G90/Z275; or _____>>** coating.

G. Reinforced Concrete Fill: Refer to Division 3 Section "Cast-in-Place Concrete."

2.06 ACCESSORIES

A. Steel Bolts, Nuts, and Washers: **<<ASTM F3125/F3125M>><< , Type 1; , Type 3; , _____; or None - N/A>><< , and galvanized to ASTM A153/A153M where connecting galvanized components; , plain; or None - N/A>>**.

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B. Welding Materials: **<<AWS D1.1/D1.1M>>**; type required for materials being welded.

C. Shop and Touch-Up Primer: **<< SSPC-Paint 15; or _____>>** or MPI #79, compatible with topcoat indicated in Division 9 Section "Painting," and comply with VOC limitations of authorities having jurisdiction.

1. At exterior and galvanized surfaces, provide zinc-rich primer; SSPC-Paint 20 or MPI #20, compatible with topcoat, and VOC-compliant.

D. Touch-Up Primer for Galvanized Surfaces: **<< SSPC-Paint 20 Type I - Inorganic; SSPC-Paint 20 Type II - Organic; or SSPC-Paint 20 or MPI #20>>**, compatible with topcoat, and comply with VOC limitations of authorities having jurisdiction.

E. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.

1. Grout: Comply with **<<ASTM C1107/C1107M>>**.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.

B. Provide anchors, **<< plates; angles; hangers; struts; and _____>>** required for connecting stairs to structure.

C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

D. Provide welded field joints where specifically indicated on **<< drawings; shop drawings; or _____>>**. Perform field welding in accordance with **<<AWS D1.1/D1.1M>>**.

E. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.

F. Obtain approval prior to site cutting or creating adjustments not scheduled.

G. After erection, prime welds, abrasions, **<< and surfaces not shop primed; and surfaces not shop primed or galvanized; or _____>>**, except surfaces to be in contact with concrete.

3.03 TOLERANCES

A. Maximum Variation From Plumb: 1/4-inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4-inch.

END OF SECTION 055100

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SECTION 055133
METAL LADDERS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AAMA 611 - Specification for Anodized Architectural Aluminum.

B. ANSI A14.3 - American National Standard for Ladders - Fixed - Safety Requirements.

C. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

F. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

G. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

H. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

I. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.

J. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.

K. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

L. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

M. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire.

N. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

O. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

P. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.

Q. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.

R. AWS D1.1/D1.1M - Structural Welding Code - Steel.

S. AWS D1.2/D1.2M - Structural Welding Code - Aluminum.

T. NAAMM MBG 531 - Metal Bar Grating Manual.

U. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.

V. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).

W. SSPC-SP 2 - Hand Tool Cleaning.

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1.02 SUBMITTALS

A. Shop Drawings:
   1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   2. Indicate welded connections using standard **<<AWS A2.4>>** welding symbols. Indicate net weld lengths.

B. Welders' Qualification Statement: Welders' certificates in accordance with **<<AWS B2.1/B2.1M>>** and dated no more than 12 months before start of scheduled welding work.

C. Designer's Qualification Statement.

1.03 QUALITY ASSURANCE

A. Design ladders under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Maryland.

B. Welder Qualifications: Welding processes and welding operators qualified in accordance with **<<AWS D1.1/D1.1M>>** and **<<AWS D1.2/D1.2M>>** and dated no more than **<< 12 months; or ____>>** before start of scheduled welding work.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: **<< ASTM A36/A36M; or _____>>**.

B. Steel Tubing: **<< ASTM A500/A500M Grade B cold-formed; ASTM A501/A501M hot-formed; or _____>>** structural tubing.

C. Plates: **<< ASTM A283/A283M; or _____>>**.

D. Pipe: **<< ASTM A53/A53M, Grade B Schedule 40; ASTM A53/A53M Grade B Schedule 80; ASTM A53/A53M Grade ____ Schedule 40; ASTM A53/A53M Grade ____ Schedule ____; or _____>>**.

E. Mechanical Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.

F. Bolts, Nuts, and Washers: **<<ASTM A307>><< , plain; , galvanized to ASTM A153/A153M where connecting galvanized components; or None - N/A>>**.

G. Welding Materials: **<<AWS D1.1/D1.1M>>**; type required for materials being welded.

H. Shop and Touch-Up Primer: **<< SSPC-Paint 15; or _____>>**, complying with VOC limitations of authorities having jurisdiction.

I. Touch-Up Primer for Galvanized Surfaces: **<< SSPC-Paint 20, Type I - Inorganic; SSPC-Paint 20 Type II - Organic; or _____>>**, complying with VOC limitations of authorities having jurisdiction.

2.02 MATERIALS - ALUMINUM

A. Extruded Aluminum: **<<ASTM B211/B211M>>**, **<< 6063 alloy; or _____>>**, **<< T6 temper; or _____>>**.

B. Bolts, Nuts, and Washers: Stainless steel.

C. Welding Materials: **<<AWS D1.2/D1.2M>>**; type required for materials being welded.

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2.03 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 STEEL FABRICATED LADDERS

A. Ladders: Steel; in compliance with **<<ANSI A14.3>>**; with mounting brackets and attachments; galvanized finish.

1. Side Rails: 5/8- by 2-1/2 inch members spaced at 18 inches.
    a. Where ladder side rails extend vertically above the top of the deck, side rails shall flare out on each side to a minimum clear width of 24 inches.
    b. Mounting Brackets: Provide brackets at top and bottom of ladder and at no more than 48 inches o.c. Top bracket shall be nominal 12 inches from top of structural mounting component, and bottom bracket shall be nominal 18 inches from finish roof or floor surface.
        1) Provide mounting bracket depth to ensure a minimum perpendicular clear space of 7 inches from the rear of the rung to the wall surface.
2. Rungs: 3/4-inch diameter solid round bar spaced 12 inches vertically on center.
    a. Cover top of each rung with a non-slip coating or with a premanufactured nonslip cover.
3. Platform: At roof-to-roof (parapet) locations, fabricate ladder with steel bar-grating platform, with 1/2-inch maximum openings between grating bars and 4-inch o.c. between grating crossbars. Provide with steel angle/bent plate frame.
    a. Fabricate bar gratings in accordance with **<<NAAMM MBG 531>>** "Metal Bar Grating Manual."
    b. Provide walk-thru railing over top of platform at 42 inch minimum height, with intermediate rail at 21 inches above platform.
    c. Return: Provide side rails and rungs on the high roof side such that bottom rung will be less than 12 inches above roof surface.
    d. Do not secure ladder to roof surface or copings. Fasten only with brackets to vertical wall surface of parapet.
4. Safety Cage: At all ladders 20 feet or more in height, and at locations indicated on Drawings, provide steel safety cage fabricated in compliance with **<<ANSI A14.3>>**.
    a. Horizontal Hoops: Provide hoops fabricated of minimum 1/4 inch thick by 2 inch flat bar; locate at top and bottom and space vertically no greater than 4 feet on center. Bottom hoop shall flare out approximately 4 inches.
    b. Vertical Bars: Provide vertical bars fabricated of minimum 3/16 inch thick by 1-1/2 inch flat bar; secured each bar to each horizontal hoop.
    c. Assemble safety cage and secure each hoop to vertical ladder side rails either by welding or with stainless-steel mechanical fasteners.
    d. Finish safety cage to match ladder.

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e. Security Gate: Provide hinged security gate securely fastened to bottom hoop of safety cage, with manufacturer's standard hinge and hasp for padlock (padlocks NIC).

5. Ladder Security Barrier: Provide minimum 6 foot height continuous panel, coordinated with full width of ladder, to prevent unauthorized access to ladder.
   a. Fabricate barrier as either:
      1) A framed assembly with hot-or cold-rolled steel channel frame, reinforced as required, and galvanized woven wire mesh or expanded metal infill, or
      2) A single piece formed sheet metal guard, fabricated of galvanized, 16 gauge steel; bent to provide closure returns at vertical ladder rails.
   b. Provide continuous piano hinge and hasp for padlock (padlocks NIC).
   c. Provide separate side guards that return to wall surface, matching height of barrier, to prevent access to rear side of ladder rungs.
   d. Secure ladder barrier to vertical ladder rails by welding or with stainless steel mechanical fasteners.
6. Telescoping Safety Post: Provide pre-fabricated safety post designed with telescoping tube section that locks automatically when fully extended. Upward and downward movement shall be controlled by a stainless steel spring balancing mechanism.
   a. Unit shall be completely assembled and provided with fasteners for securing to ladder rungs in accordance with manufacturer's instructions.
   b. Provide unit prefinished with manufacturer's standard safety yellow powder coat.

2.05 ELEVATOR PIT LADDERS

A. Elevator Pit Ladders: Match construction of side rails and rungs as specified above, and in compliance with requirements of **<<ASME A17.1>>**, except as indicated below.
   1. Provide mounting bracket depth to ensure a minimum perpendicular clear space of 4-1/2 inches from the rear of the rung to the wall surface.
   2. Coordinate sizing with elevator manufacturer for hoistway cab and clearance requirements.

2.06 PREFABRICATED ALTERNATING TREAD STAIR

A. Alternating Tread Stairs: Welded metal unit; factory fabricated to the greatest degree possible.
   1. Design Requirements:
      a. Stair Load Capacity: Support the following without exceeding the allowable working stress of the material.
         1) Single Point Load: **<< 1000 pounds; or _____ pounds>>**.
         2) Distributed Load: **<< 100 pounds per square foot; or ____ pounds per square foot>>**.
      b. Guardrail and Handrail Capacity: Support the following without exceeding the allowable working stress of the material.
         1) Single Point Load: **<< 200 pounds; or _____ pounds>>**.
         2) Distributed Load: **<< 50 pounds per linear foot; or ____ pounds per linear foot>>**.
      c. Support the following without exceeding the allowable working stress of the material.
         1) Single Point Load: **<< 1000 pounds; or _____ pounds>>**.
         2) Distributed Load: **<< 100 pounds per square foot; or ____ pounds per square foot>>**.

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2. Materials: **<< Stainless steel; ASTM A240/A240M Type 304; Carbon steel; ASTM A1011/A1011M Grade 36 minimum; Aluminum; ASTM B221 ASTM B221M 6063 alloy, T52 temper; or _____>>**.
   a. Stair Angle: 68 degrees.
   b. Components: Manufacturer's standard handrails, guardrails, non-skid treads and stringers.
   c. Finish: Class I natural anodized aluminum.
   d. Accessories: Manufacturer's standard foot divider with rubber bumper strip.
3. Manufacturers:
   a. Lapeyre Stair, Inc; Alternating Tread Stair.
   b. Precision Ladders, LLC; Aluminum Alternating Tread Stairs.

2.07 PREFABRICATED SHIPS LADDERS

A. Prefabricated Ship Ladder: Welded metal unit complying with **<<ANSI A14.3>>**; factory fabricated to greatest degree practical and in the largest components possible.
   1. Components: Manufacturer's standard rails, rungs, treads, handrails. returns, platforms and safety devices complying with the requirements of the MATERIALS article of this section.
   2. Materials: Aluminum; **<<ASTM B211/B211M>>**; 6063 alloy, T52 temper.
   3. Incline: 60 degrees.
   4. Finish: Manufacturer's standard clear anodized coating, comply with **<<AAMA 611>>**, Class 1.
   5. Manufacturers:
      a. Alaco Ladder Company; H60 - 60 Degree Ships Ladder (Hatch).
      b. O'Keeffe's Inc; Model 523A.
      c. Precision Ladders, LLC; Aluminum Ship Stairs to Roof Hatch (SL-01).

2.08 FINISHES - STEEL

A. Prime paint steel items.
   1. Do not prime surfaces in direct contact with concrete.
   2. Do not prime surfaces where field welding is required.

B. Prepare surfaces to be primed in accordance with **<< SSPC-SP2; or ____>>**.

C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

D. Prime Painting: **<< One coat; Two coats; or _____>>**.

E. Galvanizing of Non-structural Items: Galvanize after fabrication to **<<ASTM A123/A123M>>** requirements.

2.09 FINISHES - ALUMINUM

A. Class I Natural Anodized Finish: **<<AAMA 611>><< AA-M12C22A41; or None - N/A>>** Clear anodic coating not less than **<< 0.7 mils>>** thick.

B. Apply **<< one coat; or ____ coats>>** of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

2.10 FABRICATION TOLERANCES

A. Squareness: 1/8-inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16-inch.

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C. Maximum Misalignment of Adjacent Members: 1/16-inch.

D. Maximum Bow: 1/8-inch in 48 inches.

E. Maximum Deviation From Plane: 1/16-inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Masonry Walls: Confirm that masonry wall assemblies provide adequate structural support for anticipated ladder loads.

C. Metal Framed Walls: Confirm that blocking and reinforcing have been installed in appropriate locations in the wall assembly to provide adequate structural support for anticipated ladder loads.

3.02 PREPARATION

A. Supply setting templates to the appropriate entities for steel items required to be **<< cast into concrete; embedded in masonry; or _____>>**.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components as indicated**<< on drawings; on shop drawings; _____; or None - N/A>>**.

D. Perform field welding in accordance with **<<AWS D1.1/D1.1M>>**.

E. Obtain approval prior to site cutting or making adjustments not scheduled.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4-inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4-inch.

C. Maximum Out-of-Position: 1/4-inch.

END OF SECTION 055133

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SECTION 055213
PIPE AND TUBE RAILINGS

PART 1 GENERAL ***GENERAL NOTE FOR THIS SECTION: UNLESS OTHERWISE APPROVED BY MCPS, PROVIDE POWDER-COATED STEEL GUARDRAIL ASSEMBLY, WITH STAINLESS STEEL HANDRAILS. FOR DECORATIVE RAILINGS, ARCHITECT SHALL PROVIDE AN ADDITIONAL CUSTOM SECTION***

1.01 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency.

B. ADA Standards - 2010 ADA Standards for Accessible Design.

C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

F. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing.

G. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

H. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

I. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.

J. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.

K. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.

L. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

M. NAAMM AMP 500-06 - Metal Finishes Manual.

N. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.

O. SSPC-SP 1 - Solvent Cleaning.

1.02 SUBMITTALS

A. Product Data: Provide manufacturer's product data for pipe and tube railings.

B. Sustainability Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

C. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

1. Indicate welded connections using standard **<<AWS A2.4>>** welding symbols. Indicate net weld lengths.
2. Design Data: Include delegated-design shop drawings, including structural calculations and details for loadings and stresses, and anchors and connections.
3. Include the design engineer's seal and signature on each sheet of shop drawings.

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D. Selection Samples: Provide manufacturer's color charts indicating standard range of powder coat finishes.

E. Welders' Qualification Statement: Welders' certificates in accordance with **<<AWS B2.1/B2.1M>>** and dated within the previous 12 months.

F. Designer's Qualification Statement.

1.03 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State of Maryland, or personnel under direct supervision of such an engineer.

B. Welder Qualifications: Welding processes and welding operators qualified within previous **<< 12 months; or ____>>**.

C. Indoor Emissions: For each type of paint and coating, comply with the emissions requirements of California Department of Public Health **<<CAL (CDPH SM)>>**.

D. VOC Content: For each type of paint and coating, comply with VOC content restrictions as required by **<<40 CFR 59, Subpart D>>**.

PART 2 PRODUCTS

2.01 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.

B. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of **<< 75 pounds per linear foot; 50 pounds per linear foot; or ___ pounds per linear foot>>** applied to the top of the assembly and in any direction, without damage or permanent set. **<< Test in accordance with ASTM E935; or None - N/A>>**

C. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of **<< 200 pounds; or ____ pounds>>** applied at any point on the top of the assembly and in any direction, without damage or permanent set. **<< Test in accordance with ASTM E935; or None - N/A>>**

D. Allow for expansion and contraction of members and building movement without damage to connections or members.

E. Dimensions: Refer to Drawings for configurations and heights.

F. Provide brackets, flanges, anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.

1. For anchorage to concrete or solid masonry, provide brackets anchored with drilled in expansion shields and hanger or lag bolts.
2. For anchorage to hollow masonry, provide brackets anchored with toggle bolts.
3. For anchorage to stud walls, provide brackets anchored with hanger or lag bolts to fire-retardant-treated wood blocking, or with toggle bolts to steel reinforcing backing plates.
    a. Coordinate anchorage locations with Division 6 "Rough Carpentry" and / or Division 9 "Cold-Formed Steel Framing - Non-Structural (CFSF-NS)" to provide blocking or backing plates in framed walls, as applicable.

G. Provide **<< slip-on non-weld mechanical fittings; welding fittings; mechanical and welding fittings where indicated; or _____>>** to join lengths, seal open ends, and conceal

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exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.02 STEEL RAILING SYSTEM

A. General: Provide the following systems for all handrails and guardrails unless otherwise indicated:
   1. Exterior Railings: Provide black powder-coated steel for all railing components.
   2. Interior Railings: Provide stainless steel handrails. Provide **<< powder-coated; or primed and painted>>** steel for all guardrail components. ******Verify with MCPS on case-by-case basis for powder-coated or primed painted for interior guardrail components******

B. Steel Tube: **<< ASTM A500/A500M Grade B cold-formed; ASTM A501/A501M hot-formed; or _____>>** structural tubing.

C. Steel Pipe: **<< ASTM A53/A53M Grade B Schedule 40; ASTM A53/A53M Grade B Schedule 80; ASTM A53/A53M Grade ____ Schedule 40; ASTM A53/A53M Grade ____ Schedule ____; or _____>>**; unless otherwise required due to structural loading/design.

D. Stainless Steel Components: **<<ASTM A666/A666M>>**, **<< Type 304; Type 316; or _____>>**.
   1. Stainless Steel Tubing: **<<ASTM A554>>**, Type 304, **<< 16-gauge, 0.0625-inch; or ___-gauge, ___-inch>>** minimum metal thickness, 1-1/2-inch nominal diameter.

E. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.

F. Exposed Fasteners: No exposed bolts or screws.

G. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Grout: Comply with **<<ASTM C1107/C1107M>>**.

2.03 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured. **<< Provide spigots and sleeves to accommodate site assembly and installation.; or None - N/A>>**

D. Welded Joints:
   1. Exterior Components: Continuously seal joined pieces by **<< intermittent welds and plastic filler; continuous welds; or _____>>**. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
   2. Interior Components: Continuously seal joined pieces by **<< intermittent welds and plastic filler; continuous welds; or _____>>**.
   3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

2.04 FINISHES

A. General: Comply with **<<NAAMM AMP 500-06>>**.
   1. Complete mechanical finishes before fabrication. After fabrication, finish joints, bends, abrasions, and surface blemishes to match sheet.

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2. Protect mechanical finishes on exposed surfaces from damage.
3. Apply organic finishes to formed metal after fabrication.

B. **<< Powder-Coated>>** Steel Finishes:
1. Coated Steel: Clean surface in accordance with **<<SSPC-SP 1>>** before applying coating.
2. Pretreatment: Conversion coating of type suited to organic coating.
3. Powder-Coat Finish: Manufacturer's standard thermosetting polyester or acrylic urethane powder coating; minimum cured-film thickness of **<< 1.5 mils, 0.015 inch>>**.
4. Color: For interior finishes, color shall be selected by Architect from manufacturer's standard range. For exterior, provide black finish.

C. **<< Primed and Painted>>** Steel Finish:
1. Shop Primer: Manufacturer's universal shop primer, compatible with topcoat indicated in Division 9 Section "Painting," and complying with VOC limitations indicated above.
2. Touch-Up Primer: **<< SSPC-Paint 15; or _____>>** or MPI #79, compatible with shop primer, and with topcoat indicated in Division 9 Section "Painting," complying with VOC and emissions limitations indicated above.
3. Finish Coats: Coordinate with Division 9 Section "Painting."

D. Stainless Steel Finishes:
1. Remove tool marks, die marks, and stretch lines before finishing.
2. Directional Satin: No.4.
3. Directional Finishes: Run grain with long dimension of each item.
4. After polishing, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Where required, verify that installation of in-wall blocking and reinforcement is complete and ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

C. Install railings in compliance with **<<ADA Standards>>** for accessible design at applicable locations.

D. Anchor railings securely to structure.

E. Where railing posts are embedded in concrete, fill annular space around posts with non-shrink grout. At exterior conditions slope non-shrink grout away from post

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F. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4-inch per floor level, non-cumulative.

B. Maximum Offset From True Alignment: 1/4-inch.

C. Maximum Out-of-Position: 1/4-inch.

END OF SECTION 055213

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SECTION 061000
ROUGH CARPENTRY

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.

B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

C. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing.

D. ASTM D2898 - Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing.

E. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.

F. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

H. AWPA U1 - Use Category System: User Specification for Treated Wood.

I. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

J. EPA (TSCA); Title VI - Toxic Substances Control Act, Title VI: Formaldehyde Standards for Composite Wood Products.

K. PS 1 - Structural Plywood.

L. PS 20 - American Softwood Lumber Standard.

M. SCAQMD 1168 - Adhesive and Sealant Applications.

1.02 SUBMITTALS

A. Product Data: Provide technical data for fire-retardant materials and include certification that materials and treatment comply with manufacturer's requirements.

1. Evaluation Reports: Provide ICC-ES evaluation reports for each applicable item below:
    a. Fire-retardant-treated lumber.
    b. Each type of power- or powder-actuated fastener and expansion anchor.

B. Sustainability Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

1.03 QUALITY ASSURANCE

A. Testing Agency Qualifications (for **<< Fire-Retardant Treatments; or None - N/A>>**): Independent firm specializing in performing testing of treatments of type specified in this section, and performing periodic inspections to ensure that the material receiving the classification marking matches the tested material; and approved by local authority having jurisdiction.

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1.04 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with **<<PS 20>>** and requirements of specified grading agencies.

1. Grading Agencies: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org and who provides grading service for the species and grade specified.
    a. Northeastern Lumber Manufacturer's Association (NELMA) - Spruce-Pine-Fir.
    b. Southern Pine Inspection Bureau (SPIB) - Southern Pine.
    c. West Coast Lumber Inspection Bureau (WCLIB) - Douglas Fir, Hem Fir, Spruce-Pine-Fir-South.
    d. Western Wood Products Association (WWPA) - Douglas Fir, Hem Fir; Spruce-Pine-Fir-South.
    e. National Lumber Grades Authority (NLGA) - Douglas Fir-North, Hem Fir-North, Spruce-Pine-Fir.
2. Provide lumber stamped with grade mark of responsible grading agency, unless otherwise indicated.
    a. Place grade stamp on unexposed surface of lumber specified to be exposed with natural or stained finish, or omit grade stamp and submit documentation from grading agency certifying grade compliance.
3. Species and Grade:
    a. Species and grade is indicated on Structural Drawings for studs, joists, rafters, beams, columns, ceiling joists, and other structural components, as applicable.
    b. For miscellaneous lumber including non-structural miscellaneous framing, blocking, nailers, grounds, and furring, provide No. 2 or Standard grade.
    c. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.
4. Moisture Content: **<< S-dry or MC19 (19% or less); Kiln-dry or MC15 (15% or less); or _____>>**. Applies to lumber for 2-inch nominal thickness and less.

B. Sustainability Requirements:

1. Composite Wood: All composite wood materials installed inside the weatherproofing system shall meet either **<<EPA (TSCA); Title VI>>** for ultra-low-emitting formaldehyde or no added formaldehyde (ULEF / NAUF).
2. Bio-Based Wood Material: Provide sustainably harvested wood; include chain-of-custody certification. Lumber and wood products shall be certified by American Tree Farm System (ATFS), Forest Stewardship Council (FSC), or Sustainable Forestry Initiative (SFI).

2.02 WOOD CONSTRUCTION PANELS

A. Roof Sheathing (Parapet): Exposure 1, veneer faced FRT plywood sheathing. OSB is not acceptable.

1. Thickness: Minimum 5/8 inch.

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2. Screws for fastening plywood sheathing over rigid insulation at parapets:
    a. For Steel Framing: Provide #10 SIP low profile flat head or pancake head screws intended for wood-to-metal connections, at spacing indicated.
        1) Pullout Capacity: 108 lb minimum in 43 mil (18 gauge) steel.
    b. For Masonry Backup: 1/4-inch diameter, low-profile flat head type concrete screw anchors at 3 inches from each panel edge, and at spacing indicated. Length to suit embedment into CMU of 1-1/4 inches, minimum.
        1) Pullout Capacity: 100 lb minimum at 1 inch embedment in face shell of hollow CMU.

B. Wall Sheathing: Glass mat faced gypsum, **<<ASTM C1177/C1177M>>**, **<< 1/2 inch; 5/8 inch Type X fire resistant; or ____ inch>>**, unless otherwise indicated.
1. Type X Sheathing: At all fire-rated assemblies and at all locations where 5/8-inch thick sheathing is indicated on Drawings, provide 5/8-inch thick product with Type X core. For rated assemblies, product shall be one of those required by indicated tested assembly.
2. Mold Resistance: Score of 10, when tested in accordance with **<<ASTM D3273>>**.
3. Edges: **<< Square; or _____>>**.
4. Products:
    a. CertainTeed Corporation; GlasRoc Brand.
    b. Georgia-Pacific Gypsum; DensGlass Sheathing.
    c. National Gypsum Company; Gold Bond eXP Sheathing.
    d. USG Corporation; Securock Brand Glass-Mat Sheathing.

C. Communications and Electrical Room Mounting Boards: **<<PS 1>>** A-D FRT plywood, or medium density fiberboard; 3/4-inch thick; flame spread index of 25 or less, smoke developed index of 25 or less, when tested in accordance with **<<ASTM E84>>** (Class A - UL FR-S).

2.03 ACCESSORIES

A. Fasteners and Anchors:
1. Metal and Finish: Provide hot-dipped galvanized steel complying with ASTM A 153 or stainless steel at exterior, high humidity, and fire-retardant treated wood locations.
    a. Fasteners at interior FRT shall be per FRT treatment manufacturer's recommendations.
2. Drywall Screws: Bugle head, hardened steel, power driven type, **<< length three times thickness of sheathing; length to achieve full penetration of sheathing substrate; or _____>>**.
3. Anchors: **<< Toggle bolt type for anchorage to hollow masonry; Expansion shield and lag bolt type for anchorage to solid masonry or concrete; Bolt or ballistic fastener for anchorages to steel; or _____>>**.
4. Screws/Anchors for Fastening Top-of-Parapet Blocking & Nailers and for Back-of-Parapet Plywood Sheathing over Rigid Insulation:
    a. For CFSF-S Metal Framed Parapets: Provide #10 SIP low profile flat head screws intended for wood-to-metal connections, at spacing indicated. Pullout capacity of 108 lb minimum in 43 mil (18 gauge) steel.
    b. For CMU Parapets: Provide 1/4-inch diameter low-profile flat head type concrete screw anchors, at spacing indicated. Length to suit embedment into CMU of 1-1/4 inches minimum. Pullout capacity of 100 lb minimum at 1 inch embedment in face shell of hollow CMU.

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B. Flexible Flashing/Separation Material: Barrier sheet fabricated of polyethylene backed rubberized asphalt or butyl rubber sheet; not less than 25 mil overall thickness.

C. General Purpose Construction Adhesives: Comply with **<<ASTM C557>>** or **<<ASTM D3498>>**.

1. Adhesives: Adhesives field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet the chemical content requirements of **<<SCAQMD 1168>>**.

2.04 FACTORY WOOD TREATMENT ******PRESERVATIVE TREATMENTS DELETED PER MCPS REQUEST. IF ARCHITECT DESIGN PROPOSES EXTERIOR OR EXPOSED LUMBER REQUIRING TREATMENT, CONFIRM WITH MCPS******

A. Treated Lumber and Plywood: Comply with requirements of **<<AWPA U1>>** - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

1. Fire-Retardant Treated Wood: Provide FRT lumber and plywood stamped with name and mark of qualified testing agency, fire-retardant treatment product and manufacturer, wood species and drying method, testing standards, and flame spread and smoke development indices.

a. For exterior FRT and FRT that will be exposed to moisture, include accelerated weathering test language, with the words "No increase in the listed classification when subjected to Standard Rain Test **<<ASTM D2898>>**".

B. Fire Retardant Treatment:

1. Exterior Type: **<<AWPA U1>>**, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 and maximum smoke developed index of 450, when tested in accordance with **<<ASTM E84>>**, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with **<<ASTM D2898>>**.

a. Kiln dry wood after treatment to a maximum moisture content of **<< 19; 18; or ___>>** percent for lumber and **<< 15; or ___>>** percent for plywood.

b. Treat exterior rough carpentry items associated with roof construction, concealed blocking, and as indicated on Drawings.

c. Do not use treated wood in direct contact with the ground.

2. Interior Type A: **<<AWPA U1>>**, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 and maximum smoke developed index of 450, when tested in accordance with **<<ASTM E84>>**, with no evidence of significant combustion when test is extended for an additional 20 minutes.

a. Kiln dry wood after treatment to a maximum moisture content of **<< 19; 18; or ___>>** percent for lumber and **<< 15; or ___>>** percent for plywood.

b. Treat interior concealed blocking, plywood backing panels, and other rough carpentry items **<< as scheduled; as indicated; or _____>>**.

c. Do not use treated wood in applications exposed to weather or where the wood may become wet.

3. Strength Adjustments (Structural Panels/Plywood): Test FRT structural panels/plywood per ASTM D 5516 and develop strength adjustment factors per ASTM D 6305.

4. Strength Adjustments (Lumber): Test FRT lumber per ASTM D 5664 and develop strength adjustment factors per ASTM D 6841.

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PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In metal-framed walls, provide continuous FRT blocking around door and window openings for anchorage of frames, securely attached to stud framing.

C. In metal-framed walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

D. Where blocking is indicated to be installed directly adjacent to metal decking, other galvanized metals, concrete, or masonry, provide flexible flashing/separation material as a continuous barrier to prevent direct contact between wood and substrate materials.

3.04 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

1. Roof Curbs: Where prefabricated roof curbs and equipment supports are provided at sloped roofs, provide wood blocking so that curbs are level to the ground.

B. Top-of-Parapet Blocking and Nailers: Secure wood blocking and plywood nailers to prepared substrate using mechanical fasteners to attain loading design requirements. Adhesive anchorage of wood nailers & blocking is not acceptable. Coordinate with installation of continuous insulation and air barrier membrane/roof membrane materials.

1. Installation at CMU Parapets: Secure parapet blocking and nailers to CMU with screw anchors in two rows, staggered, at 32 inches on center; except within 10 feet of building corners provide two staggered rows at 24 inches on center. Provide fasteners sized for embedment length into CMU of 1-1/4 inch, minimum. Install screws in accordance with manufacturer's instructions, with screw heads flush with uppermost surface off indicated blocking or plywood nailer.
2. Installation at CFSF-S Metal Framed Parapets: Secure blocking and nailers to metal framing at #10 SIP screws in 2 rows at 16 inches on center; except within 10 feet of building corners provide 2 rows at 12 inches on center. Provide attachment in accordance with APA Form No. T625C, Table 1; for 3/4 inch plywood thickness, wall stud spacing, and wind exposure category indicated.

C. Back-of-Parapet Sheathing Over Rigid Insulation: Secure plywood sheathing over XPS / XEPS insulation to prepared substrate using mechanical fasteners to attain loading design requirements. Adhesive anchorage is not acceptable. Coordinate with installation of continuous insulation and air barrier membrane/roof membrane materials.

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1. Stagger vertical butt joints of plywood sheathing.
2. Installation at CMU Parapets: Secure sheathing over board insulation with screw anchors, embedment length of at least 1-1/4 inches into CMU substrate. Fastener spacing shall be 16 inches horizontally and 8 inches vertically.
3. Installation at CFSF-S Metal Framed Parapets: Secure sheathing over board insulation anchored directly to CFSF-S framing with #10 SIP screws. Fastener spacing shall be 16 inches horizontally and 8 inches vertically; verify with spacing of installed CFSF locations in field.

3.05 INSTALLATION OF CONSTRUCTION PANELS

A. Wall Sheathing: Comply with GA-253, **<<ASTM C1280>>**, and with manufacturer's instructions. Secure with long dimension perpendicular to wall studs, with edges butted tight, over firm bearing and staggered; secure using screws as indicated.
   1. Install sheathing with a 3/8-inch gap where abutting structural elements.
   2. Install sheathing with a 1/4-inch gap where abutting masonry, concrete, or other materials that may retain moisture.
   3. Coordinate with flashings, air barriers, joint sealants, and other materials to ensure proper sequencing and to maintain protection from the elements during construction.
   4. Screw panels to cold-formed steel framing. Provide screws spaced at approximately 8 inches apart. For perimeter fasteners provide 3/8-inch set back from all board edges.
   5. Do not overdrive screws; drive snug so that screw is tight against face of sheathing but does not tear or rip facing.
   6. Seal joints, cut edges, holes, and around penetrations with water-resistant polyether-based sealant recommended by sheathing manufacturer.

B. Communications and Electrical Room Mounting Boards: Secure with screws, with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and in field of board.
   1. At gypsum board/stud walls, verify metal stud locations and coordinate fastener pattern to secure directly to framing.
   2. At CMU walls, equipment may be secured directly to CMU without secondary mounting board.
   3. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
   4. Install bottom of boards at 4-1/2 inches above finish floor to allow for wall base.
   5. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
   6. Install adjacent boards without gaps.

3.06 CLEANING

A. Waste Disposal: Refer to Section **<< 017419 - Construction Waste Management and Disposal>>**.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

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C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 061000

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SECTION 064100
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 DEFINITIONS

A. Comply with **<<ANSI/AWI 0641>>**.

B. Exterior Surfaces: Exterior surfaces exposed to view when doors and drawers are closed, including:
   1. Cabinet bottoms more than 42 inches above finished floor.
   2. Cabinet tops more than 72 inches above finished floor.
   3. Knee spaces; front edges of stretchers, ends, divisions, tops, and bottoms; sloping tops of cabinets.

C. Exposed Interior Surfaces: Interior surfaces exposed to view in open cases or behind transparent doors, including:
   1. Shelves, including edgebanding.
   2. Front edge of divisions and partitions.
   3. Interior faces of sides, backs, and bottoms. Interior surfaces of cabinet top members 36 inches or more above finished floor.
   4. Interior face of door and applied drawer fronts.

D. Semi-Exposed Surfaces: Interior surfaces exposed to view when doors and drawers are open, including:
   1. Top and bottoms of shelves, including front edgebanding.
   2. Front edge of divisions and partitions.
   3. Interior faces of sides, backs, and bottoms. Interior surfaces of cabinet top members 36 inches or more above finished floor.
   4. Drawer sides, sub fronts, backs, and bottoms.
   5. Underside of cabinet bottoms between 24 and 42 inches above finished floor.
   6. Security panels or drawer stretchers.

E. Concealed Surfaces: Exterior and interior surfaces that are covered or not normally exposed to view, including:
   1. Toe spaces.
   2. Sleepers, stretchers, and solid sub tops.
   3. Underside of cabinet bottoms less than 24 inches above finished floor.
   4. Flat tops of cabinets more than 80 inches above finished floor, except if visible from an upper floor or building level.
   5. Three non-visible edges of adjustable shelves.
   6. Underside of knee spaces, aprons, and drawer boces that are less than 36 inches above finished floor.
   7. Faces of cabinet ends of adjoining units that butt together.

1.02 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design.

B. ANSI/AWI 0400 - Factory Finishing.

C. ANSI/AWI 0620 - Finish Carpentry/Installation.

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D. ANSI/AWI 0641 - Architectural Wood Casework.

E. ANSI/AWI SMA 0643 - Wood Stair, Handrail, and Guard Systems.

F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

G. ASTM D1037 - Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials.

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

I. AWI 100 - Submittals.

J. AWI 200 - Care and Storage.

K. AWI 300 - Materials.

L. AWI 0622.0646 - Millwork & Wood Trim.

M. AWI 1236 - Countertops.

N. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition.

O. BHMA A156.9 - Cabinet Hardware.

P. BHMA A156.18 - Standard for Materials and Finishes.

Q. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

R. CARB (ATCM) - Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products.

S. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.

T. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood.

U. ICC A117.1 - Accessible and Usable Buildings and Facilities.

V. ISFA 2-01 - Classification and Standards for Solid Surfacing Material.

W. ISO 4586-3 - High-Pressure Decorative Laminates (HPL, HPDL) – Sheets Based on Thermosetting Resins (Usually Called Laminates) – Part 3: Classification and Specifications for Laminates Less than 2 mm Thick and Intended for Bonding to Supporting Substrates.

X. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual.

Y. NEMA LD 3 - High-Pressure Decorative Laminates.

Z. NSF 2 - Food Equipment.

AA. PS 1 - Structural Plywood.

BB. PS 20 - American Softwood Lumber Standard.

CC. SCAQMD 1113 - Architectural Coatings.

DD. SCAQMD 1168 - Adhesive and Sealant Applications.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate schedule of climate-controlled rooms with schedule of storage of wood and wood-based materials requiring climate-controlled environments.

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2. Coordinate work of this section with installation of **<< wood blocking; wood backing; wood furring; metal strapping; other anchorage; and _____>>** that provides casework **<< backing; structural support; and _____>>**.
3. Coordinate work of this section with **<< rough-in plumbing; rough-in electrical; and _____>>** integrally-related with casework.

B. Preinstallation Meeting: Convene preinstallation meeting not less than **<< one week; or _____>>** prior to completion of framing behind casework; require attendance of **<< contractor; framing contractor; casework fabricator; casework installer; and _____>>**.
1. Review locations of casework backing and structural support.

1.04 SUBMITTALS

A. AWI QCP Program Submittal Requirements: Comply with **<<AWI 100>>**. ******Use AWI QCP Program if not planning to indicate AWI licensed fabricators.******

B. Product Data: Submit manufacturer's published, product descriptive data.
1. HPDL Laminates: For each type, indicate **<< description; thickness; finish; pattern; color; flame spread index; smoke developed index; impact-resistance rating; surface-wear-resistance rating; high-temperature rating; and _____>>**.
2. ABS Edgebanding: For each type.
3. Transparent Finish Systems: For each system, include **<< manufacturer's name; complete list of products to be used; general product categories; product names; and _____>>**.
4. Hardware: For each type of **<< cabinet; drawer; and _____>>** hardware.
5. Locks: For each type of **<< cabinet; drawer; and _____>>** lock.
6. Accessory Components: For each type of **<< glass; grommet; and _____>>**.

C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
1. Include field measurements and indicate where field measurements differ from documents.

D. Samples:
1. **<< AWI QCP Program; or _____>>** Requirements for Samples: Comply with **<<AWI 100>>**.
2. Selection Samples: Submit manufacturer's color charts indicating full range of available colors, for each product requiring color selection.
3. Verification Samples: Submit physical samples, manufacturer's standard size, for each specified finish and color of the following materials:
   a. For each type of architectural woodwork profile and paneling, minimum 8 inches square or 8 linear inches in length, illustrating proposed shapes, sizes, and finishes of panels, moldings, and other profiles
   b. For each solid wood or wood veneered product indicated to receive transparent finish, provide at least three samples illustrating standard range of wood grain, stain color, and sheen, for selected color.
   c. Plastic laminate.
   d. Solid surface.
   e. ABS edge banding.

E. Certificates, AWI: At end of AWI Quality Certification Program process, provide **<< two; three; or _____>>** samples indicating casework complies with specified performance requirements.

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******Required if participating in AWI QCP program. Not required if using AWI licensed fabricators.******

F. AWI Test Reports: Provide report confirming casework conforms to Architectural Woodwork Institute specified performance requirements. Provide test reports confirming: ******Required if using AWI licensed fabricators.******
   1. Casework awarded duty level.
   2. Casework conforms to **<< aesthetic requirements; installation requirements; contract documents; and _____>>**.

G. AWI Field Quality Control Inspection Reports: Provide report of inspection results first to architectural wood fabricator. After ten days, provided updated report to **<<Architect>>**, **<<Owner>>**, and **<<Contractor>>**. ******Required if participating in AWI QCP program. Not required if using AWI licensed fabricators.******

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: **<< AWI QCP-licensed woodworking firm; WI-accredited millwork company; or _____>>**. ******Indicate this paragraph if using an AWI licensed fabricator.******

B. Installer Qualifications: **<< AWI QC-accredited installer; WI QCP-accredited installer; or _____>>**. ******Indicate this paragraph when registering the project with the AWI-QCP program.******

C. Architectural Woodwork Institute (AWI) Quality Certification Program (QCP):
   1. Project Number: Project has been registered as AWI-QCP project number **<< _____>>**. ******Register project with AWI-QCP program during design.******
   2. Scope of Work:
      a. Shop drawing review provided by AWI QCP-appointed inspector.
      b. Casework fabrication provided by AWI QCP-licensed woodworking **<< company; manufacturer; firm; fabricator; or _____>>**.
      c. Fabrication inspection performed by AWI QCP-appointed inspector.
      d. Installation inspection preformed by AWI QCP-appointed inspector.
      e. Installation inspection performed by unlicensed **<< woodworking; casework; or _____>> << company; manufacturer; firm; fabricator; supplier; or _____>>**.
   3. Provide AWI QCP labels on each casework elevation indicating casework fabrication**<< and installation; _____; or None - N/A>>** complies with requirements of specified aesthetic grades and performance levels.

1.06 DELIVERY, STORAGE, AND HANDLING

A. See Section **<< 017419 - Construction Waste Management and Disposal>>** for packaging waste requirements.

B. Deliver products in original packaging materials bearing product identification.

C. Store products prior to installation on flat, level, clean surfaces; elevate products above floors and protect from sunlight.

D. Store products in interior rooms with completed **<< wet work; overhead work; and _____>>**.

E. Relative Humidity Conditions for Storing **<< Wood; Wood-Based; and _____>>** Core Products:
   1. Maintain relative humidity between **<< 25 and 45; 30 and 55; 43 and 65; or _____>>** percent.

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F. Store **<< non-wood-based products; and _____>> << under cover and elevated above grade; or _____>>**.
   1. Protect from excessive moisture and standing water.

G. For products other than **<< wood; wood-based; and _____>>** products, store and handle in accordance with **<< fabricator's; supplier's; manufacturer's; or _____>>** documented instructions.

H. Handle materials and products to prevent damage to edges, ends, or surfaces.

I. Handle **<< wood; wood-based; and _____>>** products with clean hands or gloves; protect from marks or damage.

1.07 FIELD CONDITIONS

A. Ambient Conditions for **<< Acclimation; Installation; Post-Installation; and _____>>** of **<< Wood; Wood-Based; and _____>>** Products:
   1. Acclimation Period Prior to Installation: **<< 72 hours; or _____>>** minimum, inside installation environment.
   2. Temperature Conditions During **<< Acclimation; Installation; Post-Installation; and _____>>**: Maintain temperature between **<< 60 degrees F; or ____ degrees F>>** and **<< 90 degrees F; or ____ degrees F>>**.
   3. Relative Humidity Conditions During **<< Acclimation; Installation; Post-Installation; and _____>>**: Maintain relative humidity between **<< 25 and 45; 30 and 55; 43 and 65; or _____>>** percent.
   4. Maximum Sustained Time outside Specified **<< Relative Humidity; and _____>>** Range: **<< 24; or _____>>** hours.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

B. Inspection Services: Provide AWI QCP fabrication inspection services.
   1. Inspect for compliance with contract documents; on subjects that contract documents are silent, inspect for compliance with specified AWI grade.
   2. Provide report of inspection results first to architectural woodwork fabricator. After ten days, provide updated report to **<<Architect>>**, **<<Owner>>**, and **<<Contractor>>**.

C. Single Source Responsibility: Provide and install this work from single **<< fabricator; supplier; and manufacturer>>**.
   1. It is acceptable to subcontract portions of the work to a separate specialty subcontractor (for example, pre-fabricated plastic-laminate-faced casework); however, each fabricator shall be independently accredited; submit accreditation for each fabricator. The primary woodwork contractor shall be responsible for ensuring the work of all Division 06 sections is well coordinated and properly fabricated and installed.

2.02 ARCHITECTURAL WOOD CASEWORK, GENERAL

A. Provide casework and casework components in **<< sizes; profiles; and _____>>** as indicated on drawings.
   1. Interior Clearances: Comply with specified performance requirements.

B. Adjustable Shelves, Number of Shelves Per Cabinet Unit:

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1. Base Cabinets: **<< As indicated on drawings; <u>One shelf for each cabinet unit</u>; Two shelves for each cabinet unit; Three shelves for each cabinet unit; or _____>>**.
2. Wall Cabinets: **<< As indicated on drawings; One shelf for each cabinet unit; <u>Two shelves for each cabinet unit</u>; Three shelves for each cabinet unit; Four shelves for each cabinet unit; or _____>>**.

C. Hinges, Number of Hinges for Each Cabinet Door:
1. Comply with specified performance requirements.
2. Door Heights Under **<< <u>48 inches</u>; or _____ inches>>**: Not less than **<< <u>two</u>; three; or _____>>** hinges per door.
3. Door Heights Between **<< <u>48 inches</u>; or _____ inches>>** and **<< <u>84 inches</u>; or _____ inches>>**: Not less than **<< <u>three</u>; four; or _____>>** hinges per door.
4. Door Heights Greater than **<< <u>84 inches</u>; or _____ inches>>**: Not less than **<< <u>four</u>; or _____>>** hinges per door.

D. Scribed Fillers:
1. Finish and Materials: Same materials and finish as exposed surfaces.
2. Material thickness: **<< As indicated on drawings; Fabricator's option; Supplier's option; Manufacturer's option; <u>Comply with specified performance requirements</u>; or _____>>**.

2.03 PERFORMANCE REQUIREMENTS

A. Architectural Woodwork Institute (AWI) Performance Requirements:
1. Comply with **<<AWI 300>>**, **<<ANSI/AWI 0641>>**, **<<ANSI/AWI 0400>>**, and **<<ANSI/AWI 0620>>** as applicable for specified casework finish, aesthetic grade, and performance duty level.
   a. Aesthetic Grade: Custom, unles.
   b. Product Performance Duty Level: **<< <u>Duty Level 3</u>; or Duty Level 4>>**. ******Duty Level 3 for casework unless noted otherwise.******
2. Panel and Material Thicknesses: Provide panels and materials as required to meet specified performance duty level, subject to minimum thickness requirements of **<<AWI 300>>** and **<<ANSI/AWI 0641>>** and flatness requirements indicated below.
3. Panel Flatness: Provide panels with maximum variation from flat in **<< <u>12 inches</u>>>** as measured diagonally across panel.
   a. Custom Grade: Plus or minus **<< <u>0.063 inch</u>>>** maximum.
4. Cabinet Door Flatness:
   a. Comply with specified performance requirements.

B. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with **<<ASTM E84>>**, unless noted otherwise.

C. Countertop surfaces shall comply with **<<NSF 2>>**.
1. Countertop Corners: Provide minimum 1 inch radius at exposed corners.

D. Construct casework to comply with the requirements of **<<ADA Standards>>** and **<<ICC A117.1>>**.

E. Sustainability Characteristics:
1. Ultra-Low-Emitting Formaldehyde (ULEF) Resins: Comply with **<<CARB (ATCM)>>**.
2. No-Added Formaldehyde Based (NAUF) Resins: Comply with **<<CARB (ATCM)>>**.
3. Paints and Coatings: Comply with **<<CAL (CDPH SM)>>**, **<<CARB (SCM)>>**, or **<<SCAQMD 1113>>**.

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4. Adhesives and Sealants: Comply with **<<CAL (CDPH SM)>>** and **<<SCAQMD 1168>>**.

F. Bio-Based Materials: Provide sustainably harvested wood; include chain-of-custody certification. Lumber and wood products shall be certified by American Tree Farm System (ATFS), Forest Stewardship Council (FSC), or Sustainable Forestry Initiative (SFI).

2.04 MATERIALS

A. **<<AWI 200>>** Wood Moisture Content Requirements:
   1. Climate Zone 2: Between 6 and 10 percent.

B. **<<AWI 300>>** General Requirements for Wood.
   1. Provide wood that is sound, free of decay, shake, pith, wane, and warp**<< ; plain-sawn unless otherwise indicated; ; _____; or None - N/A>>**.
   2. Provide wood in accordance with **<<AWI 300>>**.

C. Plywood: Comply with **<<PS 1>>**. ******MCPS prefers plywood core only. No particleboard.******
   1. Structural I, Grade **<< C-D, Exposure I; C-C, Exterior Exposure; or _____>>**.
   2. Performance Category: 3/4 minimum.

D. Wood Boards: Comply with **<<PS 20>>**.
   1. Thickness: 11/16 inch**<< 11/16 inch; or _____ inch>>**, actual, minimum.

E. Moisture-Resistant Wood: Where moisture-resistant wood is specified or indicated on drawings for cabinet base components, provide wood with thickness swelling of not more than 5 percent when tested in accordance with **<<ASTM D1037>>**. ******MCPS prefers moisture-resistant plywood cores at sinks.******

F. Wood Anchoring Strips:
   1. Materials and Size: **<< Fabricator's choice; Manufacturer's choice; Supplier's choice; or _____>>** subject to requirements of **<<ANSI/AWI 0641>>**.
   2. Application: As indicated on drawings.

G. Hardwood Face Veneers Intended to Receive Transparent Finish:
   1. Species and Cut: As specified in this section with wood casework for transparent finish.
   2. Face Veneer Grade: As specified in this section with wood casework intended for transparent finish; associated with **<< applicable surface exposures; specified performance requirements; and _____>>**.
   3. Face Veneer Special Characteristics: **<< In accordance with specified aesthetic grade; In accordance with specified grade; As required to match solid wood panels; Natural; Heartwood; or _____>>**.

H. High-Pressure Decorative Laminate (HPDL): Sheet consisting of fibrous material impregnated with thermosetting resins; bonded by high-pressure process.
   1. Products:
      a. Arborite.
      b. Formica Corporation.
      c. Panolam Industries International, Inc.
      d. Wilsonart LLC.
      e. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
   2. Type: Comply with specified performance requirements.
   3. Color and Pattern: As selected by Architect from manufacturer's full range.

I. Solid Surface: Slab consisting of bonded resins and pigments.

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1. Products:
   a. Avonite Surfaces, a Brand of Aristech Surfaces, LLC; Avonite.
   b. E. I. du Pont de Nemours and Company; Corian.
   c. Formica Group; Solid Surfacing.
   d. Hanwha L&C; Hanex.
   e. LG Hausys America; HI-MACS.
   f. Lotte Advanced Materials Co. Ltd.; Staron.
   g. Meganite, Inc; Meganite Acrylic Solid Surface.
   h. US Surface Warehouse; LivingStone.
   i. Wilsonart LLC; Solid Surface.
2. Thickness: **<< 1/2 inch; or 3/4 inch>>**. ******Use 1/2 thickness for most countertop applications and to minimize cost. Use 3/4 inch for heavy-duty applictions.******
3. Color and Pattern: As selected by Architect from manufacturer's full range.

J. Edgebanding: ABS, flat, finish; width to match component thickness.
1. Color: As selected by **<<Architect>>** from manufacturers' standard range.
2. Thickness: 3 mm.

K. Glazing: See Section **<< 088000 - Glazing>>**.

L. Cabinet Connectors:

M. Fasteners: Size and type to suit application.

N. Concealed Joint Fasteners: Threaded steel.

O. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; **<< galvanized; chrome-plated; or _____>>** finish in concealed locations and **<< stainless steel; chrome-plated; or _____>>** finish in exposed locations.

P. Adhesives: **<< Type recommended by AWI/AWMAC to suit application; Type recommended by WI to suit application; Type recommended by fabricator to suit application; or _____>>**.

2.05 CABINETS AND COMPONENTS

A. Types: More than one type of cabinet construction is indicated. Refer to drawings for locations. ******Indicate this when using both wood veneer and laminate clad casework on a project.******

B. Wood Casework with Transparent Finish: ******MCPS prefers wood casework for cubbies and teacher mail units.******
1. Finishing Method:
   a. Shop-applied transparent finish.
2. Casework Construction:
   a. Frameless Cabinet and Door Interface: Flush overlay.
   b. Door and Drawer Front Profile: Flush.
   c. Reveal Dimensions: Comply with specified performance requirements.
3. Wood Species for Exposed Exterior and Interior Surfaces:
4. Hardwood Species and Cut: **<< Birch; Cherry; Maple; Red oak; Sapele; Walnut; White oak; As indicated on drawings; or _____>>**; **<< plain-sliced; quarter-sliced; rotary-sliced; rift-sliced; as indicated on drawings; or _____>>**.
5. Custom Grade - Wood Casework with Transparent Finish:

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a. Comply with specified performance requirements for exposed exterior surfaces, exposed interior surfaces, semi-exposed surfaces, panels, and wood veneers.

6. Wood Drawer Boxes - Wood Casework with Transparent Finish:
   a. Comply with specified performance requirements.
   b. Wood Drawer Joinery: Fabricator's choice subject to specified performance requirements.
7. Exposed Exterior Surfaces, Matching of Veneer Leaves:
   a. Matching of Veneer Leaves: **<< Book match; Slip match; Random match; Swing match; End match; Butt match; As indicated on drawings; and _____>>**.
   b. **<< Matching of; Sequencing of; or _____>> << Veneer Leaves Within Cabinet Unit Face; Veneer Leaves Within Panel Unit Face; or _____>>**: **<< Running match; Balance match; Balance and center match; Slip Center match; As indicated on drawings; or _____>>**.
   c. **<< Matching Between; Sequencing Between; or _____>> << Doors; Drawers; Adjacent Panels; and _____>>**: **<< Blueprint matched; Sequence matched; Nonsequence matched; Sequence matched and custom width; As indicated on drawings; or _____>>**.
8. End Matching of Veneer Leaves: **<< End match; Random match; As indicated on drawings; or _____>>**.
9. Veneers from a Single Flitch:
   a. Provide veneers for **<< each elevation; each cabinet; or _____>>** from a single flitch.
10. Grain Direction of Exposed Surfaces:
    a. Fascia and Filler Panels: **<< Vertical; Horizontal; As indicated on drawings; or _____>>**.
    b. Tops: **<< Side to side; Front to back; As indicated on drawings; or _____>>**.
    c. Soffits and Bottoms: **<< Side to side; Front to back; As indicated on drawings; or _____>>**.
    d. Door: **<< Vertical; Vertical with continuous vertical matching; Horizontal; Horizontal with continuous end matching; or _____>>**.
    e. Drawer Fronts: Premium Grade, comply with specifed performance requirements.
    f. Face Frame Members: **<< Lengthwise along members; As indicated on drawings; or _____>>**.
    g. Knee Space Panels: **<< Vertical; Horizontal; As indicated on drawings; or _____>>**.
    h. Aprons and Light Valances: **<< Vertical; Horizontal; As indicated on drawings; or _____>>**.
    i. End and Divider Panels: **<< Vertical; Horizontal; As indicated on drawings; or _____>>**.
11. Edgebanding Applications for Wood Casework with Transparent Finish:
    a. Comply with specified performance requirements for all edges.
12. Edgebanding Materials for Wood Casework with Transparent Finish:
    a. ABS: Well-matched to exposed face; radiused and beveled on edges and corners if thickness is greater than 0.039 inch.

C. Wood Casework with Laminate Cladding:
   1. Casework Construction:
      a. Frameless Cabinet and Door Interface: Flush overlay.

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b. Door and Drawer Front Profile: Flush.
c. Reveal Dimensions: Comply with performance requirements.

2. Wood Drawer Boxes with Laminate Cladding:
   a. Comply with specified performance requirements.

D. Custom Grade - Laminate-Clad Wood Casework:
   a. Comply with specified performance requirements for exposed exterior surfaces, exposed interior surfaces, and semi-exposed surfaces.

E. Edgebanding Applications for Laminate-Clad Wood Casework:
   a. Comply with specified performance requirements for all edges.

F. Edgebanding Materials for Laminate-Clad Wood Casework:
   a. ABS: Well-matched to exposed face; radiused and beveled on edges and corners if thickness is greater than 0.039 inch.

G. Concealed Cabinet Base Components: ******Applies to both wood veneer and laminate clad casework.******
   1. Cabinet Base **<< Toe-Kick Subfronts; or _____>>**:
      a. Materials and Size: **<< Fabricator's choice; Manufacturer's choice; Supplier's choice; or _____>>** subject to requirements of **<<ANSI/AWI 0641>>**.
      b. Height Above **<< Subfloor; or _____>>**: **<< 4 inches; 4-1/2 inches; 5 inches; ____ inches; As indicated on drawings; or _____>>**.
      c. Finished Face of **<< Toe Kick Subfronts; or _____>>**: **<< Transparent finish; Opaque finish; As indicated on drawings; or _____>>**.
   2. Cabinet **<< Base Blocking; Stretchers; and _____>>**:
      a. Materials and Size: **<< Fabricator's choice; Manufacturer's choice; Supplier's choice; or _____>>** subject to requirements of **<<ANSI/AWI 0641>>**.
      b. Height Above **<< Subfloor; or _____>>**: **<< 4 inches; 4-1/2 inches; 5 inches; ____ inches; As indicated on drawings; or _____>>**.
   3. Cabinet Base Sleepers:
      a. Materials and Size: **<< Fabricator's choice; Manufacturer's choice; Supplier's choice; or _____>>** subject to requirements of **<<ANSI/AWI 0641>>**.
      b. Height Above **<< Subfloor; or _____>>**: **<< 4 inches; 4-1/2 inches; 5 inches; ____ inches; As indicated on drawings; or _____>>**.

H. Countertops:
   1. Architectural Woodwork Institute (AWI) Performance Requirements:
      a. Comply with **<<AWI 1236>>** as applicable for specified countertop material, aesthetic grade, and performance requirements.
         1) Aesthetic Grade: Custom.
   2. Types: More than one type is required. Refer to drawings for locations. ******Indicate this when using both plastic laminate and solid surface countertops on a project.******
   3. Plastic Laminate Countertops:
      a. Custom Grade - Laminate-Clad Countertops:
         1) Comply with specified performance requirements for exposed surfaces, joints, and edgebanding applications for laminate-clad countertops.
      b. Core: Plywood, build up core material for total countertop thickness indicated.
      c. Back **<< and End; or None - N/A>>** Splashes: 3/4-inch thick core material. Comply with specified performance requirements.

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4. Solid Surface Countertops**<< and Window Stools; or None - N/A>>**:
   a. CustomGrade - Solid Surface Countertops:
      1) Comply with specified performance requirements for exposed surfaces, joints and edge treatment for solid surface countertops.
   b. Core: Plywood, build up core material for total countertop thickness indicated.
   c. Shop-fabricate cutouts and holes in solid surface for plumbing fixtures, deck-mounted soap dispensers, and other items indicated on Drawings in compliance with specified performance requirements.
   d. Window Stools: Scribe window stools to fit jamb conditions as indicated.

2.06 FINISHED WALL PANELS

A. Wood Veneer Panels:
   1. Description: Panels consisting of wood face veneers applied to cores; panel layup with face ply, back ply, and core of either single layer or odd number of inner plies, to produce balanced construction panel; comply with **<<HPVA HP-1>>**.
      a. Panels subject to **<< size limitations; minimum thickness requirements; fabrication tolerances; and _____>>** of specified **<< aesthetic grade; performance duty level; and _____>>** in accordance with **<<AWI 300>>** and **<<ANSI/AWI 0641>>**.
   2. Back: **<< Comply with backer requirements of AWI 300; Balancing backer; Manufacturer's choice; Thermally fused laminate; Hardwood veneer; or _____>><< ; grade 1; ; grade 2; ; grade 3; ; grade 4; ; _____; or None - N/A>>**.
   3. Panel Cores: Plywood.

B. HPDL-Clad Panels:
   1. Description: Panels consisting of High-Pressure Decorative Laminate (HPDL) faces applied to cores; panel layup with face ply, back ply, and core of either single ply or odd number of inner plies, to produce balanced construction panel.
      a. Panels subject to **<< size limitations; minimum thickness requirements; fabrication tolerances; and _____>>** of specified **<< aesthetic grade; performance duty level; and _____>>** in accordance with **<<AWI 300>>** and **<<ANSI/AWI 0641>>**.
   2. HPDL Laminates Less than **<< 0.08 inch>>** Thick: Comply with **<<ISO 4586-3>>**.
      a. Exposed Backer Materials:
         1) Same materials, thickness and color as laminate face.
      b. Concealed Backer Materials:
         1) Laminate materials **<< as required for balanced construction panel; recommended by laminate manufacturer for application; and _____>>**.
   3. Panel Cores: Plywood.

C. Finished Wall Panel Reveals:
   1. Comply with specified performance requirements.
   2. Painted Reveals: Black, paint substrate prior to panel installation.
   3. Metal Reveals: **<<ASTM B221>>** extruded aluminum, 6063-T5 alloy.
      a. Width: 1/2 inch.
      b. Depth: Match depth of finish wall panels.
      c. Finish: As selected by Architect from manufacturers full range.
      d. Manufacturers:

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1) Flannery, Inc.
2) Fry Reglet.
3) Gordon, Inc.
4) Pittcon Industries.
5) Tamlyn.

2.07 SOLID WOOD AND FINISHED CARPENTRY COMPONENTS

A. Solid Wood Profiled Trim and Moulding: Compatible in color with wood veneer.
   1. Comply with requirements for custom grade aesthetic level and structural performance in accordance with **<<AWI 0622.0646>>**.

B. Closet and Utility Shelving: Comply with requirements of **<<AWI 0622.0646>>**.

C. Learning Stair Wood Flooring, Treads, and Risers: Veneered wood with transparent finish on exposed surfaces in accordance with **<<ANSI/AWI SMA 0643>>**.
   1. Aesthetic Grade: Custom.
   2. Structural Performance: Comply with specified performance requirements.
   3. Core Material: Plywood.
   4. Contrasting Strips: Wood veneer of contrasting color in accordance with ADA requirements.
   5. Cellulose-Based Fiber Board Underlayment: Refer to **<< 061000 - Rough Carpentry>>**.
   6. FRT Plywood Subflooring: Refer to **<< 061000 - Rough Carpentry>>**.

2.08 HARDWARE

A. Workstation Brackets: Fixed, L-shaped, corner reinforced, face-of-stud mounting.
   1. Size: Nominal sizes as indicated unles noted otherwise.
      a. For 30 inch deep countertops: 21 inches high by 28 inches deep.
      b. For 25 inch deep countertops: 21 inches high by 21 inches deep.
      c. Provide additional sizes as indicated on drawings.
   2. Materials: Formed steel shapes.
      a. Finish: Manufacturer's standard, factory-applied,**<< textured; veined; _____; or None - N/A>> << powder coat; primer; or _____>>**.
      b. Color: As selected by Architect from manufacturer's full range.
   3. Load Capacity: 1000 pounds minimum per pair of brackets, tested at 16 inches on center.
   4. Product:
      a. A&M Hardware, Inc; Standard Brackets.
      b. Best Brackets: ADA Workstation Support Standard Steel Bracket.
      c. FastCap; SpeedBrace.
      d. Lyman Associates; Counter Top Supports.
      e. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Hinges, Number of Hinges for Each Cabinet Door:
   1. Comply with specified performance requirements.
   2. Door Heights Greater than 84 inches: Not less than **<< four; or _____>>** hinges per door.

C. Hinges: **<< Full surface (decorative); Semiconcealed; European style concealed; Concealed (fully mortised); Butt; Pivot (knife); or _____>> << self-closing; _____; or**

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None - N/A>> type, **<<BHMA A156.9>>**, Grade 1, 2-3/4 inch, 5-knuckle **<< steel with nickel-plated finish; steel with polished finish; steel with satin finish; bronze with satin finish; or _____>>**. Provide with antifriction bearings and rounded hospital tips.

1. Provide two hinges for doors less than 48 inches high, and three hinges for doors more than 48 inches high.

D. Hinges, Self-Closing, Integrated Damper Hinges:
   1. Description: Self-closing hinges with integrated damper mechanisms.
   2. Comply with **<<BHMA A156.9>>**.
   3. Material and Finish: **<<BHMA A156.18>>**, 627 or 628 satin aluminum.

E. Cabinet Pulls:
   1. Description: **<< Back-mounted; Surface-mounted; Flush and mortised; or _____>>** pulls.
   2. Comply with specified performance requirements.
   3. Comply with **<<BHMA A156.9>>**, **<< B02011; B02041; B02201; and _____>>**.
   4. Design: **<< As indicated on drawings; U-shape wire pulls; Bar shaped; Rectangular; Oval; Round; Oblong; or _____>>**.
   5. Center-to-Center Mounting Dimension: **<< 4 inches; or _____ inches>>**.
   6. Material and Finish: **<<BHMA A156.18>>**, **<< 600 or 715 primed for painting; 613 or 640 dark oxidized satin bronze; 625 or 651 bright chromium; 626 or 652 satin chromium; 630 or 654 satin stainless steel; 627 or 628 satin aluminum; 672 or 712 or 717 bright chromium; or _____>>**.

F. Adjustable Shelf Support Systems, Standards and Shelf Rests:
   1. Description: Slotted vertical standards with shelf rests for supporting shelves; standards mounted in evenly spaced, cleanly bored holes.
   2. Load Capacity: Comply with with specified structural performance duty level.
   3. Adjustment Increment: **<< 1 inch; 1-1/4 inches; or ____ inches>>**.
   4. **<< Surface-Mounted; or Mortise-Mounted>>** Standards: Comply with **<<BHMA A156.9>>**, **<< B04063; or _____>>**.
   5. Closed Shelf Rests: Comply with **<<BHMA A156.9>>**, **<< B04083; B04081; or _____>>**.
   6. Open Shelf Rests: Comply with **<<BHMA A156.9>>**, **<< B04093; B04091; or _____>>**.
   7. Material and Finish: **<<BHMA A156.18>>**, **<< 600 or 715 primed for painting; 613 or 640 dark oxidized satin bronze; 625 or 651 bright chromium; 626 or 652 satin chromium; 630 or 654 satin stainless steel; 627 or 628 satin aluminum; 672 or 712 or 717 bright chromium; or _____>>**.

G. Drawer Slides:
   1. Description: Hardware units that suspend drawers and provide controlled drawer sliding.
   2. Comply with specified performance requirements.
   3. Comply with **<<BHMA A156.9>>** and as follows:
      a. **<< Standard Duty Grade 1; Standard Duty Grade 2; Heavy Duty Grade 1HD-100; Heavy Duty Grade 1HD-200; or _____>>**, supports minimum 100 pounds per foot for standard box drawers less than 30 inches wide.
      b. **<< Standard Duty Grade 1; Standard Duty Grade 2; Heavy Duty Grade 1HD-100; Heavy Duty Grade 1HD-200; or _____>>**, supports minimum 200 pounds per foot for file drawers or drawers more than 30 inches wide.

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4. Features: **<< Self-closing; Soft-closing; Self-closing and soft-closing; or _____>>**.
5. Mounting: **<< Bottom-edge mounted; Bottom-center mounted; Center-top mounted; Side-mounted; Side-mounted self-closing; Ball-bearing side-mounted; Ball-bearing rail-mounted; Undermount concealed; or _____>>**.
6. Extension: **<< Full extension; 3/4 extension; Full extension with overtravel; or _____>>**.
7. Material and Finish: **<<BHMA A156.18>>**, **<< 600 or 715 primed for painting; 613 or 640 dark oxidized satin bronze; 625 or 651 bright chromium; 626 or 652 satin chromium; 630 or 654 satin stainless steel; 627 or 628 satin aluminum; 672 or 712 or 717 bright chromium; or _____>>**.
8. Manufacturers:
   a. Accuride International, Inc.
   b. Fulterer USA
   c. Grass America Inc
   d. Knape & Vogt Manufacturing Company.

H. Cabinet Door Keyed Locks with Dead Bolts:
1. Description: Keyed cylinder locks for securing cabinet doors.
2. Mounting: Half-mortised into back of door.
   a. Comply with specified performance requirements.
3. Key Control: Master keyed, 4 master keys that can operate all casework locks for new casework.
4. Material and Finish: **<<BHMA A156.18>>**, **<< 600 or 715 primed for painting; 613 or 640 dark oxidized satin bronze; 625 or 651 bright chromium; 626 or 652 satin chromium; 630 or 654 satin stainless steel; 627 or 628 satin aluminum; 672 or 712 or 717 bright chromium; or _____>>**.

I. Garment Hooks:
1. Description: Devices with one or more arms projecting from attachment bases; for hanging garments.
2. Mounting: **<< Surface mounted; Recessed; or _____>>**.
3. **<< Material; Finish; Color; and _____>>**: **<< Bright chromium-plated nickel; Satin chromium-plated nickel; Bright stainless steel; Satin stainless steel; Steel with nickel-plated finish; Steel with polished finish; Steel with polished finish; Steel with zinc coating finish; Steel with powder-coat finish; or _____>>**.

J. Base Cabinet Support Levelers:
1. Description: Adjustable Base Cabinet Support Levelers.
2. Starting Installation Height: **<< 4 inches; 5-7/8 inches; or _____ inches>>**.
3. **<< Material; Finish; Color; and _____>>**: **<< Bright chromium-plated nickel; Satin chromium-plated nickel; Bright stainless steel; Satin stainless steel; Steel with nickel-plated finish; Steel with polished finish; Steel with polished finish; Steel with zinc coating finish; Steel with powder-coat finish; Satin anodized aluminum; or _____>>**.

K. Grommets: Plastic, with matching slotted caps; round.
1. Applications: **<< Where indicated on drawings; or _____>>**.
2. Shape: **<< Round; or _____>>**.
3. Inside Diameter: **<< 1-1/2 inches; or _____ inches>>**.

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4. Color: **<< Black; White; Brown; Gray; White; As indicated on drawings; or _____>>**.

L. Metal Hanging Systems:
1. Description: Cleated, z-shaped clips and rails, hanging systems.
2. Material: **<< Extruded aluminum; alloy 6005-T6 tempered in accordance with ASTM B221; or _____>>**.

2.09 FABRICATION

A. Shop-fabricate casework to **<< dimensions; profiles; details; and _____>>** indicated on drawings.

B. Fabricate to maximum extents plausible, including **<< doors; drawers; hardware; and _____>>**; fabricate units in sizes transportable through building openings.

C. When necessary to cut and fit on site, provide materials with sufficient allowance for cutting.

D. Wood Casework with Laminate Cladding: Apply laminates in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline.

E. Matching Wood Grain: Comply with requirements of quality standard for specified Grade **<< and as follows:; or _____>>**

F. Provide cutouts for **<< plumbing fixtures; plumbing lines; appliances; electrical lines; outlet boxes; inserts; communication lines; computer equipment; audio-visual equipment; similar items; hardware; and _____>>**; verify locations of cutouts from on-site dimensions. Sand and **<< seal; prime paint; or _____>>** cut edges.

G. Edgebanding: Apply where specified; do not use more than one piece for any single length.

H. Hardware: Install hardware in accordance with hardware manufacturer's written instructions; use fasteners supplied by hardware manufacturer.

I. Fabrication Tolerances: Comply with specified performance requirements.

2.10 SHOP FINISHING

A. Surface Preparation: Comply with:
1. **<<ANSI/AWI 0400>>** for specified aesthetic grade.

B. Shop Finishing: Shop finish architectural wood casework.
1. Comply with **<<ANSI/AWI 0400>>** for specified aesthetic grade.

C. Grain Fillers: Apply to **<< open-grained; or _____>>** wood substrates; tint to match wood; work fillers into wood grain; wipe excess from surfaces.

D. Wash Coats: Apply to**<< closed-grained; _____; or None - N/A>>** wood substrates.

E. Transparent Finish System:
1. **<<ANSI/AWI 0400>>** Finish System: TR-2A - Lacquer, post-catalyzed or TR-4 - Varnish, conversion. ******Both options are widely available and score high on performance for interior casework, paneling, ornamental work, stairs, frames, windows, blinds, shutters, and doors. TR-2A is repairable and resistant to stains, heat, abrasion, and chemicals. TR-4 is durable.******
2. Stain: As selected by **<<Architect>>** from stain manufacturer's full range of colors.

F. Opaque Finish System: Refer to **<< 099100 - Painting>>**.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Verify casework and materials required for installation have been delivered, handled and stored as specified.

B. Verify **<< wood blocking; wood backing; wood furring; and _____>>** that provides casework **<< backing; structural support; and _____>>** is installed as indicated on **<< drawings; and _____>>**.

C. Verify location and sizes of **<< rough-in plumbing; rough-in electrical; rough-in _____; and _____>>** associated with work of this section.

D. Verify location and sizes of cutouts for **<< appliances; special equipment; sinks; and _____>>** to be mounted in or adjacent to casework.

3.02 PREPARATION

A. Acclimate casework to environments indicated for installation.

3.03 INSTALLATION

A. Install and secure work of this section in accordance with specified performance requirements.

B. Install work of this section rigid, plumb, and level and in accordance with **<< fabricator's; manufacturer's; supplier's; or _____>>** documented instructions**<< ; secure casework as indicated on drawings; ; _____; or None - N/A>>**.

1. Align and secure adjoining cabinet units with fasteners in concealed locations.

C. **<< Wall; Base and Wall; or _____>>** Cabinet Anchorage Support Construction:

1. See Section **<< 061000>>** for**<< load-bearing; non-load-bearing; _____; or None - N/A>>** wood **<< stud framing; in-wall blocking; furring; and _____>>** providing **<< backing; support; structural support; and _____>>** for casework.

D. Install cabinet hardware in accordance with hardware manufacturer's documented instructions using hardware manufacturer's furnished fasteners.

E. Install scribe fillers**<< , as indicated on drawings,; , _____; or None - N/A>>** to close gaps between casework and adjacent walls.

F. See Section **<< 088000>>** for site-glazing of glass applications installed in casework components.

3.04 TOLERANCES

A. Comply with specified performance requirements for tolerances.

3.05 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

B. AWI QCP Inspection Services: Provide AWI QCP installation inspection services. ******Indicate this if not specifying a licensed fabricator.******

1. Inspect for compliance with contract documents; on subjects contract documents are silent, inspect for compliance with specified AWI aesthetic grade.

3.06 ADJUSTING

A. Adjust joinery and hardware for smooth operation in accordance with hardware manufacturer's documented instructions.

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B. Repair casework damaged by construction work and to remove defects.

C. Replace casework that cannot be repaired.

3.07 CLEANING

A. See Section **<< 017000 - Execution and Closeout Requirements>>** for additional requirements.

B. Clean exposed and semi-exposed surfaces of **<< casework; shelving; hardware; and _____>>**.

C. Clean, lubricate, and adjust hardware.

D. Touch up shop-applied finishes where damanged or soiled.

3.08 PROTECTION

A. Protect installed casework from subsequent construction operations.

END OF SECTION 064100

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SECTION 070150.19
PREPARATION FOR RE-ROOFING

PART 1 GENERAL ******VERIFY IF DOING A COMPLETE TEAR-OFF OR PARTIAL REPLACEMENT. FOR FULL TEAR-OFF, SOME PARTS OF THIS SPECIFICATION (SUCH AS EXISTING WARRANTY) MAY BE OMITTED******

1.01 PRICE AND PAYMENT PROCEDURES ******HELPFUL TO PROVIDE QUANTITY ALLOWANCES IF CONCEALED COMPONENTS MAY NEED TO BE REPLACED AND CONDITION IS UNKNOWN******

A. Coordinate with Division 1 Allowance and Unit Price sections, for quantity allowance requirements.
   1. Provide quantity allowances in amounts indicated on Bid Form to cover removal and replacement of **<< cover board, insulation, air barrier/vapor retarder, and substrate board>>**. ******Edit list as required******

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with affected mechanical and electrical work associated with roof penetrations.

B. Preinstallation Meeting: Convene four (4) weeks before starting work of this section.
   1. Attendees:
      a. Architect.
      b. Contractor.
      c. Owner.
      d. Roofing Installer.
      e. Roofing system manufacturer's field representative.
      f. Inspection and Testing Agency Representatives, if applicable.
   2. Meeting Agenda: Provide agenda to participants prior to meeting in preparation for discussions on the following:
      a. Removal and installation schedule.
      b. Necessary preparatory work.
      c. Protection before, during, and after roofing system installation.
      d. Removal of existing roofing system.
      e. Cleaning of existing roofing system indicated to remain.
      f. Installation of new roofing system.
      g. Patching new roofing to existing roofing to remain, where indicated.
      h. Temporary roofing and daily terminations.
      i. Transitions and connection to and with other work.
      j. Inspections and testing of installed systems.

1.03 SUBMITTALS

A. Product Data: Submit for each type of material.

B. Shop Drawings: Indicate size, configuration, and installation details.

C. Installer's Qualification Statement.

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1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with experience in re-roofing projects similar in size and scope.
   1. When same installer as new roofing system, comply with related requirements of section indicated for new roofing system.
   2. Where existing roof is covered by warranty, the Installer shall be approved by existing roofing system warrantor to work on existing warranted roof system.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.

1.06 FIELD CONDITIONS

A. Existing Roofing Assembly: **<< _____>>**. ******Provide complete description of full roof assembly to greatest extent possible to allow for accurate pricing by bidding contractors.******

B. Do not remove existing roofing membrane when weather conditions threaten the integrity of building contents or intended continued occupancy.

C. Maintain continuous temporary protection prior to and during installation of new roofing system.

D. Unless MCPS has provided written confirmation that building will be fully unoccupied, provide at least 7 days notice before starting activities that will affect normal building operations.

E. Owner will continue to occupy building areas directly below re-roofing area.
   1. Provide Owner with at least 7 days written notice of roofing activities that may affect their operations and to allow them to prepare for upcoming activities as necessary.
   2. Do not disrupt Owner's operations or activities.
   3. Maintain access of Owner's personnel to corridors, existing walkways, and adjacent buildings.
   4. Provide a secure, fenced off area or enclosed chute for removal of roofing material to the ground.
   5. If work is being performed that is hazardous to occupants below, perform walk-through of affected spaces prior to beginning work to ensure all occupants are evacuated from those areas. Provide temporary signage and/or barriers to ensure occupants do not enter those areas.

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1.07 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Existing Warranties: Perform this work using methods and materials that will maintain existing roof system warranties.
   1. The existing roof system is currently covered under warranty by **<< _____>>**. ******Coordinate existing warranty with MCPS and include as much info as is available.******
   2. Notify existing roof system warrantor prior to starting this work and obtain written instructions for procedures necessary to maintain this existing warranty.
   3. Upon completion of this work, notify warrantor of reroofing completion and obtain documentation to verify that existing roofing system has been inspected and warranty is still in effect.
      a. Submit documentation upon project closeout.

PART 2 PRODUCTS

2.01 COMPONENTS

A. Refer to Division 7 roofing section(s) for additional information on components relating to this work.

2.02 MATERIALS

A. Temporary Roofing Protection Materials:
   1. It shall be the Contractor's responsibility to select appropriate materials for temporary protection of roofing areas as determined necessary for this work.
   2. Materials used shall not damage existing components to remain.

2.03 ACCESSORIES

A. Roof Vent Pipe Extensions: Where existing pipes require extension due to increased insulation R-value, tapered insulation layout, provide solid-wall PVC fitting consisting of pipe and splice sleeve inserts, configured for insertion and sealing to existing plumbing vent piping, sized to fit inside diameter of plumbing vent piping, enabling extension of piping to field-determined height to meet local building code requirements for plumbing vent pipe height above existing roof level.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing roof surface has been cleared of materials being removed from existing roofing system and ready for next phase of work as required.

3.02 PREPARATION

A. Sweep roof surface clean of loose matter.

B. Remove loose refuse and dispose of properly off-site.

3.03 MATERIAL REMOVAL ******EDIT THE PARAGRAPHS BELOW TO CORRESPOND WITH SCOPE ON CASE-BY-CASE BASIS******

A. General: Coordinate with Division 2 Demolition and with Division 1 Construction Waste Management for additional requirements for material removal and demolition.

B. Remove only existing roofing materials that can be replaced with new materials on the same day, or as weather will permit.

C. Remove metal counter flashings.

D. Remove roofing ballasts.
   1. Rinse roofing ballast with clean water and store on site for re-installation after re-roofing process is complete.

E. Remove roofing membranes, mechanical fasteners, perimeter base flashings, penetration flashings, pitch pockets, and other associated components.

F. Remove cover board and all associated components and fasteners.

G. Remove insulation, cant strips, blocking, and other associated components and fasteners.

H. Remove vapor retarder/air barrier and any other underlayments.

I. Remove substrate board and associated components and fasteners.

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J. Roof Deck: Field verify condition of existing roof deck and coordinate with Structural Drawings.

3.04 INSTALLATION

A. Coordinate scope of this work with requirements for installation of new roofing system, refer to Division 7 roofing section(s) for additional requirements.

3.05 FIELD QUALITY CONTROL

A. Existing Warranty Inspection: Roofing manufacturer responsible for the original warranty shall inspect work and provide confirmation that existing warranty remains in place for the existing portions of roof.

3.06 PROTECTION

A. Provide protection of existing roofing system that is not having work performed on it.

B. Provide temporary protective sheeting over uncovered deck surfaces.

C. Turn sheeting up and over parapets and curbing. Retain sheeting in position with weights.

D. Provide for surface drainage from sheeting to existing drainage facilities.

E. Do not permit traffic over unprotected or repaired deck surface.

END OF SECTION 070150.19

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SECTION 071113
BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM C272/C272M - Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions.

B. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.

C. ASTM D1227/D1227M - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.

D. ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics.

E. ASTM D1668/D1668M - Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing.

F. ASTM D6506/D6506M - Standard Specification for Asphalt-Based Protection Board for Below-Grade Waterproofing.

G. NRCA (WM) - The NRCA Waterproofing Manual.

1.02 SUBMITTALS

A. Product Data: Provide properties of primer, bitumen, and mastics.

1.03 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application until dampproofing has cured, unless otherwise required by dampproofing manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers:
   1. Henry Company.
   2. Karnak Corporation.
   3. Mar-flex Waterproofing & Building Products.
   4. W. R. Meadows, Inc.

B. Source Limitations: Provide dampproofing and primer products produced by a single manufacturer and obtained through a single supplier. Auxiliary materials shall be provided by primary dampproofing manufacturer, or by manufacturer recommended by primary dampproofing manufacturer.

2.02 BITUMINOUS DAMPPROOFING

A. Bituminous Dampproofing: Cold-applied water-based emulsion; asphalt with mineral colloid or chemical emulsifying agent; with or without fiber reinforcement; asbestos-free; suitable for application on vertical and horizontal surfaces.
   1. Emulsified Asphalt Coating: **<<ASTM D1227/D1227M>>**, Type II, Class 1, consisting of mineral colloid emulsifying agents with fibrous reinforcement.
   2. VOC Content: 30 g/L or less.

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2.03 ACCESSORIES

A. Primers, Mastics, and Related Materials: Type as recommended by dampproofing manufacturer.
   1. Primer: ASTM D1227, Type III, Class 1. Provide diluted by water when recommended by manufacturer.
   2. Asphalt-Coated Glass Fabric: **<<ASTM D1668/D1668M>>**, Type I.

B. Patching Compound: Epoxy or latex-modified repair mortar of type recommended in writing by dampproofing manufacturer.

C. Protection Board: Where protection board is indicated, provide one of the following: ******Verify application location requires protection board.******
   1. Nominal 1/8-inch thick, multi-ply board fabricated of mineral-fortified asphaltic core with outer layers of asphalt-impregnated reinforced mats; in accordance with **<<ASTM D6506/D6506M>>**.
   2. Nominal 1/4-inch thick, XPS insulation board, fan-folded; with film facer on one or both sides; minimum compressive strength of 8 psi in accordance with **<<ASTM D1621>>** and maximum water absorption of 0.6% in accordance with **<<ASTM C272/C272M>>**.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing substrate conditions are acceptable prior to starting this work. Dampproofing applicator shall be present during substrate examination.
   1. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.
   2. Verify that items penetrating surfaces to receive dampproofing are securely installed.

B. Commence with installation after noncompliant conditions are corrected.

3.02 PREPARATION

A. Mask or cover adjacent surfaces not designated to receive dampproofing to prevent staining, spotting or coating with dampproofing.
   1. Protect weep holes and drains to prevent dampproofing from clogging drainage routes.

B. Clean and prepare surfaces to receive dampproofing in accordance with manufacturer's instructions. Remove all substances that would prevent dampproofing from bonding to intended substrate.

C. Do not apply dampproofing to surfaces unacceptable to manufacturer.

D. Apply patching compound to seal penetrations, small cracks, or minor honeycombs in substrate. Cover patched areas with asphalt-coated glass fabric.

3.03 APPLICATION

A. Perform this work in accordance with manufacturer's instructions.

B. Where required by manufacturer, prime surfaces and allow primer to dry thoroughly before application of dampproofing.

C. Foundation Walls: Apply dampproofing to structural CMU (back-up) wythe of foundation wall, from 2 inches below finished grade level to top of footing, and extend a minimum of 6 inches horizontally onto top of footing, unless otherwise indicated on Drawings.

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1. Apply dampproofing in a single coat, via brushed or sprayed application, at a rate not less than 3 gallons per 100 square feet.
2. Extend dampproofing 12 inches onto adjacent walls and footings where they will be concealed in the finished work.
3. Do not apply dampproofing where it will be exposed in the finished work.
4. Provide reinforcing at corners, joints, cracks, and changes of plane with a strip of asphalt-coated glass fabric embedded in a heavy coat of dampproofing.
5. Provide additional coat of dampproofing where required due to thin or uneven coverage; ensure that entire substrate has an uninterrupted and smooth coating of dampproofing.

D. Follow manufacturer's instructions for drying and cure times before application of a subsequent coat or before backfilling.

E. At items that penetrate through dampproofing surface, seal watertight with manufacturer's recommended mastic.

F. Where protection board is indicated, place protection board directly over dampproofing, butt joints, and adhere to tacky dampproofing (within 24 hours of application). Scribe and cut protection boards around projections, penetrations, and interruptions. ******Verify application location requires protection board.******

END OF SECTION 071113

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SECTION 071300
SHEET WATERPROOFING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

B. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension.

C. ASTM D570 - Standard Test Method for Water Absorption of Plastics.

D. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

E. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

F. ASTM D5385/D5385M - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes.

G. ASTM D6135 - Standard Practice for Application of Self-Adhering Modified Bituminous Waterproofing.

H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene at the Project site; at minimum two weeks prior to commencing work of this section.

1. Attendees: Owner, Owner's Insurer (if applicable), Architect, Contractor, waterproofing applicator, waterproofing manufacturer's representative, concrete subcontractor, and other installers whose work interfaces with waterproofing for this Project, including but not limited to masonry, flashing, and air barrier installers.
2. Review and finalize the construction schedule, verify availability of materials, verify installation personnel, equipment, and facilities required to perform work and avoid delays.
3. Review required surface/substrate conditions and preparations, field conditions for application and curing/drying time, special installation details and procedures, inspection, and protection and repair.
    a. Waterproofing manufacturer's representative shall submit a report detailing observations from substrate inspection.
    b. Waterproofing manufacturer's representative and installer shall discuss specific manufacturer requirements and conditions effecting performance, and note compliance of completed construction.
4. Document the proceedings, including potential corrective measures and actions required, and distribute a copy for record to each participant.

1.03 SUBMITTALS

A. Product Data: Provide data for each waterproofing membrane product and for each required accessory product, including but not limited to drainage panel, primer, detailing materials, and sealants.

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B. Shop Drawings: Provide drawings showing complete layout and extents of waterproofing. Indicate special joint or termination conditions and conditions of interfaces and tie-ins with other waterproofing or other adjacent materials.
   1. Provide details for joint and crack conditions, flashings, penetrations, and inside and outside corners.

C. Field Inspection Reports:
   1. Submit report by manufacturer's technical representative detailing substrate conditions.
   2. Submit progress field inspection reports by manufacturer's technical representative detailing

D. Sustainable Design Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

E. Installer's qualification statement.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified; approved and/or certified in writing by manufacturer for installation of specified products.

B. Source Limitations: Provide waterproofing products from a single manufacturer and through a single source. Accessory products shall be provided by primary waterproofing manufacturer or by a manufacturer specifically approved in writing by waterproofing manufacturer.
   1. If it is necessary to provide products by different manufacturers to proceed with the work, the Contractor shall submit written compatibility statements from each manufacturer that the submitted products will properly bond.

1.05 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until liquid or mastic accessories have cured.

B. Do not apply waterproofing when the substrate is damp or wet, or during snow, rain, fog, mist, or other wet conditions.

C. Ensure that adequate ventilation is maintained throughout application of waterproofing.

1.06 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Contractor shall correct defective Work within period of five years after Date of Substantial Completion; remove and replace materials concealing waterproofing at no extra cost to Owner.

C. Provide five year manufacturer materials-only warranty for material failure or waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

PART 2 PRODUCTS

2.01 SHEET WATERPROOFING MATERIALS

A. Self-Adhered Modified Bituminous Sheet Membrane:
   1. Total Thickness: 60 mil, 0.060-inch, minimum.
      a. Construction: 56 mil rubberized asphalt, laminated to a 4 mil polyethylene-film reinforcement, with release liner on adhesive side.
   2. Performance Properties:

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a. Tensile Strength: 250 psi, minimum, measured in accordance with **<<ASTM D412>>** Method A, using die C and at spindle-separation rate of 2 inches per minute.

b. Elongation at Break: 300 percent, minimum, measured in accordance with **<<ASTM D412>>**.

c. Water Vapor Permeance: 0.05 perm, maximum, measured in accordance with **<<ASTM E96/E96M>>**.

d. Low Temperature Flexibility: Unaffected when tested in accordance with **<<ASTM D1970/D1970M>>** at **<< minus 20 degrees F>>**, 180 degree bend on **<< 1 inch>>** mandrel.

e. Water Absorption: 0.2 percent increase in weight, maximum, measured in accordance with **<<ASTM D570>>**, 24 hour immersion.

f. Hydrostatic Pressure Resistance: Membrane resists leakage for at least one hour from pressure equivalent to 200 feet head of water applied in accordance with test method **<<ASTM D5385/D5385M>>**.

g. Puncture Resistance: 40 lb, minimum, measured in accordance with **<<ASTM E154/E154M>>**.

3. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.

4. Available Products:

a. GCP Applied Technologies; Bituthene 4000.

b. Henry Company; Blueskin WP 200 or MiraDRI 860/861.

c. Polyglass; Mapethene 60 HT/LT.

d. Polyguard Products; Polyguard 650.

e. W. R. Meadows, Inc; MEL-ROL.

B. Underslab Sheet Membrane: HDPE, thermoplastic, or elastomeric sheet recommended by manufacturer for placement below concrete slabs and on outside face of below grade walls before placement of concrete. Underslab waterproofing shall form an integral bond to poured concrete.

1. Application: Underslab at elevator pit.

a. Coordinate with modified bituminous product for vertical walls above. Manufacturer shall ensure compatible chemistry between the two products or shall provide a compatible transition product or separation layer for a complete waterproofing system at elevator pit.

2. Low Temperature Flexibility: Unaffected when tested in accordance with **<<ASTM D1970/D1970M>>** at **<< minus 20 degrees F>>**, 180 degree bend on **<< 1 inch>>** mandrel.

3. Hydrostatic Pressure Resistance: Membrane resists leakage for at least one hour from pressure equivalent to **<< 231 feet; or ___ feet>>** head of water applied in accordance with test method **<<ASTM D5385/D5385M>>**.

4. Elongation at Break: 300 percent, minimum, measured in accordance with **<<ASTM D412>>**.

5. Adhesion: **<< 150 psi; or ____ psi>>**, minimum, measured in accordance with **<<ASTM D4541>>**.

6. Water Vapor Permeance: **<< 0.01 perm; or ____ perm>>**, maximum, measured in accordance with **<<ASTM E96/E96M>>**.

7. Water Absorption: 0.5 percent increase in weight, maximum, measured in accordance with **<<ASTM D570>>**, 24 hour immersion.

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8. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.
9. Products:
   a. GCP Applied Technologies; Preprufe 300R Plus/LT.
   b. Henry Company; Blueskin PreSeal 435 or MiraPLY-H with SeamLock.
   c. Polyglass; Mapeproof AL Pro.
   d. Polyguard Products; Underseal Underslab Membrane.
   e. W. R. Meadows, Inc; PRECON.

2.02 ACCESSORIES

A. General: Provide all accessories required by waterproofing manufacturer for a complete waterproof assembly for substrate and installation type indicated.

B. Primer or Surface Conditioner: Liquid product recommended by waterproofing manufacturer for substrate preparation.

C. Seaming Materials: As recommended by membrane manufacturer.

D. Detail Strip: Self-adhering waterproofing strips, fabricated of same material and thickness as waterproofing membrane, minimum 6 inch wide, unless otherwise indicated, for use at joints and details.

E. Detailing Liquid Membrane: Manufacturer's recommended two-component trowel grade liquid membrane.

F. Membrane Sealant: As recommended by membrane manufacturer.

G. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrates and waterproofing materials.

H. Drainage Panel: Drainage layer with non-woven geotextile filter fabric on earth side.
   1. Composition: Dimpled molded-plastic-sheet core; polypropylene or polyester filter fabric bonded to one side, and a polymeric film bonded to the other side. Compressive strength of 15,000 psi.
   2. Thickness: 0.40-inch, minimum.
   3. Products: One of the following or comparable product by one of the waterproofing manufacturers listed above.
      a. American Hydrotech, Inc.; Hydrodrain 400.
      b. GCP Applied Technologies; Hydroduct 220.
      c. Henry Company; MiraDRAIN 6200.
      d. W.R. Meadows, Inc; Mel-Drain**<< 5012; 5012-B; 5035; 5035-B; 7055; 7555; 7572; 9055; _____; or None - N/A>>**.

I. Below-Grade Board Insulation: Extruded polystyrene (XPS) board; comply with **<<ASTM C578>>** Type IV, 25 psi; unfaced, with ship lap or tongue-and-groove edges. ******Verify insulation is detailed where needed. 25 psi is OK unless you have a very tall foundation wall (10 ft+).******

J. Termination Bars: Aluminum or stainless steel; 1 inch by 1/8-inch; compatible with membrane and adhesives. Termination bar shall be predrilled for fasteners at maximum 12 inch spacing, and no more than 1 inch from ends.

K. Adhesives: As recommended by membrane manufacturer.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions are acceptable prior to starting work.

B. Verify horizontal/underslab subgrade surfaces are well compacted, dry, smooth, and ready to receive waterproofing system.

C. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.

D. Verify that items penetrating surfaces to receive waterproofing are securely installed.

E. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect adjacent surfaces from damage not designated to receive waterproofing.

B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.

C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.

D. Crack and Joint Repair: Ensure that cracks and joints are clear of dust and dirt before filling.

1. Prime area around cracks and joints before application of detailing membrane.
2. Fill nonmoving joints and cracks with a liquid detailing membrane or cover with detailing strip.
    a. For cracks larger than 1/16-inch, saw cut crack to 1/4-inch wide by 1/4-inch deep and fill with liquid detailing membrane.
3. Seal moving cracks with sealant and nonrigid filler, using procedures recommended by sealant and waterproofing manufacturers.
4. Unless otherwise required by manufacturer, provide minimum 6-inch wide detailing strips or liquid membrane, centered over crack or joints. Overlap ends of strips at least 3 inches.
5. At expansion joints, prepare in strict accordance with waterproofing manufacturer's approved detail.

3.03 INSTALLATION

A. General: Install membrane waterproofing in accordance with manufacturer's instructions.

1. For self-adhered modified bituminous waterproofing, comply with installation recommendations of **<<ASTM D6135>>**.
2. Roll out membrane to relax, and minimum wrinkles and bubbles.

B. Horizontal (Underslab) Membrane: Form membrane around footing construction and extend up to top of footing.

C. Apply primer at manufacturer's required rate.

D. At all vertical and horizontal inside corners, apply a 3/4-inch cant bead of detailing liquid membrane.

E. Provide 12 inch wide detailing strip at all outside corners, include top corner of all footings, extended 6 inches each direction from corner.

F. Where inside and outside corners meet horizontal planes, provide manufacturer's preformed corner elements, or field form details in strict accordance with manufacturer's detailing instructions.

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G. Self-Adhering Membrane: Remove release paper layer, and roll out onto substrate with a mechanical roller to provide full contact bond.
   1. Install in horizontal rows from bottom to top to provide shingling effect.

H. Overlap edges and ends, minimum 3 inches, seal permanently waterproof by method recommended by manufacturer, and apply uniform bead of sealant to joint edge.

I. Offset or stagger end laps of each row by at minimum 8 inches, unless otherwise required by manufacturer.

J. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.

K. Weather lap joints on sloped substrate in direction of drainage, and seal joints and seams.

L. Install building expansion joints at locations as indicated on drawings.

M. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.

N. Seal membrane and flashings to adjoining surfaces.
   1. Install termination bar along edges.
   2. Install counterflashing over exposed edges.

3.04 INSTALLATION - DRAINAGE PANEL

A. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward; scribe and cut boards around projections, penetrations, and interruptions. At footings, extend drainage panel horizontally over footing and down face of footing and overlap bottom of sheet waterproofing a minimum of 2 inches. Set drainage panels in manufacturer's recommended adhesive.
   1. Where insulation is indicated, install board insulation with manufacturer's recommended adhesive prior to installation of drainage panels.

3.05 FIELD QUALITY CONTROL

A. Manufacturer's technical representative shall provide inspection service of at least one review per building elevation (minimum of 4) in addition to initial substrate review performed at preinstallation meeting. Inspections shall be performed prior to full installation of drainage/protection board and shall review membrane application, flashings, and protection and drainage components.

B. Prepare and submit field quality control reports.

C. Where field inspection identifies deficiencies, the Contractor shall be responsible for performing repairs, patching, or for removal and reapplication of waterproofing.

3.06 PROTECTION, REPAIR, AND CLEANING

A. Do not permit traffic over unprotected or uncovered membranes.

B. Until backfill can be completed, provide temporary protection measures to protect installed waterproofing system from damage and abuse, weather exposure, and UV exposure.

C. Immediately prior to backfill, perform a visual inspection of waterproofing system with Installer present; provide repairs and cleaning to ensure integrity of waterproofing after backfill is completed.

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D. Clean waterproofing system of soiling, staining, and marking left by other construction activities. Use only cleaning materials and procedures approved by waterproofing manufacturer.

END OF SECTION 071300

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SECTION 072100
THERMAL INSULATION

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

E. ASTM C1029 - Standard Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation.

F. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

I. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C.

J. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

K. CAN/ULC-S705.1 - Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Material Specification.

L. NFPA 259 - Standard Test Method for Potential Heat of Building Materials.

M. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components.

N. UL (GGG) - GREENGUARD Gold Certified Products.

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1.02 SUBMITTALS

A. Product Data: Provide data on **<< product characteristics; performance criteria; product limitations; and _____>>**.

B. Sustainable Design Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.03 QUALITY ASSURANCE

A. **<<NFPA 285>>** Tested Assembly: Provide foam plastic insulation products located in exterior wall assemblies that have been tested in accordance with NFPA 285 which represent those exterior wall assemblies for this Project.

1. Potential heat in Btu per square feet shall not exceed the potential heat of the foam plastic insulation contained in the wall assembly tested as determined by tests in accordance with **<<NFPA 259>>**.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect foam-plastic insulation from physical damage, including chipping, cracking, or soiling. Do not use boards that are damaged due to delivery or handling.

B. Store insulation in a manner that protects from damage or deterioration, including moisture, soiling, or UV exposure.

1.05 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

B. Coordinate with insulation manufacturer for UV exposure requirements and coordinate the schedule of construction to ensure insulation is concealed in a timely manner.

PART 2 PRODUCTS

2.01 INSULATION MATERIALS, GENERAL

A. Recycled Content: Provide insulation products with recycled content as follows:
   1. Polystyrene (XPS) Insulation: Minimum 15%.
   2. Mineral Wool: Minimum 75%.
   3. Glass Fiber: Minimum 20%.

B. Low-Emitting Materials (Insulation): Insulation that is exposed to the interior of the building shall be certified compliant with **<<CAL (CDPH SM)>>** Standard Method v1.1 or with **<<UL (GGG)>>** GREENGUARD Gold.

2.02 FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene (XPS) Board Insulation: Comply with **<<ASTM C578>>** with either natural skin or cut cell surfaces.
   1. Type and Compressive Resistance: **<< Type XII, 15 psi (104 kPa); Type X, 15 psi (104 kPa); Type XIII, 20 psi (138 kPa); Type IV, 25 psi (173 kPa); Type VI, 40 psi (276 kPa); Type VII, 60 psi (414 kPa); or Type V, 100 psi (690 kPa)>>**, minimum.
   2. Flame Spread Index (FSI): **<< Class A - 0 to 25; Class B - 26 to 75; or Class C - 76 to 200>>**, when tested in accordance with **<<ASTM E84>>**.
   3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with **<<ASTM E84>>**.
   4. Type and Thermal Resistance, **<< R-value>>**: **<< Type XII, 4.6 (0.81); Type X, 5.0 (0.88); Type XIII, 3.9 (0.68); Type IV, 5.0 (0.88); Type VI, 5.0 (0.88); Type VII, 5.0 (0.88); or Type V, 5.0, (0.88)>>**, minimum, per **<< 1 inch>>** thickness at **<< 75 degrees F>>** mean temperature.
   5. Embodied Carbon: Maximum 0.8 kg CO_2eq / bd ft.
   6. Complies with fire resistance requirements as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with **<<NFPA 285>>**.
   7. Board Edges: **<< Square; Shiplap; Tongue-and-groove; Scored square; or _____>>**.
   8. Water Absorption: 0.3 percent by volume, maximum, by total immersion.
   9. Products: (Low-GWP Products)
      a. DuPont de Nemours, Inc; Styrofoam XPS Grey (Reduced GWP)
      b. Kingspan Insulation LLC; GreenGuard **<< GG25-LG; GG40-LG; GG60-LG; or _____>>** XPS Insulation Board.

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c. Owens Corning Corporation; FOAMULAR NGX (Next Generation Extruded).

B. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, comply with **<<ASTM C1289>>**. ******Foil-faced polyiso can be an option at some NFPA 285 assemblies******

1. Classifications:
   a. Type I: Faced with aluminum foil on both major surfaces of the core foam.
      1) Class 1 - Non-reinforced core foam.
      2) Grade 1 or 2: Minimum compressive strength of 20 psi.
      3) Thermal Resistance: Minimum R-13.0 at 2 inches thick and R-16.0 at 2.5 inches thick; at 75 degrees F.
2. Flame Spread Index (FSI): **<< Class A - 0 to 25; Class B - 26 to 75; or Class C - 76 to 200>>**, when tested in accordance with **<<ASTM E84>>**.
3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with **<<ASTM E84>>**.
4. Water Vapor Permeance: 0.1 perm, maximum, at 1 inch thickness, and when tested in accordance with **<<ASTM E96/E96M>>**, desiccant method.
5. Comply with fire resistance requirements as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with **<<NFPA 285>>**.
6. Board Edges: **<< Square; Shiplap; Channel vented; or _____>>**.
7. Products:
   a. Atlas Roofing Corporation; EnergyShield Pro.
   b. Hunter Panels; Xci Foil (Class A).
   c. Johns Manville; AP Foil-Faced.
   d. Rmax Inc; ECOMAXci FR.

2.03 MINERAL FIBER BOARD INSULATION MATERIALS

A. Mineral Wool Block and Board Thermal Insulation: Complying with **<<ASTM C612>>**. ******For use in exterior cavity walls in lieu of XPS. May be required for certain NFPA 285 assemblies******

1. Facing: None, unfaced.
2. Flame Spread Index: 25 or less, when tested with facing, if any, in accordance with **<<ASTM E84>>**.
3. Smoke Developed Index: 50 or less, when tested with facing, if any, in accordance with **<<ASTM E84>>**.
4. Board Thickness: Manufacturer's standard; as required to meet total thickness indicated on Drawings.
5. Board Edges: Square.
6. Thermal Conductivity (R-value): Minimum R-value of 4 per inch, at **<< 75 degrees F>>** when tested in accordance with **<<ASTM C518>>**.
7. Maximum Density: 11 pcf, nominal.
8. Products:
   a. Johns Manville; CladStone 110.
   b. Owens Corning Corporation; Thermafiber RainBarrier ci HC Plus.
   c. ROCKWOOL; COMFORTBOARD 110.

2.04 BLANKET INSULATION MATERIALS

A. Fiberglass Batt Insulation: Preformed insulation, complying with **<<ASTM C665>>**; friction fit.

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1. Flame Spread Index: 25 or less, when tested in accordance with **<<ASTM E84>>**.
2. Smoke Developed Index: 50 or less, when tested in accordance with **<<ASTM E84>>**.
3. Combustibility: Non-combustible, when tested in accordance with **<<ASTM E136>><< , except for facing, if any; , _____; or None - N/A>>**.
4. Facing: Unfaced.
5. Manufacturers:
   a. CertainTeed Corporation.
   b. Johns Manville.
   c. Knauf Insulation.
   d. Owens Corning Corporation.

B. Mineral Wool Batt Insulation: Flexible or semi-rigid preformed insulation, complying with **<<ASTM C665>>**.
1. Flame Spread Index: Zero (0), when tested in accordance with **<<ASTM E84>>**.
2. Smoke Developed Index: Zero (0), when tested in accordance with **<<ASTM E84>>**.
3. Facing: Unfaced.
4. Products:
   a. Johns Manville; MinWool SAFB.
   b. ROCKWOOL; COMFORTBATT.
   c. Thermafiber, Inc; SAFB.

2.05 MISCELLANEOUS GAP / CRACK FILLER

A. General: Fill miscellaneous joints and cracks with mineral wool batt insulation (specified above) or with closed-cell polyurethane foam at Contractor's option.

B. Closed Cell Polyurethane Foam:
1. Provide insulation that conforms to **<<CAN/ULC-S705.1>>**, "Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Material" or **<<ASTM C1029>>**, Type II, and performance requirements listed.
2. Flame-spread index of 0 and maximum smoke development index of 5, when tested in accordance with ASTM E84.
3. Products:
   a. Dow; Enerfoam Professional Foam Sealant.
   b. Dupont; Great Stuff Pro Gaps & Cracks.
   c. Hilti; CF-AS Crack and Joint All Seasons.

2.06 ACCESSORIES

A. Insulation Fasteners: Impaling clip of galvanized steel with washer retainer and clips, to be secured to surface to receive insulation, of type and length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.

B. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.

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B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER

A. Apply adhesive to back of boards per manufacturer's instructions, but not less than three continuous beads per board length.

B. Install boards horizontally on foundation perimeter.
   1. Place boards to maximize adhesive/substrate contact.
   2. Install in running bond pattern.
   3. Butt edges and ends tightly to adjacent boards and to protrusions.

C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 BOARD INSTALLATION AT CAVITY WALLS

A. Secure impaling fasteners to substrate to manufacturer's required quantity and spacing.

B. Apply adhesive to back of boards per manufacturer's instructions, but not less than three continuous beads per board length.

C. Install boards to fit snugly between wall ties or continuous insulation framing system, as applicable.

D. Install boards horizontally on walls.
   1. Place boards to maximize adhesive/substrate contact.
   2. Install in running bond pattern.
   3. Butt edges and ends tightly to adjacent boards and protrusions.
   4. Place impale fastener locking discs.

E. Cut and fit insulation tightly to protrusions, penetrations, and other interruptions to the insulation plane.

3.04 BATT INSTALLATION

A. Install insulation in accordance with manufacturer's instructions.

B. Install in exterior framed spaces, where indicated on Drawings, without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.05 MISCELLANEOUS GAP/CRACK FILLER

A. Install mineral wool batt insulation or sprayed polyurethane gap and crack filler to fill miscellaneous voids in exterior insulation. Install in accordance with manufacturer's instructions to completely fill the required space. If using sprayed polyurethane, ensure that it is not exposed to the interior space unless covered by a compatible thermal barrier product.

3.06 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION 072100

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SECTION 072700
AIR BARRIERS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension.

B. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

C. ASTM D2178/D2178M - Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

E. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

F. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials.

G. ASTM E2357 - Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies.

H. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene at the Project site; at minimum two weeks prior to commencing work of this section.

1. Attendees: Owner, Owner's Insurer (if applicable), Architect, Contractor, air barrier Installer, air barrier manufacturer's representative, and other installers whose work interfaces with the air barrier for this Project, including but not limited to masonry, sheathing, flashing, roofing, waterproofing, cladding systems, curtainwall/storefront, doors, windows, and louvers.
2. Review and finalize the construction schedule, verify availability of materials, verify installation personnel, equipment, and facilities required to perform work and avoid delays.
3. Review required surface/substrate conditions and preparations, field conditions for application and curing/drying time, special installation details and procedures, inspection, and protection and repair.
    a. Air barrier manufacturer's representative shall submit a report detailing observations from substrate inspection.
    b. Air barrier manufacturer's representative and installer shall discuss specific manufacturer requirements and conditions effecting performance, and note compliance of completed construction.
4. Document the proceedings, including potential corrective measures and actions required, and distribute a copy for record to each participant.

1.03 SUBMITTALS

A. Product Data: Provide data on material characteristics, performance criteria, and limiatations.

1. Provide product data on transition membranes, including reports indicating compatibility with primary air barrier material(s).

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2. Provide separate product data for manufacturer's low-temperature product if application temperature is expected to be below 40 deg F.

B. Shop Drawings: Provide project-specific drawings of location and extent of air barrier assemblies. Details shall include methods for maintaining air barrier continuity.
   1. Provide termination, transition, and joint details. Include specific details for the following:
      a. Bridging of gaps in construction, including expansion joints.
      b. Inside and outside corners.
      c. Sealing around penetrations at pipes, conduits, and boxes.
      d. Continuity of air barrier at flashings, ledge and shelf angles, and similar interruptions.
      e. Continuity of air barrier at foundation.
      f. Continuity of air barrier at roof.

C. Sustainable Design Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

D. Compatibility Data: Provide manufacturer's data indicating compatibility between submitted primary air barrier material and transition membrane products.

E. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection required by ABAA QAP.

F. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

G. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification; keep copies of each contractor accreditation and installer certification on site during and after installation, and present on-site documentation upon request.

H. Testing agency qualification statement.

1.04 QUALITY ASSURANCE

A. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP):
   1. Installer Qualification: Use accredited contractor, certified installers, evaluated materials, and third-party field quality control audit.

B. Air Barrier Association of America (ABAA) Evaluated Air Barrier Assemblies: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture, and use secondary materials approved in writing by primary material manufacturer.

C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

1.05 MOCK-UPS

A. Integrated Exterior Mockups: Attend preinstallation conference for and provide air barrier components for integrated exterior mockup as **<< indicated on Drawings and as ; or None - N/A>>**specified in Division 1 Section "Quality Requirements."

1.06 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

1.07 WARRANTY

A. Special Warranty: Provide a 5 year warranty starting at the date of Substantial Completion. Warranty shall cover all components of the air barrier assembly, including loss of airtight seal,

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loss of watertight seal, loss of adhesion, loss of cohesion, failure to cure properly, and compatibility and bonding with transition membranes and other adjacent materials.

PART 2 PRODUCTS

2.01 AIR BARRIER ASSEMBLY, GENERAL

A. Air Barrier Material: An air barrier material is an airtight barrier made of material that is virtually air impermeable, and may be water vapor permeable or impermeable, with sealed seams and sealed joints to adjacent surfaces.
   1. Air Permeance (Material): 0.004 cfm/sq ft, maximum, when tested in accordance with **<<ASTM D2178/D2178M>>**.

B. Air Barrier Assembly: An air barrier assembly is multiple air barrier materials, including the primary air barrier membrane, transition membranes, termination strips, sealants, mastics, tapes, and other accessory materials that
   1. Air Permeance (Assembly): 0.04 cfm/sq ft, maximum, when tested in accordance with **<<ASTM E2357>>**.

C. Source Limitations and Compatibility: All air barrier materials shall be manufactured by the primary air barrier membrane manufacturer, or by manufacturers specifically approved in writing by the primary air barrier membrane manufacturer. Provide compatibility data indicating that submitted accessory products are compatible with air barrier membrane and with each other.
   1. Coordinate with roof manufacturer to ensure that transition membrane between wall air barrier and roof air barrier/roof membrane are compatible and submit written confirmation.

2.02 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE) ******PERMEABLE AIR BARRIER IS REQUIRED IF USING A HYBRID INSULATION SYSTEM (INSULATION IN STUD FRAMING WITH CONTINUOUS INSULATION OUTBOARD)******

A. Air Barrier Sheet, Self-Adhered: Vapor permeable, minimum 20 mils thick.
   1. Material: Manufacturer's breathable membrane with release film; for installation over primer when required.
   2. Air Permeance: **<< 0.004 cfm/sq ft>>**, maximum, when tested in accordance with **<<ASTM E2178>>**.
   3. Water Vapor Permeance: 10 perms, minimum, when tested in accordance with **<<ASTM E96/E96M>>** using Procedure A - Desiccant Method, at **<< 73.4 degrees F>>**.
   4. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 90 days of weather exposure, minimum.
   5. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A when tested in accordance with **<<ASTM E84>>**.
   6. Comply with **<<NFPA 285>>** requirements for wall assembly.
   7. Seam and Perimeter Tape: As recommended by sheet manufacturer.
   8. Products:
      a. GCP Applied Technologies; Perm-A-Barrier VPS 30.
      b. Henry Company; Blueskin VP160.
      c. Polyglass; Vertiwrap VPS.
      d. Soprema, Inc; SOPRASEAL Stick VP.
      e. VaproShield, LLC; RevealShield SA - Self-Adhered.
      f. W. R. Meadows, Inc; Air-Shield SMP.

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B. Air Barrier, Fluid Applied: Vapor permeable, elastomeric waterproofing.
   1. Material: Water-based acrylic.
   2. Dry Film Thickness (DFT): Comply with manufacturer requirements to achieve air and water vapor permeance performance.
   3. Air Permeance: **<< 0.004 cfm/sq ft>>**, maximum, when tested in accordance with **<<ASTM E2178>>**.
   4. Water Vapor Permeance: 11 perms, minimum, when tested in accordance with **<<ASTM E96/E96M>>** using Procedure B - Water Method, at **<< 73.4 degrees F>>**.
   5. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 90 days of weather exposure, minimum.
   6. Elongation: 300 percent, minimum, when tested in accordance with **<<ASTM D412>>**.
   7. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A when tested in accordance with **<<ASTM E84>>**.
   8. Nail Sealability: Pass, when tested in accordance with **<<ASTM D1970/D1970M>>**.
   9. VOC Content: 50 g/L maximum.
      a. Sealants, Tapes and Accessories: As recommended by coating manufacturer.
   10. Low-Temperature Formulation: If application temperature is expected to be below 40 degrees F, provide complementary low-temperature product if manufacturer's standard listed product below is not approved for low temperatures. Low-temperature product shall comply with other performance requirements listed and shall be submitted for approval.
   11. Products:
      a. GCP Applied Technologies; Perm-A-Barrier VPL 50.
      b. Henry Company; Air-Bloc 17MR.
      c. Polyglass; VertiWrap VPL.
      d. Sika; Sikagard AWB 660.
      e. Sto Corp; Sto AirSeal.
      f. Tremco Commercial Sealants & Waterproofing; ExoAir 230.
      g. W.R. Meadows, Inc; Air-Shield LMP.

2.03 AIR BARRIER MATERIALS (WATER VAPOR IMPERMEABLE) ******MAY USE IMPERMEABLE IF ALL INSULATION IS OUTBOARD OF THE AIR BARRIER******

A. Air and Vapor Barrier Sheet, Self-Adhered:
   1. Air Permeance: **<< 0.004 cfm/sq ft>>**, maximum, when tested in accordance with **<<ASTM E2178>>**.
   2. Water Vapor Permeance: 0.1 perm, maximum, when tested in accordance with **<<ASTM E96/E96M>>** using Procedure B - Water Method.
   3. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 90 days of weather exposure, minimum.
   4. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A when tested in accordance with **<<ASTM E84>>**.
   5. Complies with **<<NFPA 285>>** requirements for wall assembly.
   6. Seam and Perimeter Tape: As recommended by sheet manufacturer.
   7. Products:
      a. GCP Applied Technologies; Perm-A-Barrier NPS.
      b. Henry Company; Blueskin SA or CCW 705.
      c. Polyglass; VertiWrap NPS.

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d. Polyguard Products, Inc; Airlok 200 BU/NP.
e. Tremco Commercial Sealants & Waterproofing; ExoAir 110.

B. Air and Vapor Barrier, Fluid-Applied:
1. Material: Synthetic acrylic coating.
2. Dry Film Thickness (DFT): Comply with manufacturer requirements to achieve air and water vapor permeance performance.
3. Air Permeance: **<< 0.004 cfm/sq ft>>**, maximum, when tested in accordance with **<<ASTM E2178>>**.
4. Water Vapor Permeance: **<< 1 perm; 0.1 perm; or ___ perm>>**, maximum, when tested in accordance with **<<ASTM E96/E96M>>** using Procedure A - Desiccant Method, at **<< 73.4 degrees F>>**.
5. Water Penetration Resistance Around Nails: Pass, when tested in accordance with **<<ASTM D1970/D1970M>>**.
6. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 90 days of weather exposure, minimum.
7. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A when tested in accordance with **<<ASTM E84>>**.
8. Complies with **<<NFPA 285>>** requirements for wall assembly.
9. Seam and Perimeter Tape: As recommended by sheet manufacturer.
10. Low-Temperature Formulation: If application temperature is expected to be below 40 degrees F, provide complementary low-temperature product if manufacturer's standard listed product below is not approved for low temperatures. Low-temperature product shall comply with other performance requirements listed and shall be submitted for approval.
11. Products:
a. GCP Applied Technologies; Perm-A-Barrier NPL 10.
b. Henry Company; Air-Bloc 16MR or Barritech NP.
c. Hohmann & Barnard, Inc; ENVIRO-BARRIER.
d. Polyglass; VertiWrap NPL.
e. Polyguard Products; Airlok Flex.
f. Sika; Sikagard AWB 660 I.
g. TK Products; TK-AIRMAX 2102.
h. Tremco Commercial Sealants & Waterproofing; ExoAir 130.
i. W.R. Meadows, Inc.; Air-Shield LSR.
j. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

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2.04 ACCESSORIES

A. Sealants, Tapes, and Accessories for Sealing Air Barrier and Adjacent Substrates: As indicated or in compliance with air barrier manufacturer's installation instructions.

B. Compatibility of Materials: Provide sealants, tapes, transition membranes, and other accessory materials that are tested to be compatible with the primary air barrier material and with each other. Provide compatibility charts with product data submittal indicating material compatibility.

C. Primer: Liquid applied polymer, of type recommended by air-barrier manufacturer for substrate.

D. Membrane at Transitions in Substrate and Connections to Adjacent Elements: Nominal 40-mil thick, impermeable, self-adhering sheet membrane.

1. Provide product manufactured by or approved in writing by primary air barrier manufacturer above. Available Products:
    a. GCP; Perm-A-Barrier Flashing.
    b. Henry Company; Blueskin SA or CCW-705.
    c. Polyguard Products; Airlok Sheet 400 NP.
    d. Tremco, Inc.; ExoAir 110.
    e. W. R. Meadows, Inc.; Air Shield.

E. Counterflashing for Masonry Through-Wall Flashing: Nominal 40-mil thick, impermeable, self-adhering membrane.
1. Available Products: Provide one of the following or comparable product manufactured by or approved in writing by primary air barrier manufacturer above.
    a. Grace Construction Products; Perm-A-Barrier Flashing.
    b. Henry Company; Blueskin TWF or CCW-705 TWF.
    c. Polyguard Products; Airlok Sheet 400 NP.
    d. Tremco, Inc.; ExoAir TWF.
    e. W. R. Meadows, Inc.; Detail Strip.

F. Preformed Transition Membrane: Semirigid silicone or polyester composition, tapered edges, tear resistant.
1. Products: Provide one of the following or comparable product manufactured by or approved in writing by primary air barrier manufacturer above.
    a. Dow; DOWSIL Silicone Transition Strip and System.
    b. Elbex; Elbex HS Silicone Sheeting, with compatible GE or Dow sealant.
    c. Tremco Commercial Sealants & Waterproofing; ProGlaze ETA System 1.

G. Stainless Steel Flashing: Self-adhering flexible flashing with 2 mil, 0.002 inch thick Type 304 stainless steel sheet, 8 mil, 0.008 inch of butyl adhesive and siliconized release liner.
1. Overlap joints at least **<< 2 inches>>**.
2. Products:
    a. Momentive Performance Materials, Inc/GE Silicones; GE Elemax SS Flashing.
    b. York Flashings; York 304 SA.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and conditions are ready for work of this section.

B. Where existing conditions are responsibility of another installer, notify Architect of unsatisfactory conditions.

C. Do not proceed with this work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect adjacent surfaces from damage not designated to receive air barrier.

B. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

C. Clean substrate surfaces to receive adhesives and sealants in accordance with manufacturer's installation instructions.

D. For rough surfaces such as CMU, grind smooth any sharp protrusions and fins exceeding 1/4-inch, and fill and smooth any bugholes or voids that are 1/4-inch or larger with manufacturer's recommended sealant filler or patching compound.

E. Verify that substrates are dry and clear of debris or contaminants before proceeding with application.

F. When required by manufacturer for indicated substrates, apply primer at manufacturer's recommended rate.

G. Do not prime surfaces unless air barrier membrane will be applied on the same day.

3.03 INSTALLATION

A. Install materials in accordance with manufacturer's installation instructions.

B. Air Barriers: Install continuous airtight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

C. Apply sealants and adhesives within recommended temperature range in accordance with manufacturer's installation instructions.

D. Self-Adhered Sheets:
   1. Prepare substrate in accordance with sheet manufacturer's installation instructions; fill and tape joints in substrate and between dissimilar materials.
   2. Lap sheets shingle fashion to shed water and seal laps airtight.
   3. Once sheets are in place, press firmly into substrate with resilient hand roller; ensure that laps are firmly adhered with no gaps or fishmouths.
   4. Use same material, or other material approved by sheet manufacturer, to seal to adjacent substrates, and as flashing.
   5. At wide joints, provide extra flexible membrane allowing joint movement.

E. Fluid-Applied Coatings or Membranes:
   1. Prepare substrate in accordance with manufacturer's installation instructions; treat joints in substrate and between dissimilar materials as indicated.
   2. Where exterior masonry veneer is being installed, install masonry anchors before installing air barrier over masonry; provide airtight seal around anchors.
   3. Apply fluid-applied air barrier coating in accordance with manufacturer's instructions and to manufacturer's required thickness, but no less than 30 mils dry film thickness (DFT).
   4. Apply bead or trowel coat of mastic sealant with minimum thickness of 1/4-inch along coating seams, rough cuts, and as recommended by manufacturer.
   5. Use flashing to seal to adjacent construction and to bridge joints in coating substrate.

F. Openings and Penetrations in Exterior Air Barriers:
   1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto air barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
   2. At openings with nonflanged frames, seal air barrier to each side of framing at opening using flashing at least 9 inches wide, and covering entire depth of framing.
   3. At head of openings, install flashing under air barrier extending at least 2 inches beyond face of jambs; seal air barrier to flashing.
   4. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
   5. Service and Other Penetrations: Form flashing around penetrating item and seal to air barrier surface.

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3.04 FIELD QUALITY CONTROL

A. ABAA Tests and Inspections:
   1. The Contractor shall arrange and provide for testing and inspection required by ABAA QAP.
   2. Notify ABAA in writing of schedule for air barrier work, and allow adequate time for testing and inspection.
   3. Cooperate with ABAA testing agency.
   4. Allow access to air barrier work areas and staging.

B. Manufacturer's Field Inspections: Air barrier manufacturer's technical representative shall provide a minimum of 3 field reviews during installation and provide technical reports to Contractor, Owner, and Architect.

C. Corrections to the Work: If testing and inspection reveals any defects, promptly remove and replace defective work at no additional expense to the Owner.
   1. Patch air barrier work that was removed or damaged due to testing.

D. Do not cover installed air barriers until all required inspections have been completed.

E. Obtain approval of installation procedures from air barrier manufacturer based on a mock-up installed in place, prior to proceeding with remainder of installation.

F. Take digital photographs of each portion of installation prior to covering up air barriers.

3.05 PROTECTION

A. Do not leave materials exposed to weather/UV light longer than recommended by manufacturer.

B. Protect air barrier assemblies from damage during subsequent construction activities per manufacturer recommendations.

C. Protect air barrier assemblies from incompatible materials that may cause degradation or loss of adhesion. Immediately clean soiled areas with cleaning materials and procedures that are approved by air barrier manufacturer.

END OF SECTION 072700

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SECTION 072736
SPRAYED FOAM (SPF) AIR BARRIER

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

B. ASTM C1029 - Standard Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation.

C. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

E. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

F. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials.

G. ASTM E2357 - Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies.

H. CAN-ULC-S705.1 - Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Material Specification.

I. CAN-ULC-S705.2 - Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Application.

J. NFPA 259 - Standard Test Method for Potential Heat of Building Materials.

K. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week prior to commencing work of this section.

1.03 SUBMITTALS

A. Product Data: Provide product description, insulation properties, and preparation requirements.
   1. Provide current Evaluation Service Report upon request.

B. Shop Drawings: Provide project-specific drawings of location and extent of air barrier assemblies.
   1. Provide details for each wall assembly substrate condition. Include field adhesion test value requirements for each substrate indicated.
   2. Provide termination, transition, and joint details. Details shall include methods for maintaining air barrier continuity and continuous insulation (CI). Include specific details for the following:
      a. Bridging of gaps in construction.
      b. Inside and outside corners.
      c. Perimeter of window and door openings.
      d. Sealing around penetrations at pipes, conduits, and boxes.
      e. Spray-stop / screed angle, including transition membrane.
      f. Continuity of air barrier at flashings, ledge and shelf angles, and similar interruptions.

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C. Sustainable Design Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

D. Compatibility Data: Provide manufacturer's data indicating compatibility between submitted SPF and transition membrane products.

E. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection as required by ABAA QAP.

F. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

G. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of all contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.04 QUALITY ASSURANCE

A. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP):

1. Installer Qualification: Use accredited contractor, certified installers, evaluated materials, and third-party field quality control audit.

a. Install shall also be certified by ABAA/BPQI (Building Performance Quality Institute) in accordance with the training requirements outlined in the **<<CAN-ULC-S705.2>>** Installation Standard. Installers shall have their photo-identification certification cards in their possession and available on the project site, for inspection upon request.

2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

B. **<<NFPA 285>>** Tested Assembly: Provide foam plastic insulation products located in exterior wall assemblies that have been tested in accordance with NFPA 285 which represent those exterior wall assemblies for this Project.

1. Potential heat in Btu per square feet shall not exceed the potential heat of the foam plastic insulation contained in the wall assembly tested as determined by tests in accordance with **<<NFPA 259>>**.

1.05 MOCK-UPS

A. Integrated Exterior Mockups: Attend preinstallation conference for and provide spray-foam components for integrated exterior mockup as **<< indicated on Drawings and as ; or None - N/A>>**specified in Division 1 Section "Quality Requirements."

1.06 FIELD CONDITIONS

A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.

1.07 WARRANTY

A. Material Warranty: Manufacturer's standard warranty against manufacturing defects, for a minimum period of 3 years.

B. Installation Warranty: Air barrier subcontractor's installation warranty, effective from date of Substantial Completion for a minimum period of 2 years. Installation warranty shall include all components of the air barrier assembly, including loss of airtight seal, loss of watertight seal, loss of adhesion, loss of cohesion, or failure to cure properly.

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PART 2 PRODUCTS

2.01 MATERIALS

A. Spray Polyurethane Foam (SPF) Air Barrier/Insulation: Medium-density, rigid, closed cell polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
   1. Provide insulation that conforms to **<<CAN-ULC-S705.1>>** or **<<ASTM C1029>>**, Type II, and performance requirements listed.
   2. Thermal Resistance: **<< R-value>>** of 6.9, minimum, per **<< 1 inch>>** thickness at **<< 75 degrees F>>** mean temperature when tested in accordance with **<<ASTM C518>>**.
   3. Density: Minimum 1.9 pounds per cubic foot.
   4. Water Vapor Permeance: Vapor retarder; **<< 2 perms; or ___ perms>>**, maximum, when tested at intended thickness in accordance with **<<ASTM E96/E96M>>**, desiccant method.
   5. Water Absorption: Less than 2 percent by volume, maximum, when tested in accordance with **<<ASTM D2842>>**.
   6. Air Permeance (Material): Not to exceed 0.004 cfm per square foot, when tested at intended thickness in accordance with **<<ASTM E2178>>** at 1.57 psf.
   7. Ozone Depletion Potential (ODP): Zero.
   8. Closed Cell Content: At least 90 percent.
   9. Surface Burning Characteristics: Flame spread/smoke developed index of 25/450, maximum, when tested in accordance with **<<ASTM E84>>**.
   10. Products:
      a. BASF Corporation; WALLTITE US.
      b. Carlisle Spray Foam; SealTite Pro One Zero.
      c. Green Valley Products; GVP Pro 2.0 HFO.
      d. Henry Company; Henry HFO Closed Cell Spray Foam.
      e. Huntsman Building Solutions; Heatlok HFO Pro.
      f. Johns Manville; JM Corbond IV.
      g. NCFI Polyurethanes; InsulBloc HFO.

B. Air Barrier Assembly Performance: Air barrier assembly, including primary air barrier and auxiliary materials, including joints and transitions to adjacent materials, shall have an air leakage rate not to exceed 0.04 cfm per square foot, at 1.57 psf pressure differential when tested per **<<ASTM E2357>>**. The air barrier assembly shall also serve as liquid water control layer, and shall be flashed to direct moisture to the exterior.

2.02 ACCESSORIES

A. Compatibility of Materials: Provide sealants, tapes, transition membranes, and other accessory materials that are tested to be compatible with the primary air barrier material and with each other. Provide compatibility charts with product data submittal indicating material compatibility.

B. Primer: As required by insulation manufacturer.

C. Membrane at Transitions in Substrate and Connections to Adjacent Elements: Nominal 40-mil thick, impermeable, self-adhering sheet membrane.
   1. Available Products:
      a. Carlisle Coatings and Waterproofing; CCW-705.
      b. Grace Construction Products; Perm-A-Barrier Flashing.
      c. Henry Company; Blueskin SA.

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d. Polyguard; Airlok Sheet 400 NP.
e. Tremco, Inc.; ExoAir 110.
f. W. R. Meadows, Inc.; Air Shield.

D. Membrane at Transitions between Spray Foam Air Barrier and Roofing and Other Adjacent Materials: Provide impermeable transition membrane that complies with both air barrier manufacturer's recommendations and adjacent material manufacturer's recommendations.

E. Spray Foam Stop and Screed: L-shaped stop and screed designed as a spray foam termination accessory, fabricated of stable UV-resistant plastic and acceptable to spray foam manufacturer. Outer leg shall be sized to match spray foam thickness indicated. **<< "Jam-Ex" by Exo-Tec Manufacturing, Inc., or equivalent product.; or None - N/A>>**

F. Counterflashing for Masonry Through-Wall Flashing: Nominal 40-mil thick, impermeable, self-adhering membrane.
1. Available Products:
a. Grace Construction Products; Perm-A-Barrier Flashing.
b. Henry Company; Blueskin TWF or CCW-705 TWF.
c. Polyguard; Airlok Sheet 400 NP.
d. Tremco, Inc.; ExoAir TWF.
e. W. R. Meadows, Inc.; Detail Strip.

G. Preformed Transition Membrane: Semirigid silicone or polyester composition, tapered edges, tear resistant.
1. Products:
a. Dow; DOWSIL Silicone Transition Strip and System.
b. Elbex; Elbex HS Silicone Sheeting, with compatible GE or Dow sealant.
c. Tremco Commercial Sealants & Waterproofing; ProGlaze ETA System 1.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify work within construction spaces or crevices is complete before insulation application.

B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation adhesion.

3.02 PREPARATION

A. Mask and protect adjacent surfaces from over spray or dusting.

B. Apply primer in accordance with manufacturer's instructions.

3.03 APPLICATION

A. Apply insulation in accordance with manufacturer's instructions.

B. Apply insulation by spray method, to a uniform monolithic density without voids.

C. Apply to the minimum cured thickness indicated on Drawings.

D. Patch damaged areas.

E. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind operable parts.

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F. Building Expansion Joints: Do not bridge joints with spray foam material. Provide a L-shaped stop/screed on each side of joint, pack joint with compressible insulation, and bridge the joint with flexible transition membrane to provide continuous air barrier assembly.

G. Trim excess away for applied trim or remove as required for continuous sealant bead.

3.04 FIELD QUALITY CONTROL

A. Field inspections and tests will be performed by a third party ABAA testing agency.

B. Inspection will include verification of insulation thickness and density.

C. Coordination of ABAA Tests and Inspections:

1. Arrange and pay for testing and inspection required by ABAA QAP.
    a. Testing and inspection shall verify conformance with ABAA Quality Assurance Program, the **<<CAN-ULC-S705.2>>** Installation Standard, manufacturer's written installation instructions, and other requirements of this section.
    b. Unless indicated otherwise, provide ABAA Quality Assurance Program audits in accordance with current "Frequency & Cost of Audits" posted on ABAA website. Forward written inspection reports to the Architect within 10 working days of the inspection and test being performed. In the case of deficiencies, the ABAA-licensed inspector may verbally advise the licensed installer at time of inspection.
2. Notify ABAA in writing of schedule for air barrier work. Allow adequate time for testing and inspection.
3. Cooperate with ABAA testing agency.
4. Allow access to air barrier work areas and staging.
5. Do not cover air barrier work until tested, inspected, and accepted.

D. In addition to the ABAA site inspector, coordinate and provide access for air barrier manufacturer's technical representative to provide a minimum of 3 field reviews during installation and provide technical reports to Contractor, Owner, and Architect.

E. Patch air barrier work that was removed or damaged due to testing.

F. If testing and inspection reveals any defects, promptly remove and replace defective work at no additional expense to the Owner.

3.05 PROTECTION

A. Do not permit subsequent construction work to disturb applied insulation.

END OF SECTION 072736

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SECTION 073113
ASPHALT SHINGLES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

B. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.

C. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

D. ASTM D3462/D3462M - Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules.

E. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement.

F. ASTM D4869/D4869M - Standard Specification for Asphalt-Saturated Organic Felt Underlayment Used in Steep Slope Roofing.

G. ASTM D7158/D7158M - Standard Test Method for Wind Resistance of Asphalt Shingles (Uplift Force/Uplift Resistance Method).

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

I. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings.

J. ASTM F1667/F1667M - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.

K. ICC-ES AC188 - Acceptance Criteria for Roof Underlayments.

L. NRCA (RM) - The NRCA Roofing Manual.

M. PS 2 - Performance Standard for Wood Structural Panels.

1.02 SUBMITTALS

A. Product Data: Provide data indicating **<< material characteristics; performance criteria; limitations; and _____>>**.

B. Shop Drawings: For metal flashings, indicate **<< specially configured metal flashings; jointing methods and locations; fastening methods and locations; installation details; and _____>>**.

C. Samples: Submit **<< two; or ____>>** samples of each shingle color indicating color range and finish texture/pattern**<< ; for color selection; or None - N/A>>**.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Installer's qualification statement.

1.03 CLOSEOUT SUBMITTALS

A. Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in **<<Owner>>**'s name and registered with manufacturer.

B. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.

1. Extra Shingles: Provide one square (100 sq ft / 3 bundles) of each type and color.

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1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in installing asphalt shingles, with certification from shingle manufacturer for installation of specified products.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store materials with labels intact in manufacturer's unopened packaging until ready for installation.

B. Store materials under dry and waterproof cover, well ventilated, and elevated above grade on a flat surface.

C. Protect materials from harmful environmental elements, construction dust, direct sunlight, and other potentially detrimental conditions.

D. When storing roofing materials on roofing system ensure no damage occurs to supporting members and other materials.

1.06 FIELD CONDITIONS

A. Do not install shingles or underlayment when surface, ambient air, or wind chill temperatures are below 45 degrees F.

1.07 WARRANTY

A. Provide a minimum **<< 40 year; or 50 year>>** manufacturer warranty for materials, with at least the first **<< 10 years; 15 years; 20 years; or None - N/A>>** nonprorated.

B. Provide **<< lifetime; or 10 year>>** manufacturer's warranty for coverage against black streaks caused by algae.

C. Provide **<< 5-year; or 15 -year>>** manufacturer's warranty for **<< wind damage; or _____>>**.

1. Wind damage warranty shall cover damage due to wind speeds up to **<< 110 mph; or 130 mph>>**.

D. Installer's Extended Correction Period: Correct defective work within **<< 2-year; or ____>>** period commencing on Date of Substantial Completion. Refer to Installer's Warranty form at the end of this section.

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PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Asphalt Shingles:

1. Atlas Roofing Corporation.
2. Certainteed Roofing.
3. GAF.
4. IKO Industries Inc.
5. Owens Corning Corp.
6. TAMKO Building Products.

2.02 ASPHALT SHINGLES

A. Asphalt Shingles: Asphalt-coated glass felt, mineral granule surfaced, complying with **<<ASTM D3462/D3462M>>**.

1. Fire Resistance: Class A, complying with **<<ASTM E108>>**.

2. Wind Resistance (Uplift): **<< Class D; Class G; or Class H>>**, when tested in accordance with **<<ASTM D7158/D7158M>>**.
3. Warranted Wind Speed: **<< tested wind resistance; 60 mph; 90 mph; 110 mph; 115 mph; 150 mph; 190 mph; or ___ mph>>**.
4. Algae resistant.
5. **<< Self-sealing; Interlocking; Self-sealing or interlocking; or _____>>** type.
6. Style: Laminated overlay (architectural shingles).
7. Color: To be selected by Architect from manufacturer's **<< full; or standard>>** range.

2.03 UNDERLAYMENT

A. Underlayment: Self-adhering rubber-modified asphalt sheet complying with **<<ASTM D1970/D1970M>>**; 40 mil minimum total thickness; with strippable release film and woven polypropylene or polyethylene-film top surface, and with non-slip granule surfacing.
   1. Minimum Requirements: Comply with **<<ICC-ES AC188>>**.
   2.
   3. Self Sealability: Passing nail sealability test specified in **<<ASTM D1970/D1970M>>**.
   4. Low Temperature Flexibility: Passing test specified in **<<ASTM D1970/D1970M>>**.
   5. Ultraviolet (UV) Resistance and Weatherability: Approved in writing by manufacturer for exposure to weather for minimum of **<< six months; twelve months; or 3 months>>** (90 days).
   6. Performance: Meet or exceed requirements for **<<ASTM D226/D226M>>**, Type II asphalt-saturated organic felt.
   7. Liquid Water Transmission: Passes **<<ASTM D4869/D4869M>>**.
   8. Products:
      a. Certainteed Roofing; Vycor Ice and Water Shield.
      b. GAF; WeatherWatch Ice & Water Leak Barrier.
      c. GCP Applied Technologies; Grace Ice & Water Shield.
      d. Henry Company; Blueskin RF200 Ice & Water Barrier

2.04 SHEATHING

A. Roof Sheathing, Vented: Wood construction panel and **<< 1 inch; or _____ inch>>** spacers attached to insulation board. ******Provide vented sheathing if there is rigid roof insulation below shingles. Not required for vented attic.******
   1. Construction Panel: Minimum 5/8 inch APA rated CDX plywood; Exposure 1.
   2. Spacers: 1 inch thickness; solid lumber or high compressive strength EPS spacer blocks, as standard with manufacturer.
   3. Insulation Board: Rigid polyisocyanurate (ISO) insulation board, **<<ASTM C1289>>**, Type II, Class I (faced with glass fiber reinforced cellulosic felt facers on both major surfaces); Grade 2 - 20 psi, minimum.
   4. Products:
      a. Atlas; ACFoam CrossVent.
      b. GAF; ThermaCal 1 Ventilated Roof Insulation Panels.
      c. Hunter Panels; Cool-Vent.
      d. Johns Manville; Vented Nailboard.
      e. Substitutions: **<< See Section 016000 - Product Requirements; Not permitted; or _____>>**.

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B. Roof Sheathing: APA rated, **<<PS 2>>** type; Structural I Sheathing. ******Provide standard plywood sheathing for vented attic applications.******
   1. Bond Classification: **<< Exterior; Exposure 1; or _____>>**.
   2. Span Rating: **<< 16; 20; 24; 32; 40; 48; 54; 60; or 48/24>>**.
   3. Performance Category: **<< 7/16 PERF CAT; 1/2 PERF CAT; 5/8 PERF CAT; 3/4 PERF CAT; or ___ PERF CAT>>**.

2.05 INSULATION

A. Surface Burning Characteristics: Foam plastic insulation shall have a maximum flame spread index of 75, and maximum smoke developed index of 450, when tested in accordance with**<<ASTM E84>>** at maximum thickness intended for use.

B. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with **<<ASTM C1289>>**.
   1. Classifications: Type II, Class I (faced with glass fiber reinforced cellulosic felt facers on both major surfaces); Grade 2 - 20 psi, minimum.

2.06 FLASHING

A. Metal Flashings: Provide sheet metal **<< eave edge; gable edge; ridge; ridge vents; open valley flashing; chimney flashing; dormer flashing; other flashing as indicated; and vent pipe flashings and other flashings as required for roof conditions indicated>>**.
   1. Fabricate flashings from prefinished aluminum, minimum 0.040-inch thick, or galvanized steel, minimum 24 gauge (0.028-inch); and in accordance with Division 7 Section "Sheet Metal Flashing and Trim."
   2. Form flashings **<< to profiles indicated on drawings; to protect roofing materials from physical damage and shed water; or _____>>**.
   3. Form sections square and accurate to profile, in maximum possible lengths, free from distortion or defects detrimental to appearance or performance.
   4. Hem exposed edges of flashings minimum 1/4 inch on underside.
   5. Coat concealed surfaces of flashings with bituminous paint.

2.07 ACCESSORIES

A. Roofing Nails: Standard round wire shingle type, **<< galvanized steel; stainless steel; aluminum roofing nails; copper roofing nails; or _____>>**, minimum **<< 3/8-inch; or ___-inch>>** head diameter, **<< 12-gauge, 0.109-inch; or ___-gauge, ___-inch>>** nail shank diameter, **<< 1 inch; 1-1/2 inches; or ___ inches>>** long and complying with **<<ASTM F1667/F1667M>>**.

B. Asphalt Roof Cement: **<<ASTM D4586/D4586M>>**, asbestos-free.

C. Bituminous Paint: Acid and alkali resistant type; black color.

D. Lap Cement: Fibrated cutback asphalt type, recommended for use in application of underlayment, free of toxic solvents.

E. Rigid Ridge Vents: Extruded, high-density polypropylene or other UV-stabilized plastic, with vent openings that do not permit direct water or weather entry; with minimum 18 square inches of net free area per linear foot; with internal rib reinforcing, external wind baffle, and flanges to receive ridge shingles. Include screening to prevent insect entry. Provide 11 or 11.5 inch wide as standard with manufacturer to receive 12 inch wide ridge shingles; no greater than 1 inch high.
   1. Products:
      a. Air Vent; Shingle Vent II.

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b. Cor-A-Vent; V-600E.
c. DCI Products; SmartRidge II.
d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

F. Eave Vents: Low-profile, extruded, high-density polypropylene or other UV-stabilized plastic; with baffles to protect from weather and insect screening. Vent shall be installed under shingles. Coordinate with sheathing below to provide cut outs to allow air flow into unconditioned attic space per manufacturer's instructions.
1. Products:
a. Cor-A-Vent; IN-Vent.
b. DCI Products; SmartVent.
c. GAF; Cobra IntakePro.
d. Lomanco, Inc; Deck-Air Vent (DA-4).
e. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

G. Roof-to-Wall Vents: Extruded, high-density polypropylene or other UV-stabilized plastic; with baffles to protect from weather and insect screening. Vent shall be installed under shingles to vent roof at high point where roof meets vertical wall. Coordinate with metal flashing and cap shingles to cover over vent per manufacturer's instructions.
1. Products:
a. Cor-A-Vent; Roof-2-Wall Vent.
b. DCI Products; SmartVent Shed Wall.
c. Lomanco, Inc; Omni-Wall Vent.
d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

H. Eave Ventilation Baffles (Vent Chutes): Tear resistant, extruded polystyrene sheet, sized to fit between roof framing members; provides ventilation from eave into unconditioned attic spaces.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions prior to starting this work.
B. Verify roof deck is of sufficient thickness to accept fasteners.
C. Verify roof penetrations and plumbing stacks are in place and flashed to deck surface.
D. Verify roof openings are correctly framed.
E. Verify deck surfaces are dry, free of ridges, warps, or voids.

3.02 PREPARATION

A. Seal roof deck joints wider than 1/16 inch as recommended by shingle manufacturer.
B. Broom clean deck surfaces before installing underlayment or eave protection.
C. Protect surrounding areas and adjacent surfaces from damage during execution of this work.
D. Install **<< eave edge; and gable edge>>** flashings tight with fascia boards, weather lap joints **<< 2 inches; or ____ inches>>** and seal with roof cement, and secure flange with nails spaced **<< no greater than 12 inches>>** on center.

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3.03 INSTALLATION

A. Underlayment:

1. Roof Slopes Up to 4:12: Install two layers of underlayment over **<< entire roof area; area not protected by eave protection; or _____>>**, with ends and edges weather lapped minimum **<< 4 inches; 6 inches; or ____ inches>>**; stagger end laps of each consecutive layer and nail in place.
2. Roof Slopes Greater Than 4:12: Install underlayment perpendicular to slope of roof, with ends and edges weather lapped minimum **<< 4 inches; 6 inches; or ____ inches>>**; stagger end laps of each consecutive layer, nail in place, and weather lap minimum **<< 4 inches; or ____ inches>>** over eave protection.
3. Weather lap and seal watertight with plastic cement any items projecting through or mounted on roof.

B. Valley Protection:

1. Install valley flashing in accordance with manufacturer's instructions**<< and NRCA (RM) applicable requirements; and _____; or None - N/A>>**.
2. Weather lap joints minimum **<< 2 inches; or ____ inches>>**.
3. Nail in place minimum **<< 18 inches; or ____ inches>>** on center, **<< 1 inch; or ____ inch>>** from edges.
4. At Exposed Valleys: Install one layer of sheet metal flashing, minimum **<< 24 inches; or ____ inches>>** wide, centered over open valley and crimped to guide water flow. Weather lap joints with minimum **<< 2-inch; or ____-inch>>** wide band of lap cement along each edge and nail in place minimum **<< 18 inches; or ____ inches>>** on center and **<< 1 inch; or ____ inch>>** from edges.

C. Metal Flashing:

1. Weather lap joints minimum **<< 2 inches; or ____ inches>>** and seal weather tight with plastic cement.
2. Secure in place with nails at **<< maximum 18 inches>>** on center, and conceal fastenings.
3. Items Projecting Through or Mounted on Roofing: Flash and seal weather tight with plastic cement.

D. Shingles:

1. Install shingles in accordance with **<< manufacturer's instructions; NRCA (RM) applicable requirements; and _____>>**.
   a. Fasten strip shingles using minimum four nails per strip, or as required by manufacturer and local building code, whichever is greater.
2. Place shingles in **<< straight; or _____>>** coursing pattern with **<< 5-inch; or ____-inch>>** weather exposure to produce **<< double; triple; or _____>>** thickness over full roof area**<< , and provide double course of shingles at eaves; , and provide triple course of shingles at eaves; , _____; or None - N/A>>**.
3. Project first course of shingles **<< 3/4 inch; or ____ inch>>** beyond fascia boards.
4. Extend shingles **<< 1/2 inch; or ____ inch>>** beyond face of gable edge fascia boards.
5. Cap **<< hips; and ridges>>** with individual shingles, maintaining **<< 5-inch; or ___-inch>>** weather exposure, and place to avoid exposed nails.
6. After installation, place **<< one daub; or ____ daubs>>** of plastic cement **<< 1-inch; or ___-inch>>** diameter under each individual shingle tab exposed to weather to prevent lifting.

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7. Coordinate installation of roof mounted components or work projecting through roof with weathertight placement of counterflashings.
8. Complete installation to provide weathertight service.

3.04 CLEANING

A. See Section **<< 017000 - Execution and Closeout Requirements>>** for additional requirements.

B. Clean exposed work upon completion of installation; remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to finish.

3.05 PROTECTION

A. Do not permit traffic over finished roof surface; protect roofing until completion of project.

B. Touch-up, repair, or replace damaged asphalt shingles or accessories before Date of Substantial Completion.

END OF SECTION 073113

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SECTION 074113
METAL ROOF PANELS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

C. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

D. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

E. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

F. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

I. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.

J. ASTM E1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.

K. ASTM E1680 - Standard Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems.

L. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials.

M. FM 4470 - Examination Standard for Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction.

1.02 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Storage and handling requirements and recommendations.
   2. Installation methods.
   3. Include confirmation from metal roof panel manufacturer that submitted snow guard attachment is compatible with roof panel standing seam configuration and warranty requirements.

B. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.
   1. Show work to be field-fabricated or field-assembled.

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2. Include details of vapor barrier/underlayment connection to membrane roofing system or other boundary construction to accomplish continuous air barrier system for an airtight building enclosure.

C. Selection Samples: For each roofing system specified, submit color chips representing manufacturer's full range of available colors and patterns.

D. Verification Samples: For each roofing system specified, submit samples of minimum size 12 inches square, representing actual roofing metal, thickness, profile, color, and texture.

E. Installer's qualification statement.

F. Test Reports: Indicate compliance of metal roofing system to specified requirements.

G. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in **<<Owner>>**'s name and are registered with manufacturer.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and approved by manufacturer for installation of specified products.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Provide strippable plastic protection on prefinished roofing panels for removal after installation.

B. Store roofing panels on project site as recommended by manufacturer to minimize damage to panels prior to installation.

1.05 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Finish Warranty: Provide manufacturer's special warranty covering failure of factory-applied exterior finish on metal roof panels and agreeing to repair or replace panels that show evidence of finish degradation, including significant fading, chalking, cracking, or peeling within specified warranty period of twenty (20) years from Date of Substantial Completion.

C. Waterproofing Warranty: Provide manufacturer's warranty for weathertightness of roofing system, including agreement to repair or replace roofing that fails to keep out water due to material or workmanship, within specified warranty period of twenty (20) years from Date of Substantial Completion.

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PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Standing Seam Metal Roof Panels:
1. Architectural Metal Systems; Loc-Seam 360.
2. ATAS International, Inc; 2" Field-Lok.
3. Berridge Manufacturing Company; Double-Lock Zee-Lock Panel.
4. Construction Metal Products, Inc; Series 2500.
5. Drexel Metals Inc; 200S Profile.
6. Elevate; UNA-CLAD UC-6.
7. Englert, Inc; S2500.
8. Fabral; Stand N Seam.
9. IMETCO; Twin-Lok 2.0.
10. MBCI; SuperLok.

11. Merchant and Evans; 2" Zip Lok.
12. Metal Roofing Systems, Inc; System 2500 Metal Roof Panels.
13. Metal Sales Manufacturing Corporation; Magna-Loc 180.
14. Morin Corporation; SLR Standing Seam.
15. Petersen Aluminum Corporation; Tite-Loc Plus Panel.
16. Sentrigard; ML200 2" Mechanical Lock Panel.

2.02 PERFORMANCE REQUIREMENTS

A. Metal Roof Panels: Provide complete roofing assemblies, including roof panels, clips, fasteners, connectors, and miscellaneous accessories, tested for compliance with the following minimum standards:

1. Structural Design Criteria: Provide panel assemblies designed to safely support design loads at support spacing indicated, with deflection not to exceed **<< L/180; L/140; or L/___>>** of span length(L) when tested in accordance with **<<ASTM E1592>>**.
   a. Live Loads: As required by ASCE 7 and per the requirements on the Structural Drawings.
   b. PV Ready: Manufacturer's panel assembly shall be "PV-ready" and approved to safely support photovoltaic assemblies to be installed at a later date, using non-penetrating (clamping) means. Installation of roof-mounted panels shall not void manufacturer's warranty. Photovoltaic panels **<< are not; or are>>** a part of this Project.
2. Overall: Complete weathertight system tested and approved in accordance with **<<ASTM E1592>>**.
3. Air Infiltration: Maximum **<< 0.06 cfm/sq ft; or ___ cfm/sq ft>>** at air pressure differential of **<< 6.24 lbf/sq ft; or 1.57 lbf/sq ft>>**, when tested according to **<<ASTM E1680>>**.
4. Water Penetration: No water penetration when tested according to procedures and recommended test pressure of **<< 2.86 lbf/sq. ft.; or 6.24 lbf/sq. ft.>>** according to **<<ASTM E1646>>**. **<< None - N/A; or Perform test immediately following air infiltration test.>>**
5. Thermal Movement: Design system to accommodate without deformation anticipated thermal movement over ambient temperature range of **<< 100 degrees F; 120 degrees F; or ___ degrees F>>**.
6. Thermal Resistance: Provide a minimum total roof assembly R-value of R-30. Polyiso insulation R-value shall be based on an industry standard Long Term Thermal Resistance (LTTR) of 5.7 per inch.
7. Thermal Resistance: Provide a minimum system R-value of R-30 in accordance with **<<ASTM C1289>>**.
8. Accelerated Weathering Test: Demonstrate physical integrity over the working life of the roof based upon 2,000 hours of exposure to accelerated weathering tests conducted in accordance with ASTM G152, ASTM G155, or ASTM G154.
9. Impact Resistance: Resist impact damage based on the results of tests in accordance with ASTM D3746, ASTM D4272, CGSB 37-GP-52M, or the "Resistance to Foot Traffic Test" in Section 5.5 of **<<FM 4470>>**.

2.03 METAL ROOF PANELS

A. Metal Roof Panels: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.

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B. Metal Panels: Factory-formed panels with **<< factory-applied; mill; or _____>>** finish.
   1. Steel Panels:
      a. Zinc-coated steel complying with **<<ASTM A653/A653M>>**; minimum **<< G60; G90; or ___>>** galvanizing.
      b. Aluminum-zinc alloy-coated steel complying with **<<ASTM A792/A792M>>**; minimum **<< AZ50; AZ55; AZ60; or _____>>** coating.
      c. Steel Thickness: Minimum **<< 24 gauge, 0.028 inch; 22 gauge, 0.030 inch; or _____>>**.
   2. Profile: Standing seam, with minimum 1.75 inch seam height, and with intermediate ribs or striations; concealed fastener system for field seaming.
      a. Panels shall be double-seamed (manufacturer's "double-lock", or 180 degree seam).
   3. Texture: Smooth.
   4. Length: Maximum possible length to minimize lapped joints. Where lapped joints are unavoidable, space laps so that each sheet spans over three or more supports.
      a. End Lap Joints/Splices:
         1) Coordinate splice location and fixed clip "point of fixity" with manufacturer's detailing to ensure entire roof system is coordinated for thermal movement.
         2) Lap panels with a minimum 6-inch lap; in shingle fashion to shed water to low side of roof.
   5. Width: Panel coverage of 16 inches.

C. Metal Soffit Panels:
   1. Profile: Flush, with **<< venting provided (perforated panels); or venting not provided (solid panels)>>**; total panel height of 7/8-inch.
   2. Width: Panel coverage of 12 inches.
   3. Material: Precoated aluminum sheet, **<< 20 gauge, 0.032 inch; 18 gauge, 0.0403 inch; 16 gauge, 0.0508 inch; or ___ gauge, ___ inch>>** minimum thickness.
   4. Color: To be selected by **<<Architect>>** from Manufacturer's **<< full; or standard>>** range.

2.04 ATTACHMENT SYSTEM

A. Concealed System: Provide manufacturer's standard **<< stainless steel; nylon-coated aluminum; or _____>>** concealed anchor clips designed for specific roofing system and engineered to meet performance requirements, including anticipated thermal movement.
   1. Provide a combination of fixed and floating clips to provide point of fixity at center of panel lengths; allowing for equal thermal movement toward each end.

2.05 FABRICATION

A. Panels: Provide **<< factory; field; or _____>>** fabricated panels**<< with applied finish; _____; or None - N/A>>** and accessory items, using manufacturer's standard processes as required to achieve specified appearance and performance requirements.
   1. Portable Roll-Forming Equipment for Field-Fabricated Panels: Where panel length exceeds transportation capacity, use of UL-certified portable roll-forming equipment to produce full length panels on site is acceptable. Panels shall be warranted by manufacturer to be same as factory-formed products. Maintain UL certification of equipment for duration of the Work.

B. Joints: Provide captive gaskets, sealants, or separator strips at panel joints to ensure weathertight seals, eliminate metal-to-metal contact, and minimize noise from panel movements.

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2.06 FINISHES

A. Fluoropolymer Coil Coating System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with **<<AAMA 2605>>**, including at least 70 percent PVDF resin, and at least 80 percent of coil coated metal surfaces having minimum total dry film thickness (DFT) of **<< 0.9 mil, 0.0009 inch>>**; color and gloss **<< as scheduled; to match sample; as indicated on drawings; as selected by Architect from manufacturer's standard line; or _____>>**.

B. Concealed Surfaces: For interior surfaces of panels that will not be exposed in the finished work, provide epoxy primer and light-colored silicone-modified polyester (SMP) enamel or acrylic enamel topcoat, with minimum dry film thickness (DFT) of 0.5 mil.

2.07 ACCESSORIES

A. Miscellaneous Sheet Metal Items: Provide **<< flashings; gutters; downspouts; trim; moldings; closure strips; preformed crickets; caps; equipment curbs; _____; and similar sheet metal items>>** of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.

B. Rib and Ridge Closures: Provide prefabricated, close-fitting components of **<< steel with corrosion resistant finish; closed-cell synthetic rubber, neoprene, or PVC; combination steel and closed-cell foam; or _____>>**.

C. Sealants:
   1. Exposed Sealant: Elastomeric, silicone, polyurethane, or silyl-terminated polyether/polyurethane.
   2. Concealed Sealant: Non-curing butyl sealant or tape sealant.
   3. Seam Sealant: Factory-applied, non-skinning, non-drying type.

D. Deck Sheathing: Glass mat faced gypsum panels, **<<ASTM C1177/C1177M>>**, fire resistant type, 1/2-inch-thick.
   1. Products:
      a. CertainTeed Corporation; GlasRoc Sheathing.
      b. Georgia-Pacific Corporation; DensDeck Prime.
      c. National Gypsum Company; Gold Bond eXP Extended Exposure Sheathing.
      d. USG Corporation; Securock Glass Mat Roof Board.

E. Vapor Retarder/Air Barrier Sheet; Self-Adhered: Minimum 30 mils.
   1. Air Permeance: **<< 0.004 cfm/sq ft>>**, maximum, when tested in accordance with **<<ASTM E2178>>**.
   2. Water Vapor Permeance: 0.1 perms, maximum, when tested in accordance with **<<ASTM E96/E96M>>** using Procedure A - Desiccant Method, at **<< 73.4 degrees F>>**.
   3. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A when tested in accordance with **<<ASTM E84>>**.
   4. Seam and Perimeter Tape: As recommended by sheet manufacturer.
   5. Products:
      a. GCP Applied Technologies; Ice and Water Shield.
      b. Henry Company; Blueskin RF200.
      c. Owens Corning; WeatherLock.
      d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

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F. Thermal Insulation: Polyisocyanurate (ISO) board insulation, rigid cellular foam, complying with ASTM C 1289.
   1. Classification: Type II.
      a. Class 1 or Class 2 - Faced with glass fiber reinforced cellulosic felt or glass-fiber mat on both major surfaces of core foam.
      b. Compressive Strength: **<< Classes 1-2-3, Grade 1 - 16 psi (110 kPa); Classes 1-2-3, Grade 2 - 20 psi (138 kPa); Classes 1-2-3, Grade 3 - 25 psi (172 kPa); Class 4, Grade 1 - 80 psi (551 kPa); Class 4, Grade 2 - 110 psi (758 kPa); or Class 4, Grade 3 - 140 psi (965 kPa)>>**, minimum.
      c. Thermal Resistance, R-value: Minimum Long Term Thermal Resistance of 5.7 per inch.

G. High-Temperature Underlayment: Self-adhering rubber-modified asphalt sheet complying with **<<ASTM D1970/D1970M>>**; **<< 22 mil; or 30 mil>>** minimum total thickness; with strippable release film and slip-resistant **<< woven polypropylene or polyethylene sheet; woven polyolefin; fiberglass mat; or _____>>** top surface.
   1. Self Sealability: Nail sealability in accordance with **<<ASTM D1970/D1970M>>**.
   2. Low Temperature Flexibility: Comply with **<<ASTM D1970/D1970M>>**.
   3. High Temperature Resistance: Passes thermal stability test at 240 degrees F, as specified in ASTM D 1970.
   4. Products:
      a. Carlisle Coatings and Waterproofing; WIP 300HT.
      b. Drexel Metals; MetShield.
      c. GCP Applied Technologies, Inc.; Ultra.
      d. Henry Company**<< ; Blueskin PE200HT; ; ____; or None - N/A>>**.
      e. Kirsch Building Products, LLC; Sharkskin Ultra SA.
      f. Owens Corning; WeatherLock Metal High Temperature Underlayment.
      g. Polyglass USA, Inc**<< ; Polystick MTS Self-Adhered High Temperature Roof Underlayment; ; Polystick TU Plus Self-Adhered High Temperature Roof Underlayment; ; ____; or None - N/A>>**.

2.08 SNOW GUARDS

A. Bar-Type Snow Guard: Continuous snow guard; provide manufacturer's standard assembly with an extruded aluminum bar/channel with slot for insertion of metal trim piece matching roof panel color. Metal panel manufacturer shall coordinate to provide matching metal trim.
   1. Products:
      a. Alpine SnowGuards; SnowMax.
      b. AceClamp by PMC Industries, Inc; Color Snap.
      c. S-5!; ColorGard.
   2. Clamps for Standing Seam Roof: Structural aluminum or stainless steel clamps secured to vertical standing seams of roof panels; non-penetrating.
   3. Ice Flag Accessory: Provide accessory product that mounts to bar component and extends down to surface of roof panel to prevent snow and ice migration under the snow guard. Provide at all snow guard locations, and evenly space at midpoint between ribs.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.

3.02 PREPARATION

A. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to ensure that completed roof will be free of leaks.

B. Remove protective film from surface of roof panels immediately prior to installation; strip film carefully to avoid damage to prefinished surfaces.

C. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by metal roof panel manufacturer.

D. Protect surrounding areas and adjacent surfaces from damage during execution of this work.

E. At locations where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.03 INSTALLATION

A. Overall: Install roofing system in accordance with**<< approved shop drawings and; or None - N/A>>** metal roof panel manufacturer's instructions and recommendations, as applicable to specific project conditions; securely anchor components of roofing system in place allowing for thermal and structural movement.

1. Install roofing system with concealed clips and fasteners**<< , except as otherwise recommended by manufacturer for specific circumstances; or None - N/A>>**.
2. Minimize field cutting of panels. Where field cutting is required, use methods that will not distort panel profiles. Use of torches for field cutting is prohibited.

B. Accessories: Install necessary components that are required for complete roofing assembly, including **<< flashings; gutters; downspouts; trim; moldings; closure strips; preformed crickets; caps; equipment curbs; rib closures; ridge closures; similar roof accessory items; and _____>>**.

C. Insulation: Install insulation in a minimum of two layers, with joints of each succeeding layer staggered at least 6 inches in each direction. Install in total thickness as required for a total roofing assembly Long Term Thermal Resistance (LTTR) value of R-30 (minimum of 5.2 inches).

D. Underlayment: Apply primer to substrate if required per manufacturer's instructions. Install self-adhering high temperature underlayment full coverage across entire roof surface, as the layer directly under metal roof panels. Apply from eaves to ridge in shingle fashion, overlapping horizontal joints a minimum of 3-1/2 inches. Overlap side and end laps a minimum of 6 inches and stagger at least 24 inches between courses. Roll all laps with a roller.

1. Comply with manufacturer's instructions for temperature and exposure requirements; but do not leave underlayment exposed for more than 14 days.

E. Roof Panels: Install metal roof panels in accordance with manufacturer's installation instructions, minimizing transverse joints except at junction with penetrations.

1. Form weathertight standing seams incorporating concealed clips, using an automatic mechanical seaming device approved by panel manufacturer.
2. Install sealant or sealant tape at end laps and side joints as recommended by metal roof panel manufacturer.

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F. Snow Guards: Secure base clamps to metal roof panel seams at spacing recommended by manufacturer. Do not penetrate the metal roof panels. Provide one row of snow guards continuous along length of metal roofing, mounted at 24 inches up from gutter or eave, unless otherwise indicated.

3.04 CLEANING

A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

3.05 PROTECTION

A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.

B. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

END OF SECTION 074113

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SECTION 074213
METAL WALL PANELS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

D. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components.

1.02 SUBMITTALS

A. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
   1. Physical characteristics of components shown on shop drawings.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions and recommendations.

B. Shop Drawings: Indicate dimensions, layout, joints, construction details, support clips**<< , _____; or None - N/A>>**, and methods of anchorage.

C. Sustainable Design Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

D. Selection Samples: Submit manufacturer's color charts representing manufacturer's **<< standard; or full>>** range of available colors.

E. Verification Samples: Submit physical samples in manufacturer's standard size indicating panel profile and selected color, for each type of product required.

F. Test Reports: Submit test report verifying compliance with **<<NFPA 285>>** for **<< previously-tested; project-specific; or _____>>** exterior wall assembly.

1.03 QUALITY ASSURANCE

A. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

1.04 MOCK-UPS

A. Integrated Exterior Mockups: Attend preinstallation conference for and provide metal wall panel work for integrated exterior mockup as **<< indicated on Drawings and as ; or None - N/A>>**specified in Division 1 Section "Quality Requirements."

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.

B. Store prefinished material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.

C. Prevent contact with materials that may cause discoloration or staining of products.

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1.06 FIELD CONDITIONS

A. Do not install wall panels when air temperature or relative humidity are outside manufacturer's limits.

1.07 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Finish Warranty: Correct defective work within a **<< five; ten; twenty; or ____>>** year period after Date of Substantial Completion for degradation of panel finish, including color fading caused by exposure to weather.

C. Weathertightness Warranty: Correct defective work within a **<< five; or ____>>** year period after Date of Substantial Completion, including defects in **<< water tightness; integrity of seals; and _____>>** for metal wall panels.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Wall Panels - Concealed Fasteners: ******For some profiles or wall panel types, may need to verify with listed manufacturers to ensure which ones offer the design profiles******

1. ATAS International, Inc.
2. Centria.
3. Construction Metal Products, Inc.
4. Dimensional Metals, Inc.
5. Englert, Inc.
6. Fabral.
7. McElroy Metal.
8. Metal Roofing Systems, Inc.
9. Morin Corporation.
10. Petersen Aluminum Corporation.

2.02 METAL WALL PANEL SYSTEM

A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.

1. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
2. Design Pressure: In accordance with ASCE 7 and requirements on Structural Drawings.
3. Fire Performance: Tested in accordance with, and complying with acceptance criteria of **<< NFPA 285; or _____>>**.
4. Maximum Allowable Deflection of Panel: **<< L/180; L/90; L/60; or L/ ___>>** for length(L) of span.
5. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
6. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
7. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.

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8. Corners: Factory-fabricated in one continuous piece with minimum **<< 2-inch; 18-inch; or ___-inch>>** returns.

B. Exterior Wall Panels:
1. Basis-of-Design Product: **<< _____>>**. ******Provide BOD if desired******
2. Profile: **<< _____>>**. ******Add description of panel profile here, add multiple types as required******
3. Side Seams: **<< Double-interlocked, tight-fitting; Double-interlocked with reveal; Batten-covered; or _____>>**, **<< sealed with continuous gaskets; sealed with continuous bead of sealant; or _____>>**.
4. Material: Precoated steel sheet, 22 gauge, 0.0299-inch minimum thickness. ******22 gauge steel is standard; aluminum (below) is an option******
5. Material: Precoated aluminum sheet, 0.040-inch minimum thickness. ******Delete if using standard steel******
6. Panel Width: **<< _____>>**. ******Panel width depends on selected profile/BOD. Coordinate.******
7. Color: To be selected by **<<Architect>>** from manufacturer's **<< full; or standard>>** range.

C. Soffit Panels: ******Coordinate with Metal Roofing - if providing both specs, soffit panels should default to roofing spec******
1. Profile: Flush panel without reveal, with manufacturer's standard venting provided. ******Verfiy profile and venting and modify if needed******
2. Material: Precoated aluminum sheet, 20 guage, 0.032 inch minimum thickness.
3. Color: To be selected by **<<Architect>>** from manufacturer's **<< full; or standard>>** range.

D. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; **<< shop cut and factory mitered; or brake formed>>** to required angles.

E. Expansion Joints: Same material, thickness and finish as exterior sheets; **<< manufacturer's standard brake formed; infill; or _____>>** type, of profile **<< to suit system; or as detailed>>**.

F. **<< Trim; Closure Pieces; Caps; Flashings; Facias; Infills; and _____>>**: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

G. Anchors: **<< Galvanized steel; Aluminum; Stainless steel; or _____>>**.

2.03 MATERIALS

A. Precoated Steel Sheet: Hot-dipped galvanized steel sheet, **<<ASTM A653/A653M>><< , Structural Steel (SS) or Forming Steel (FS); , _____; or None - N/A>>**, with **<< G90/Z275; G115/Z350; or _____>>** coating; continuous coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.

B. Precoated Aluminum Sheet: **<<ASTM B209/B209M>><< , 3105 alloy, O temper; , ___ alloy, ___ temper; or None - N/A>>**, with **<< smooth surface texture; stucco embossed; or _____>>**; continuous-coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.

2.04 FINISHES

A. Fluoropolymer Coil Coating System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with **<<AAMA 2605>>**, including at least 70 percent PVDF resin, and at least 80 percent of coil coated metal surfaces having minimum total

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dry film thickness (DFT) of **<< 0.9 mil, 0.0009 inch>>**; color and gloss **<< as scheduled; to match sample; as indicated on drawings; as selected by Architect from manufacturer's standard line; or _____>>**.

B. Panel Backside Finish: Panel manufacturer's standard siliconized polyester wash coat.

2.05 ACCESSORIES

A. Cladding Support System: Refer to Division 5 Section "Continuous Insulation Framing System."

B. Gaskets: Manufacturer's standard type suitable for use with system, permanently resilient**<< ; ultraviolet and ozone resistant; or None - N/A>>**.

C. Concealed Sealants: Non-curing butyl sealant or tape sealant, see Section **<< 079200>>**

D. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.

E. Fasteners: Manufacturer's standard type to suit application;**<< with soft neoprene washers,; _____ ,; or None - N/A>> << steel, hot dip galvanized; stainless steel; or _____>>.<< Fastener cap same color as exterior panel.; Exposed fasteners same finish as panel system.; _____; or None - N/A>>**

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building subframing members are ready to receive panels, and that air barrier and insulation work is complete, inspections are completed, and ready for installation of cladding.

3.02 PREPARATION

A. Install subgirts/furring perpendicular to panel length, securely fastened to substrates and shimmed and leveled to uniform plane, and spaced at **<< intervals indicated; 24 inches on center, maximum; or ___ inches on center, maximum>>**.

B. Protect surrounding areas and adjacent surfaces from damage during execution of this work.

3.03 INSTALLATION

A. Install panels on **<< walls; soffits; and _____>>** in accordance with manufacturer's instructions.

B. Fasten panels to structural supports; aligned, level, and plumb.

C. Locate joints over supports.

D. Lap panel ends **<< 2 inches; or ___ inches>>**, minimum.

E. Provide **<< expansion; control; and _____>>** joints where length exceeds that recommended by manufacturer.

F. Use concealed fasteners unless otherwise indicated by **<<Architect>>**.

3.04 TOLERANCES

A. Offset From True Alignment Between Adjacent Members Abutting or In Line: **<< 1/16 inch; or ___ inch>>**, maximum.

B. Variation from Plane or Location As Indicated on Drawings: **<< 1/4 inch; 1/8 inch; or ____ inch>>**, maximum.

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3.05 CLEANING

A. Remove site cuttings from finish surfaces.

B. Remove protective material from wall panel surfaces.

C. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

3.06 PROTECTION

A. Protect metal wall panels until completion of project.

B. Touch-up, repair, or replace damaged wall panels or accessories before Date of Substantial Completion.

END OF SECTION 074213

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SECTION 074213.23
METAL COMPOSITE MATERIAL WALL PANELS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

E. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes.

F. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

G. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

H. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

I. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

J. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

K. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.

L. ASTM D1781 - Standard Test Method for Climbing Drum Peel for Adhesives.

M. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics.

N. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

O. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

P. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

Q. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

R. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting: Convene one week before starting work of this section to verify project requirements, coordinate with installers of other work, establish condition and completeness of building substrate, and review manufacturers' installation instructions and warranty requirements.

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1. Require attendance by MCM installer, CI framing installer (if a different entity), and other relevant sub-contractors (such as aluminum storefront/curtain wall, air barrier, insulation).
2. Include MCM sheet manufacturer's representative and wall system manufacturer's representative to review procedures.
3. Review in detail the schedule, personnel, and installation of adjacent materials and substrate.
4. Review project specific details including joint details (both panel-to-panel joints and panel to adjacent construction), penetrations, openings.
5. Review field testing, inspection, and other quality assurance requirements.
6. Review procedures for protection of work and other construction.

1.03 SUBMITTALS

A. Product Data - MCM Sheets: Manufacturer's data sheets on each product to be used, including thickness, physical characteristics, and finish, and:
   1. Finish manufacturer's data sheet showing physical and performance characteristics.
   2. Storage and handling requirements and recommendations.
   3. Fabrication instructions and recommendations.
   4. Specimen warranty for finish, as specified herein.

B. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
   1. Physical characteristics of components shown on shop drawings.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions and recommendations.
   4. Specimen warranty for wall system, as specified herein.

C. Shop Drawings: Show layout and elevations, dimensions and thickness of panels, connections, details and location of joints, sealants and gaskets, method of anchorage, support clips, number of anchors, supports, reinforcement, trim, flashings, and accessories.
   1. Indicate panel numbering system.
   2. Differentiate between shop and field fabrication.
   3. Indicate substrates and adjacent work with which the wall system must be coordinated.
   4. Include large-scale details of anchorages and connecting elements.
   5. Include large-scale details or schematic, exploded or isometric diagrams to fully explain **<< flashing; drainage system; rainscreen interface; and _____>>** at a scale of not less than **<< 1-1/2 inches per 12 inches; or ____ inches>>**.
   6. Include design engineer's stamp or seal on shop drawings for attachments and anchors.

D. Sustainable Design Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

E. Selection Samples: Submit manufacturer's color charts representing manufacturer's **<< full; standard; custom; or _____>>** range of available colors.

F. Verification Samples: For each finish product specified, submit physical sample in manufacturer's standard size indicating selected colors.

G. Test Report: Submit report of full-size mock-up tests for air infiltration, water penetration, and wind performance.

H. Test Report: Submit test report verifying compliance with **<<NFPA 285>>** for **<< previously-tested; project-specific; or _____>>** exterior wall assembly utilizing identical products and components to those submitted for installation on this project.

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I. Manufacturer's Field Reports: Provide within 48 hours of field review. State what was observed and what changes, if any, were requested or required.

J. Installer's qualification statement.

K. Testing agency's qualification statement.

L. Maintenance Data: Care of finishes and warranty requirements.

1.04 QUALITY ASSURANCE

A. Field Measurements: Verify actual dimensions by field measurement before fabrication; show recorded measurements on shop drawings.

B. Installer Qualifications: Company specializing in performing work of type specified in this section.
   1. Approved / certified in writing by wall panel system manufacturer.

C. Testing Agency Qualifications: Independent agency experienced in testing assemblies of the type required for this project and having the necessary facilities for full-size mock-up testing of the type specified.

1.05 MOCK-UPS

A. Integrated Exterior Mockups: Attend preinstallation conference for and provide metal composite material panels and associated components for integrated exterior mockup as **<< indicated on Drawings and as ; or None - N/A>>**specified in Division 1 Section "Quality Requirements."

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
   1. Protect finishes by applying heavy-duty removable plastic film during production.
   2. Package for protection against transportation damage.
   3. Provide markings to identify components consistently with drawings.
   4. Exercise care in unloading, storing, and installing panels to prevent bending, warping, twisting, and surface damage.

B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
   1. Store in well-ventilated space out of direct sunlight.
   2. Protect from moisture and condensation with tarpaulins or other suitable weathertight covering installed to provide ventilation.
   3. Store at a slope to ensure positive drainage of accumulated water.
   4. Do not store in enclosed space where ambient temperature can exceed 120 degrees F.
   5. Avoid contact with other materials that might cause staining, denting, or other surface damage.

1.07 FIELD CONDITIONS

A. Do not install panels when air temperature or relative humidity are outside manufacturer's limits.

1.08 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

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B. Special Warranty: Provide **<< 2-year; 5-year; or ____>>** warranty covering water tightness and integrity of seals of wall panels. Complete forms in **<<Owner>>**'s name and register with warrantor.

C. Finish Warranty: Provide **<< 5-year; 10-year; 20-year; or _____>>** manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in **<<Owner>>**'s name and register with warrantor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Composite Material (MCM) Sheet Manufacturers:
1. ALUCOBOND by 3A Composites USA; Alucobond Plus.
2. Alcoa, Inc.; Reynobond FR.
3. Alfrex, LLC; Alfrex FR.
4. ALPOLIC Materials; ALPOLIC/fr (Fire Retardant core).
5. Fairview Architectural LLC; Vitrabond FR (Non-Combustible).

2.02 WALL PANEL SYSTEM

A. Wall Panel System: Metal panels, fasteners, and anchors designed to be supported by framing or other substrate provided by others; provide installed panel system capable of maintaining specified performance without defects, damage, or failure.
1. Provide structural design by or under direct supervision of a Structural Engineer licensed in **<<the State in which the Project is located>>**.
2. **<< Wet-Seal System:>>** Provide panel jointing and weatherseal using a "wet" sealant-sealed system.
3. **<< Dry-Seal System:>>** Provide panel jointing and weatherseal using mechanically-retained gaskets. "Wet seal" exposed sealant joints are unacceptable except for perimeter and horizontal joints.
4. **<< Rainscreen System:>>** Provide panel jointing using a drained and back-ventilated (D/BV) rainscreen type system with an open reveal joint and a separate MCM strip or spline at the rear of the reveal. "Wet seal" exposed sealant joints are unacceptable except for perimeter joints and exposed horizontal joints.
5. Anchor panels to supporting framing without exposed fasteners.

B. **<<NFPA 285>>** Fire Propagation Test: Exterior metal-faced composite material wall panel assemblies shall be tested and pass NFPA 285; assembly shall have been tested using identical products and components to those submitted for installation on this project.

2.03 PERFORMANCE REQUIREMENTS

A. Thermal Movement: Provide for free and noiseless vertical and horizontal thermal movement due to expansion and contraction under material temperature range of **<< minus 20 degrees F; or ____ degrees F>>** to **<< 180 degrees F; or ____ degrees F>>** without buckling, opening of joints, undue stress on fasteners, or other detrimental effects; allow for ambient temperature at time of fabrication, assembly, and erection procedures.
1. Wind Performance: Provide system **<< tested in accordance with ASTM E330/E330M; or that will perform>>** without permanent deformation or failures of structural members under the following conditions:

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a. Design Wind Pressure: In accordance with ASCE 7 and requirements on Structural Drawings.
b. Maximum deflection of perimeter framing member of L/175 normal to plane of the wall; maximum deflection of individual panels of L/60.
c. Maximum anchor deflection in any direction of **<< 1/16 inch>>** at connection points of framing members to anchors.

B. Air Leakage: **<< 0.10 cfm/sq ft; or ___ cfm/sq ft>>** maximum leakage when tested at **<< 1.57 psf; or ___ psf>>** pressure difference in accordance with **<<ASTM E283/E283M>>**. ******N/A at rainscreen system******

C. Water Penetration: No water penetration under static pressure when tested in accordance with **<<ASTM E331>>** at a differential of **<< 10 percent; or _____>>** of inward acting design load, **<< 6.27 psf; or ___ psf>>** minimum, after 15 minutes. ******N/A at rainscreen system******
1. Water penetration is defined as the appearance of uncontrolled water on the interior face of the wall.
2. Design to drain leakage and condensation to the exterior face of the wall.

D. Fire Performance: Provide panels that have been tested in approved assemblies, in accordance with, and complying with acceptance criteria of **<< NFPA 285; or _____>>**.

2.04 PANELS

A. Panels: 1 inch deep pans formed of metal composite material sheet by routing back edges of sheet, removing corners, and folding edges.
1. Provide concealed attachment to supporting structure by adhering attachment members to back of panel; attachment members may also function as stiffeners.
2. Maintain maximum panel bow of 0.8 percent of panel dimension in width and length; provide stiffeners of sufficient size and strength to maintain panel flatness without showing local stresses or read-through on panel face.
3. Secure members to back face of panels using structural silicone sealant approved by MCM sheet manufacturer.
4. For directional finishes such as metallics, maintain consistent grain direction of MCM sheet; specifically, do not rotate sheet purely to avoid waste. Coordinate with manufacturer.
5. Fabricate panels under controlled shop conditions.
6. Where final dimensions cannot be established by field measurement before commencement of manufacturing, make allowance for field adjustments without requiring field fabrication of panels.
7. Fabricate as indicated on drawings and as recommended by MCM sheet manufacturer.
a. Make panel lines, breaks, curves, and angles sharp and true.
b. Keep plane surfaces free from warp or buckle.
c. Keep panel surfaces free of scratches or marks caused during fabrication.
8. Column Covers/Radiused Panels: Where curved or radiused panels are indicated, roll round faces to a precise radius, accounting for joints, to provide a constant, consistent radius across the complete assembly.
9. Provide joint details providing a watertight and structurally sound wall panel system that allows no uncontrolled water penetration on inside face of panel system.
10. For "dry" jointing, secure extrusions to returned pan edges with stainless steel rivets.
11. Provide means of concled drainage for panel condensation and water that might accumulate in members of system; drill perforated weep holes on underside return of each panel, and provide insect baffle at each weep hole.

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2.05 MATERIALS

A. Metal Composite Material (MCM) Sheet: Fire-retardant composite panel fabricated of two sheets of **<< aluminum; stainless steel; zinc; copper; or _____>>** sandwiching a mineral-filled core; no foamed insulation material content.

1. Overall Sheet Thickness: 4 mm (0.157 inch) minimum nominal thickness.
2. Face Sheet Thickness: 0.020 inches (0.5 mm), minimum, equal thickness for both exterior and interior facings. Unequal facings are not acceptable.
3. Bond and Peel Strength: No adhesive failure of the bond between the core and the skin nor cohesive failure of the core itself below **<< 22.4 inch-pound/inch; or ____ inch-pound/inch>>** with no degradation in bond performance, when tested in accordance with **<<ASTM D1781>>**, simulating resistance to panel delamination, after 8 hours of submersion in boiling water and after 21 days of immersion in water at **<< 70 degrees F>>**.
4. Surface Burning Characteristics: Flame spread index of **<< 25; 10; or ___>>**, maximum; smoke developed index of 450, maximum; when tested in accordance with **<<ASTM E84>>**.
5. Flammability: Self-ignition temperature of **<< 650 degrees F>>** or greater when tested in accordance with **<<ASTM D1929>>**.

B. Metal Framing Members: Coordinate with Division 5 Section "Continuous Insulation Framing System". Provide manufacturer's recommended sub-girts/furring channels, installation clips, base and sill angles and channels, as required for complete installation over continuous insulation framing system.

1. Provide material strength, dimensions, configuration as required to meet applied loads and in compliance with applicable building code.
2. Aluminum Components: **<<ASTM B209/B209M>>**; or **<<ASTM B221>>** (**<<ASTM B221M>>**).

2.06 FINISHES

A. Fluoropolymer Coil Coating System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with **<<AAMA 2605>>**, including at least 70 percent PVDF resin, with at least 80 percent of coil coated metal surfaces having minimum total dry film thickness (DFT) of **<< 0.9 mil, 0.0009 inch>>**. ******Select design choice from options below******

1. Color/Texture: To be selected by Architect from manufacturer's standard or stock range.
2. Color/Texture: To be selected by Architect from manufacturer's full and complete range including metallics, premiums, and micas.
3. Color/Texture: Custom color shall be required to match Architect's sample; manufacturer's standard texture.

2.07 ACCESSORIES

A. Flashing: Sheet aluminum, 0.040-inch thick, minimum; finish and color to match MCM sheet.

B. CI Framing System: Refer to Division 5 Section "Continuous Insulation Framing System".

C. Anchors, Clips, and Accessories: Use one of the following:

1. Stainless steel complying with **<<ASTM A276/A276M>>**, **<<ASTM A480/A480M>>**, or **<<ASTM A666/A666M>>**.
2. Steel complying with **<<ASTM A36/A36M>>** and hot-dip zinc coating to **<<ASTM A153/A153M>>**.

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3. Steel complying with **<<ASTM A36/A36M>>** and hot-dip galvanized to **<<ASTM A123/A123M>>**, with Coating Thickness Grade of **<< 100; 75; 50; 35; or ___>>**.

D. Fasteners:
1. Screws: Self-drilling or self-tapping Type 410 stainless steel or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal wall panels.
2. Bolts: Stainless steel.
3. Fasteners for Flashing and Trim: Blind fasteners of high-strength aluminum or stainless steel.

E. Joint Sealer: Provide in color selected by Architect; exterior silicone sealant of type specified in Division 7 Section "Joint Sealants," approved by MCM sheet manufacturer, and in compliance with **<<ASTM C920>>**.

F. Provide panel system manufacturer's and installer's **<< standard corrosion resistant; stainless steel; hot-dipped galvanized; or _____>>** accessories, including fasteners, clips, anchorage devices, and attachments.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine dimensions, tolerances, and interfaces with other work.
1. Verify that air barrier system/insulation and CI framing system are properly installed.

B. Examine substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturer's written instructions.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

D. Notify Architect in writing of conditions detrimental to proper and timely completion of work, and do not proceed with erection until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect adjacent work areas and finish surfaces from damage during installation.

3.03 INSTALLATION

A. Do not install products that are defective, including warped, bowed, dented, and broken members, and members with damaged finishes.

B. Comply with instructions and recommendations of MCM sheet manufacturer and wall system manufacturer**<< , as well as with approved shop drawings; or None - N/A>>**.

C. Install wall system securely allowing for necessary thermal and structural movement; comply with wall system manufacturer's instructions for installation of concealed fasteners.

D. Do not handle or tool products during erection in manner that damages finish, decreases strength, or results in visual imperfection or failure in performance. Return component parts that require alteration to shop for refabrication, if possible, or for replacement with new parts.

E. Do not form panels in field unless required by wall system manufacturer and approved by the Architect; comply with MCM sheet manufacturer's instructions and recommendations for field forming.

F. Separate dissimilar metals; use gasket fasteners, isolation shims, or isolation tape where needed to eliminate possibility of electrolytic action between metals.

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G. Where joints are designed for field-applied sealant, seal joints completely with specified sealant.

H. Install flashings as indicated on shop drawings. At flashing butt joints, provide a lap strap under flashing and seal lapped surfaces with a full bed of non-hardening sealant.

I. Install square, plumb, straight, and true, accurately fitted, with tight joints and intersections maintaining the following installation tolerances:
   1. Variation From Plane or Location: 1/2-inch in 30 feet of length and up to 3/4-inch in 300 feet, maximum.
   2. Deviation of Vertical Member From True Line: 0.1 inch in 25 feet run, maximum.
   3. Deviation of Horizontal Member From True Line: 0.1 inch in 25 feet run, maximum.
   4. Offset From True Alignment Between Two Adjacent Members Abutting End To End, In Line: 0.03 inch, maximum.

J. Replace damaged products.
   1. Exception: Field repairs of minor damage to finishes are permitted only when approved in writing by **<<Architect>>**, panel manufacturer, and fabricator.
   2. Field Repairs to Finishes: Using materials and methods sufficient that repairs are not discernible when viewed at distance of **<< 10 feet; or ___ feet>>** under all typical light conditions experienced at the project.

3.04 FIELD QUALITY CONTROL

A. Wall System Manufacturer's Field Services: Provide field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with instructions.

3.05 CLEANING

A. Ensure weep holes and drainage channels are unobstructed and free of dirt and sealants.

B. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.

C. Remove temporary coverings and protection of adjacent work areas.

D. Clean installed products in accordance with manufacturer's instructions.

3.06 PROTECTION

A. Protect installed panel system from damage until Date of Substantial Completion.

END OF SECTION 074213.23

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SECTION 075100
BUILT-UP BITUMINOUS ROOFING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

C. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

D. ASTM D41/D41M - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.

E. ASTM D312/D312M - Standard Specification for Asphalt Used in Roofing.

F. ASTM D1863/D1863M - Standard Specification for Mineral Aggregate Used on Built-Up Roofs.

G. ASTM D2178/D2178M - Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.

H. ASTM D3909/D3909M - Standard Specification for Asphalt Roll Roofing (Glass Felt) Surfaced with Mineral Granules.

I. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement.

J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

K. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

L. FM (AG) - FM Approval Guide.

M. ITS (DIR) - Directory of Listed Products.

N. NRCA (RM) - The NRCA Roofing Manual.

O. UL (DIR) - Online Certifications Directory.

P. UL (FRD) - Fire Resistance Directory.

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1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of associated counterflashings installed by other sections as the work of this section proceeds.

B. Preinstallation Meeting: Convene two weeks minimum before starting work of this section.

1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.03 SUBMITTALS

A. Product Data: Provide data indicating membrane and bitumen materials, base flashings, cover board, insulation, vapor retarder/air barrier, substrate board, and surfacing materials.

B. Shop Drawings: Indicate **<< joint or termination detail conditions; conditions of interface with other materials; setting plan for tapered insulation; mechanical fastener layout; and _____>>**.

C. Sustainable Design Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

D. Manufacturer's Certificate: Certify that products meet or exceed **<< specified requirements; or _____>>**.
   1. Submit in the form of manufacturer's assembly letter, indicating each component of the roofing assembly as specified, and that assembly meets performance requirements and manufacturer's warranty conditions.

E. Manufacturer's Field Reports: Indicate **<< procedures followed; ambient temperatures; humidity; wind velocity during application; supplementary instructions given; and _____>>**.

F. Manufacturer's qualification statement.

G. Installer's qualification statement.

H. Warranty: Submit manufacturer warranty and ensure forms have been completed in **<<Owner>>**'s name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacture of products specified, with UL-listed roof assemblies for roof systems indicated.

B. Installer Qualifications: Company specializing in performing the work of this section. Installer shall be certified by primary roofing membrane material manufacturer for installation of specified roofing assembly.

C. Insulation Manufacturer Qualifications: Approved by roof membrane manufacturer, and approved and labeled under third party quality program as required by applicable building code.
   1. Insulation Labeling: All foam insulation shall bear the label of testing/inspection agency, and shall include manufacturer identification, product identification, performance characteristics, and other information as necessary to verify code compliance for intended end use.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact.

B. Store materials in weather protected environment, clear of ground and moisture.

C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.

D. Protect foam insulation from direct exposure to sunlight.

1.06 FIELD CONDITIONS

A. Do not install roofing materials during unsuitable weather, or when unsuitable weather is expected. Proceed only when field conditions are in accordance with roofing manufacturer's installation and warranty requirements.

B. Do not expose materials vulnerable to water**<< or sun damage; None - N/A; or _____>>** in quantities greater than can be weatherproofed the same day.

C. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.07 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

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B. Special Warranty - Manufacturer: Manufacturer's warranty form, customized for project-specific conditions.
   1. Manufacturer's warranty shall be a "total system" or "edge-to-edge" warranty; no dollar limit ("NDL").
   2. Include all components of roofing system including, but not limited to, roofing membrane, roof insulation, adhesives and fasteners, flashings, edge metals and copings, **<< substrate board; vapor retarder/air barrier; cover board; roof insulation; roof paver system; and walkway pads>>**.
   3. Provide wind coverage to 74 mph and hail coverage.
   4. Manufacturer's Total System Warranty Period: 25 years, from date of Substantial Completion.

C. Special Warranty - Installer: Installer shall sign and submit per warranty form attached at end of this section.
   1. Installer's warranty shall cover all components of roofing system, matching manufacturer's warranty above.
   2. Installer's Warranty Period: 2 years, from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Built-Up Bituminous Roofing (Primary Membrane):
   1. Carlisle SynTec; SureMB Type VI Glass Ply Felt.
   2. GAF; GAFGLAS Type VI.
   3. Johns Manville; GlasPly Premier.
   4. Polyglass USA, Inc; Polyglass Ply VI.
   5. Soprema; SOPRA VI.
   6. Tremco, Inc; THERMglass Premium VI.

2.02 ROOFING - CONVENTIONAL APPLICATION

A. Built-up Bituminous Roofing: Asphalt felt membrane, four plies plus base sheet, over cover board, polyiso insulation, air barrier/vapor retarder, and substrate board on metal roof deck.

B. Roofing Assembly Requirements:
   1. General: Installed roofing assembly and all associated components shall remain secure and watertight and shall withstand weather exposure, wind uplift pressures specified, and thermal movements. Roofing manufacturer shall certify that all roofing assembly components are compatible with each other and with adjacent materials for applications indicated.
   2. Roof Covering External Fire Resistance Classification: **<< ITS (DIR); UL (DIR); UL (FRD); or _____>>** Class A.
   3. Assembly Resistance to Internal Fire: Manufacturer's assembly shall be tested to and satisfactorily pass NFPA 276 or UL 1256.
   4. Wind / Uplift Design: Membrane roofing system shall be identical to system that has been successfully tested by a qualified testing and inspecting agency to resist uplift pressures calculated according to **<<ASCE 7>>** as established by applicable building code and loading indicated.
      a. Corner, Perimeter, Field-of-Roof Uplift Pressures: Per applicable building code and values indicated on Structural Drawings.

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b. Static Uplift: In addition to uplift requirements above, system shall be tested for static uplift per FM 4474, UL 580, or UL 1897.

5. Assembly Thermal Resistance (R-Value): Provide roof assembly with a minimum assembly R-value of R-30 in accordance with applicable IECC requirement for commercial roofing.
6. Accelerated Weathering: 2,000 hours minimum exposure, when tested in accordance with ASTM G152, ASTM G154, or ASTM G155.
7. Ponding Water: Ponding water shall not remain on the roof 24 hours after a rainfall event.
8. Solar Reflectance Index (SRI): **<< 78; or ___>>**, minimum, calculated in accordance with **<<ASTM E1980>><< , based on 3-year aged data; _____; or None - N/A>>**.
   a. Field applied coating **<< may not; may; or _____>>** be used to achieve specified SRI.

2.03 SHEET MATERIALS

A. Base Sheets: **<<ASTM D2178/D2178M>> << Type IV; Type VI; or _____>>**; asphalt-coated glass fiber, unperforated.

B. White Cap Sheet: Asphalt-saturated glass fiber roll roofing surfaced with flexible acrylic coating**<< and ceramic granules; _____; or None - N/A>>**, complying with **<<ASTM D3909/D3909M>>**.
   1. Solar Reflectance: **<< 0.75; or _____>>**, minimum, initial, and **<< 0.60; or _____>>**, minimum, 3-year aged, certified by Cool Roof Rating Council.
   2. Thermal Emissivity: **<< 0.80; or _____>>**, minimum, initial, and **<< 0.85; or _____>>**, minimum, 3-year aged, certified by Cool Roof Rating Council.

2.04 BITUMINOUS MATERIALS

A. Bitumen: **<<ASTM D312/D312M>>**, **<< Type I; Type II; Type III; Type IV; or _____>>**, asphalt.

B. Asphalt Primer: **<<ASTM D41/D41M>>**, asphalt type.

C. Asphalt Roof Cement: **<<ASTM D4586/D4586M>>**, Type I, asbestos-free.

2.05 DECK SHEATHING

A. Deck Sheathing: Glass-mat faced gypsum panels, **<<ASTM C1177/C1177M>>**.
   1. Thickness: 1/2-inch, fire-resistant.
   2. Products:
      a. CertainTeed Corporation; GlasRoc Sheathing.
      b. Georgia-Pacific; DensDeck Prime.
      c. National Gypsum Company; DEXcell Glass Mat Roof Board.
      d. USG Corporation; Securock Ultralight Glass-Mat Roof Board.

2.06 INSULATION

A. Surface Burning Characteristics: Foam plastic insulation shall have a maximum flame spread index of 75, and maximum smoke developed index of 450, when tested in accordance with**<<ASTM E84>>** at maximum thickness intended for use.

B. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with **<<ASTM C1289>>**.
   1. Classifications:

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a. Type II: Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.
   1) Class 1 - Faced with glass fiber reinforced cellulosic facers on both major surfaces of the core foam.
   2) Compressive Strength: Grade 2 - 20 psi, minimum.
   3) Thermal Resistance: Nominal R-value of 5.7 per inch at 75 degrees F.

2. Tapered Board: Slope as indicated, but no lower than 1/4 inch per foot; minimum thickness 1/2-inch; fabricate of fewest layers possible.
3. Preformed Shapes: Provide saddles crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated, but no less than 1/4 inch per 12 inches, and no less than 1/8 inch per 12 inches in valleys.

2.07 SURFACING MATERIALS<< , CONVENTIONAL; OR NONE - N/A>>

A. Aggregate: **<< ASTM D1863/D1863M; or None - N/A>>** Sound, hard **<< washed river gravel; roofer's pea gravel; white dolomite chips; crushed shale; stone; or _____>>**; **<< 1/4-inch; or ___-inch>>** minimum to **<< 1/2-inch; or ____-inch>>** maximum size.

2.08 ACCESSORIES

A. Cant and Edge Strips: Bitumen-impregnated wood fiberboard, compatible with roofing materials**<< ;; or None - N/A>><< cants formed to 45-degree angle; tapered edge strips; other configurations as detailed; and _____>>**.

B. Stack Boots: Provide manufacturer's standard preformed flexible flashings, using clamps and tents, to secure roof penetrations watertight. Pitch pockets shall be avoided to the greatest extent possible.
   1. Pitch Pocket: Where pitch pocket is unavoidable due to penetration's complexity of shape, fill pitch pockets with pourable urethane sealer.

C. Insulation Fasteners: Appropriate for purpose intended**<< and approved by roofing manufacturer; and approved by FM (AG) Factory Mutual and roofing manufacturer; _____; or None - N/A>>**.
   1. Length as required for thickness of insulation material and penetration of deck substrate**<< , with metal washers; None - N/A; or _____>>**.

D. Strip Reglet Devices: **<< Galvanized steel; Extruded plastic; or _____>>**, maximum possible lengths per location, with attachment flanges.

E. Insulation Perimeter Restraint: **<< Stainless steel; Metal; or _____>>** edge device configured to restrain insulation boards in position and provide top flashing over ballast.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and **<< cant strips; nailing strips; reglets; and _____>>** are in place.

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3.02 PREPARATION - METAL DECK

A. Install deck sheathing on metal deck:
   1. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.
   2. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.
   3. Tape joints.
   4. Mechanically fasten sheathing to roof deck, in accordance with roofing manufacturer's instructions and per the following:
      a. At locations where metal roof deck will be exposed from below in the finished work, carefully coordinate fastener attachment such that fasteners do not penetrate the bottom flanges of the metal deck. Remove fasteners that penetrate the bottom flanges and replace with properly located fasteners, and restore metal deck to Owner's satisfaction.

3.03 INSTALLATION - AIR BARRIER/VAPOR RETARDER AND INSULATION

A. Install vapor retarder over substrate surface in accordance with manufacturer's instructions.
   1. Extend vapor retarder under under cant strips and blocking to deck edge.
   2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane. Coordinate with installer of wall air barrier assembly for transition membrane information and tie in.

B. Ensure vapor retarder is clean and dry, continuous, and ready for application of roofing system.

C. Attachment of Insulation:
   1. Mechanically fasten first layer of insulation to deck in accordance with roofing manufacturer's instructions.
      a. At locations where metal roof deck will be exposed from below in the finished work, carefully coordinate fastener attachment such that fasteners do not penetrate the bottom flanges of the metal deck. Remove fasteners that penetrate the bottom flanges and replace with properly located fasteners, and restore metal deck to Owner's satisfaction.
   2. Embed each subsequent layer of insulation into flood coat mopping of hot bitumen in accordance with roofing and insulation manufacturers' instructions.
   3. Install a minimum of two layers of insulation, with a minimum total thickness of 5.2 inches, followed by a cover board (R-0.5), to achieve a cumulative roof assembly Long Term Thermal Resistance (LTTR) value of 30 per ASTM C1289.

D. Lay subsequent layers of insulation with joints staggered minimum **<< 6 inches; or ___ inches>>** from joints of preceding layer.

E. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.

F. On metal deck, place boards **<< parallel; perpendicular; or _____>>** to flutes with insulation board **<< edges; ends; or _____>>** bearing on deck flutes. ******Keep this paragraph if no substrate/sheathing board******

G. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

H. At roof drains, use **<< factory-tapered boards; boards cut to slope; or _____>>** to slope down to roof drains over a distance of **<< 18 inches; 24 inches; or ____ inches>>**.

I. Do not apply more insulation than can be covered with membrane in same day.

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J. Cover Boards: Secure cover boards in accordance with roofing manufacturer's instructions. Install cover boards with joints staggered minimum 6 inches from joints of preceding insulation layer.

3.04 INSTALLATION - MEMBRANE

A. Install built-up bituminous roofing system in accordance with manufacturers recommendations**<< and NRCA (RM) applicable requirements; _____; or None - N/A>>**.

B. Equiviscous Temperature (EVT) at Point of Application: Comply with **<< NRCA (RM) recommendations; or _____>>**.

C. Apply membrane plies, weather lap edges and ends, and mop with **<< 20 lb/100 sq ft; or ___ lb/100 sq ft>>** of bitumen per ply unless otherwise required by manufacturer. **<< Apply plies two on two in same direction.; Apply plies two on two in opposite direction.; _____ .; or None - N/A>>**

D. Apply smooth, free from air pockets, wrinkles, fish-mouths, or tears.

E. At end of day's operation, install two plies membrane and bitumen glaze coat for cut-off. Glaze exposed felts. Remove cut-off before resuming roofing.

F. At intersections with vertical surfaces:

1. Extend membrane**<< and base sheet; None - N/A; or _____>>** over cant strips and up a minimum of **<< 4 inches; 6 inches; or ____ inches>>** onto vertical surfaces.
2. Mop on base flashing of two additional plies of felt and one ply of base flashing material.

G. At gravel stops, extend membrane**<< and base sheet; None - N/A; or _____>>** under gravel stop and to the outside face of the wall.

H. Around roof penetrations, mop in and seal flanges and flashings with two additional plies of felt.

I. Coordinate installation of roof **<< drains; sumps; and _____>>** and related flashings.

3.05 APPLICATION - AGGREGATE SURFACING<< , CONVENTIONAL; OR NONE - N/A>>

A. Apply uniform flood coat of bitumen at rate of **<< 60 lb/100 sq ft>>**.

B. While flood coat is hot, embed aggregate at rate of **<< 400 lb/100 sq ft; 300 lb/100 sq ft; or ___ lb/100 sq ft>>**.

C. Evenly distribute aggregate and ensure bond with flood coat; extend aggregate to bottom edge of cant strips.

3.06 CLEANING

A. Remove bituminous markings from finished surfaces.

B. In areas where finished surfaces are soiled by bitumen or other source of soiling caused by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their**<< documented; None - N/A; or _____>>** instructions.

C. Repair or replace defaced or damaged finishes caused by work of this section.

3.07 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION 075100

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SECTION 075423
TPO MEMBRANE ROOFING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

B. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

C. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.

D. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

E. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

F. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin-Based Sheet Roofing.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

I. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

J. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials.

K. FM (AG) - FM Approval Guide.

L. NRCA (RM) - The NRCA Roofing Manual.

M. NRCA (WM) - The NRCA Waterproofing Manual.

N. UL (FRD) - Fire Resistance Directory.

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1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene at the Project site on **<< <u>one week</u>; or _____>>** before starting work of this section.

1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.03 SUBMITTALS

A. Product Data: Provide data indicating membrane materials, **<< <u>flashing materials</u>; <u>insulation</u>; <u>vapor retarder</u>; <u>surfacing</u>; <u>fasteners</u>; and _____>>**.

B. Shop Drawings: Submit drawings that indicate **<< <u>joint or termination detail conditions</u>; <u>conditions of interface with other materials</u>; setting plan for tapered insulation; mechanical fastener layout; paver layout; and _____>>**.

1. Include details of tapered insulation and crickets.
2. Include edge conditions showing details of roofing assembly connection to wall air barrier material to maintain a continuous air barrier system.

C. Sustainable Design Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
   1. Submit in the form of manufacturer's assembly letter, indicating each component of the roofing assembly as specified, and that assembly meets performance requirements and manufacturer's warranty conditions.

E. Manufacturer's Field Reports: Indicate **<< procedures followed; ambient temperatures; humidity; wind velocity during application; supplementary instructions given; and _____>>**.

F. Manufacturer's qualification statement.

G. Installer's qualification statement.

H. Warranty Documentation:
   1. Submit manufacturer warranty and ensure that forms have been completed in **<<Owner>>**'s name and registered with manufacturer.
   2. Submit installer's written verification that installation complies with warranty conditions for waterproof membrane.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacture of products specified, with UL-listed roof assemblies for roof systems indicated.

B. Installer Qualifications: Company specializing in installation of roof systems indicated, and approved / certified by roofing manufacturer to install products specified.

C. Insulation Manufacturer Qualifications: Approved by roof membrane manufacturer, and approved and labeled under third party quality program as required by applicable building code.
   1. Insulation Labeling: All foam insulation shall bear the label of testing/inspection agency, and shall include manufacturer identification, product identification, performance characteristics, and other information as necessary to verify code compliance for intended end use.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact, unless otherwise indicated.

B. Store materials in weather protected environment, clear of ground and moisture.

C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.

D. Protect foam insulation from direct exposure to sunlight.

1.06 FIELD CONDITIONS

A. Do not install roofing materials during unsuitable weather, or when unsuitable weather is expected. Proceed only when field conditions are in accordance with roofing manufacturer's installation and warranty requirements.

B. Do not expose materials vulnerable to water or sun damagein quantities greater than can be weatherproofed the same day.

C. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.07 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

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B. Special Warranty - Manufacturer: Manufacturer's warranty form, customized for project-specific conditions.
   1. Manufacturer's warranty shall be a "total system" or "edge-to-edge" warranty; no dollar limit ("NDL").
   2. Include all components of roofing system including, but not limited to, roofing membrane, roof insulation, adhesives and fasteners, flashings, edge metals and copings, **<< substrate board; vapor retarder/air barrier; cover board; roof insulation; roof paver system; and walkway pads>>**.
   3. Manufacturer's Total System Warranty Period: 20 years, from date of Substantial Completion.

C. Special Warranty - Installer: Installer shall sign and submit per warranty form attached at end of this section.
   1. Installer's warranty shall cover all components of roofing system, matching manufacturer's warranty above.
   2. Installer's Warranty Period: 2 years, from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Thermoplastic Polyolefin (TPO) Membrane Roofing Materials:
   1. Carlisle Roofing Systems, Inc.
   2. Elevate.
   3. GAF.
   4. Johns Manville.

2.02 ROOFING

A. Thermoplastic Membrane Roofing: One ply membrane, **<< mechanically fastened; fully adhered; spot adhered; or _____>><< , over insulation; , over vapor retarder and insulation; None - N/A; or , over cover board, insulation, vapor retarder/air barrier, substrate board, and metal roof decking>>**.

B. Roofing Assembly Performance Requirements:
   1. General: Installed roofing assembly and all associated components shall remain secure and watertight and shall withstand weather exposure, wind uplift pressures specified, and thermal movements. Roofing manufacturer shall certify that all roofing assembly components are compatible with each other and with adjacent materials for applications indicated.
   2. Solar Reflectance Index (SRI): Minimum of 64 based on three-year aged value; if three-year aged data is not available, minimum of 82 initial value.
      a. Calculate SRI in accordance with **<<ASTM E1980>>**.
      b. A field applied coating may not be used to achieve specified SRI.
   3. Roof Covering External Fire Resistance Classification: **<< ITS (DIR); UL (DIR); UL (FRD); or _____>>** Class A.
   4. Assembly Resistance to Internal Fire: Manufacturer's assembly shall be tested to and satisfactorily pass NFPA 276 or UL 1256.
   5. Wind / Uplift Design: Membrane roofing system shall be identical to system that has been successfully tested by a qualified testing and inspecting agency to resist uplift pressures calculated according to **<<ASCE 7>>** as established by applicable building code and loading indicated.

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a. Corner, Perimeter, Field-of-Roof Uplift Pressures: Per applicable building code and values indicated on Structural Drawings.
b. Static Uplift: In addition to uplift requirements above, system shall be tested for static uplift per FM 4474, UL 580, or UL 1897.

6. Assembly Thermal Resistance (R-Value): Provide roof assembly with a minimum assembly R-value of R-30 in accordance with applicable IECC requirement for commercial roofing.
7. Accelerated Weathering: 2,000 hours minimum exposure, when tested in accordance with ASTM G152, ASTM G154, or ASTM G155.
8. Ponding Water: Ponding water shall not remain on the roof 24 hours after a rainfall event.

2.03 MEMBRANE ROOFING AND ASSOCIATED MATERIALS

A. Membrane Roofing Materials:
1. TPO: Thermoplastic polyolefin (TPO) complying with **<<ASTM D6878/D6878M>>**, sheet contains reinforcing fabrics or scrims.
a. Thickness: 80 mil, 0.080-inch, minimum.
1) Where roof membrane is applied to vertical surfaces (roof-to-wall, parapet, and similar applications), 60 mil thickness is acceptable.
2. Sheet Width: **<< Factory fabricated into widest possible sheets.; _____; or None - N/A>>**
3. Color: White.

B. Seaming Materials: **<< As recommended by membrane manufacturer; or _____>>**.

C. Flexible Flashing Material: **<< Same material as membrane; Material recommended by membrane manufacturer; or _____>>**.

2.04 DECK SUBSTRATE BOARD

A. Deck Substrate Board: Glass-mat faced gypsum panels complying with **<<ASTM C1177/C1177M>>**.
1. Thickness: 1/2-inch, fire-resistant.
2. Products:
a. CertainTeed Corporation; GlasRoc Sheathing.
b. Georgia-Pacific; DensDeck Prime.
c. National Gypsum Company; DEXcell Glass Mat Roof Board.
d. USG Corporation; Securock Ultralight Glass-Mat Roof Board.

2.05 VAPOR RETARDER / AIR BARRIER

A. Vapor Retarder / Air Barrier Sheet, Self-Adhered: Composite sheet fabricated of rubberized asphalt factory laminated to polyethylene/polypropylene film with release liner. Product shall be approved by primary roofing manufacturer, and comply with the following:
1. Total Thickness: 30 mils, minimum.
2. Air Permeance: Less than 0.004 cfm/sq.ft. when tested per **<<ASTM E2178>>**.
3. Vapor Permeance: Less than 0.1 perm when tested per **<<ASTM E96/E96M>>**.
4. Products:
a. Carlisle; VapAir Seal 725 TR.
b. Elevate; V-Force Vapor Barrier.
c. GAF; SA Vapor Retarder XL.

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d. Johns Manville; JM Vapor Barrier SA.

2.06 COVER BOARDS

A. Cover Board: High compressive strength polyisocyanurate (ISO) board insulation complying with **<<ASTM C1289>>**, and the following characteristics:

1. Classifications:
   a. **<< Type II - Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam; or Type ___ - _____>>**.
      1) **<< Class 4 - Faced with coated or uncoated glass fiber mat facers on both major surfaces of the core foam. This product is used at a maximum thickness of 1/2 inch (12.7 mm); or Class ___ - _____>>**.
         (a) Compressive Strength: 80 psi, minimum.
2. Board Size: 48 by 48 inches, maximum.
3. Board Thickness: 1/2-inch.
4. Thermal Resistance: **<< R-value>>** of 2.5, minimum, at **<< 1/2 inch>>** thick and **<< 75 degrees F>>** mean temperature.
5. Products:
   a. Carlisle; SecurShield HD.
   b. Elevate; Isogard HD Cover Board.
   c. GAF; EnergyGuard HD.
   d. Johns Manville; ProtectoR.

2.07 INSULATION

A. Surface Burning Characteristics: Foam plastic insulation shall have a maximum flame spread index of 75, and maximum smoke developed index of 450, when tested in accordance with**<<ASTM E84>>** at maximum thickness intended for use.

B. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with **<<ASTM C1289>>**.

1. Classifications:
   a. Type II:
      1) **<< Class 1 - Faced with glass fiber reinforced cellulosic felt facers on both major surfaces of core foam; Class 2 - Faced with coated polymer-bonded glass fiber mat facers on both major surfaces of core foam; Class 3 - Faced with uncoated polymer-bonded glass fiber mat facers on both major surfaces of core foam; or Class 4 - Faced with coated or uncoated polymer-bonded glass fiber mat facers on both major surfaces of core foam; maximum thickness of 1/2 inch (12.7 mm)>>**.
      2) Compressive Strength: **<< Grade 2 - 20 psi; Grade 3 - 25 psi; or _____>>**, minimum.
2. Tapered Board: Slope as indicated, but no lower than 1/4 inch per foot; minimum thickness 1/2 inch; fabricate of fewest layers possible.
3. Preformed Shapes: Provide saddles crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated, but no less than 1/4 inch per 12 inches, and no less than 1/8 inch per 12 inches in valleys.

2.08 ACCESSORIES

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A. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; **<< same material as membrane; elastomeric material compatible with membrane; or _____>>**.

B. Sheathing Joint Tape: **<< Paper; Heat resistant; or _____>>** type, self adhering.

C. Insulation Fasteners: Appropriate for purpose intended**<< and approved by roofing manufacturer; and approved by Factory Mutual and roofing manufacturer; None - N/A; or _____>>**.

1. Length as required for thickness of insulation material and penetration of deck substrate**<< , with metal washers; None - N/A; or _____>>**.

D. Membrane Adhesive: As recommended by membrane manufacturer.

E. Insulation Adhesive: As recommended by insulation manufacturer.

F. Sealants: As recommended by membrane manufacturer.

G. Walkway Pads: Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane.

1. Composition: **<< Asphaltic with mineral granule surface; Rubber with mineral granule surface; Porous rubber with natural surface; Roofing membrane manufacturer's standard; or _____>>**.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and other accessories are in place.

3.02 PREPARATION - METAL DECK

A. Install deck sheathing on metal deck:

1. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.
2. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.
3. Tape joints.
4. Mechanically fasten substrate board to roof deck, in accordance with roofing manufacturer's instructions and per the following:
   a. At locations where metal roof deck will be exposed from below in the finished work, carefully coordinate fastener attachment such that fasteners do not penetrate the bottom flanges of the metal deck. Remove fasteners that penetrate the bottom flanges and replace with properly located fasteners, and restore metal deck to Owner's satisfaction.

3.03 INSTALLATION, GENERAL

A. Perform work in accordance with **<< manufacturer's instructions; NRCA (RM); NRCA (WM); and _____>>** applicable requirements.

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B. Do not apply roofing membrane during cold or wet weather conditions.

C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.

D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

E. Do not expose materials vulnerable to water**<< or sun damage; _____; or None - N/A>>** in quantities greater than can be weatherproofed the same day.

F. Coordinate this work with installation of associated counterflashings installed by other sections as the work of this section proceeds.

3.04 INSTALLATION - AIR BARRIER/VAPOR RETARDER AND INSULATION, UNDER MEMBRANE

A. Install vapor retarder over substrate surface in accordance with manufacturer's instructions.
   1. Extend vapor retarder under blocking to deck edge.
   2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane. Coordinate with installer of wall air barrier assembly for transition membrane information and tie in.

B. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.

C. Attachment of Insulation:
   1. Mechanically fasten first layer of insulation to deck in accordance with roofing manufacturer's instructions.
      a. At locations where metal roof deck will be exposed from below in the finished work, carefully coordinate fastener attachment such that fasteners do not penetrate the bottom flanges of the metal deck. Remove fasteners that penetrate the bottom flanges and replace with properly located fasteners, and restore metal deck to Owner's satisfaction.
   2. Embed subsequent layer(s) of insulation into either ribbons or full bed of adhesive as required to comply with performance or warranty requirements, and in accordance with roofing and insulation manufacturers' instructions.
   3. Install a minimum of two layers of insulation, with a minimum total thickness of 5 inches, to achieve a cumulative Long Term Thermal Resistance (LTTR) value of 28.5 per ASTM C 1289, followed by a R-2.5 cover board for total system LTTR of R-31.

D. Lay subsequent layers of insulation with joints staggered minimum 6 inches from joints of preceding layer.

E. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.

F. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes. ******Keep this paragraph if no substrate/sheathing board******

G. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

H. At roof drains, use **<< factory-tapered boards; boards cut to slope; or _____>>** to slope down to roof drains over a distance of **<< 18 inches; 24 inches; or ___ inches>>**.

I. Do not install more insulation than can be covered with membrane in same day.

J. Cover Boards: Secure cover boards in accordance with roofing manufacturer's instructions with manufacturer's insulation adhesive. Install cover boards with joints staggered minimum 6 inches from joints of preceding insulation layer.

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3.05 INSTALLATION - MEMBRANE

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.

B. Shingle joints on sloped substrate in direction of drainage.

C. Fully Adhered Application: Apply adhesive to substrate per manufacturer's instruction. Fully embed membrane in adhesive except in areas directly over or within **<< 3 inches; or ___ inches>>** of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.

D. Overlap edges and ends and seal seams by heat welding, minimum **<< 3 inches; or ___ inches>>**. Seal permanently waterproof.

E. At intersections with vertical surfaces other than parapets:
   1. Extend membrane over cant strips and up a minimum of 8 inches onto vertical surfaces and secure with a termination bar.
   2. Coordinate with Division 7 "Sheet Metal Flashing and Trim" for counterflashing.

F. Around roof penetrations, seal flanges and flashings with flexible flashing.

G. Install roofing expansion joints where indicate**<< where indicated; None - N/A; or _____>>**. Make joints watertight.

H. Coordinate installation of roof **<< drains; sumps; and _____>>** and related flashings.

I. Install walkway pads in layout indicated. If not indicated, provide from roof access hatch/door to each major piece of rooftop equipment and fully around perimeter of equipment. **<< Space pad joints to permit drainage.; _____ .; or None - N/A>>**

3.06 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

B. Provide on-site inspection by roofing manufacturer's technical representative **<< at least three times (deck/substrate examination, in-progress, and warranty inspection); before beginning installation (deck/substrate examination), weekly, at minimum, during installation, and post-installation (warranty inspection); or daily>>** during installation of this work.

C. Repair or replace roofing components where inspection determines they are defective.
   1. Repair or replace roofing system where ponding occurs in excess of specified requirement.

3.07 CLEANING

A. See Section **<< 017000 - Execution and Closeout Requirements>>** for additional requirements.

B. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their**<< documented; _____; or None - N/A>>** instructions.

C. Repair or replace defaced or damaged finishes caused by work of this section.

D. Provide a final cleaning of the roof membrane immediately prior to Substantial Completion to remove dirt, clay and other soiling.

3.08 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

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ROOFING INSTALLER'S WARRANTY

WHEREAS _____

of (Address) _____

herein called "Contractor," has provided roofing and associated "work" for the following project:

Owner: _____

Address: _____

Area of Work: _____ Date of Acceptance: _____

Warranty Period: _____ Date of Expiration: _____

Roofing Contractor: _____

Address: _____

1.

AND WHEREAS Contractor has contracted directly with the Owner to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period.

NOW THEREFORE the (General) Contractor shall maintain the entire roof system in a completely watertight condition at no cost to the Owner for two (2) years from date of final acceptance; except this watertight guarantee shall not be enforced when the Contractor can prove water damage was caused by the Owner.

This guarantee covers the roofing membrane and flashing, metal flashing, parapet copings and edge metals, and properly detailed penetrations of the roofing membrane for such things as stacks, curbs, and expansion joints which exist when the work is performed

The Roofing Contractor shall guarantee its materials and workmanship associated with the roofing, flashings, and sheet metal work incidental to the work required under the roofing subcontract, against defect due to faulty materials or workmanship for a period of two (2) years from the date of completion of such work. It is understood and agreed by all parties hereto that the responsibility of the roofing contractor under this guarantee form or any contract document shall be limited to the limited guarantee herein expressed by said roofing contractor.

The undersigned named Owner agrees, from the date of acceptance of the project, to maintain the roof in accordance with the manufacturer’s written requirements and agrees to avoid damage to the roof surface by any parties under his control working or walking on the roof. The Owner recognizes his responsibility to inspect the roof semi-annually.

IN WITNESS THEREOF, this instrument has been duly executed this

_____ day of _____, 20_____ .

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_____

General Contractor (Firm)

By:

_____

Name

_____

Authorized Signature

_____

Roofing Contractor (Firm)

By:

_____

Name

_____

Authorized Signature

_____

Owner

By:

_____

Name

_____

Authorized Signature

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END OF SECTION 075423

SECTION 075563
VEGETATED PROTECTED MEMBRANE ROOFING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM E2397/E2397M - Standard Practice for Determination of Dead Loads and Live Loads Associated with Vegetative (Green) Roof Systems.

B. ASTM E2398/E2398M - Standard Test Method for Water Capture and Media Retention of Geocomposite Drain Layers for Vegetative (Green) Roof Systems.

C. ASTM E2399/E2399M - Standard Test Method for Maximum Media Density for Dead Load Analysis of Vegetative (Green) Roof Systems.

D. ASTM E2777 - Standard Guide for Vegetative (Green) Roof Systems.

E. CSA A123.24 - Standard Test Method for Wind Resistance of Vegetated Roof Assembly.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to start of this work; attendance required by each affected installer.

1. Review installation procedures and coordination required with related work.

1.03 SUBMITTALS

A. Product Data: Provide product data on each component of vegetated roof.

B. Shop Drawings: Indicate size and outline of roof, location and type of materials, and details of accessories and edge treatments.

C. Manufacturer Certification: Submit written approval by membrane manufacturer of the proposed vegetated roof assembly and its components.

D. Preinstallation Field Report: Provide documentation that membrane installation has been approved by manufacturer and has passed specified testing.

E. Installer's Qualification Statement.

F. Project Record Documents: Record actual locations of planted areas, hardscape features, existing concealed drains, and irrigation system (if provided).

G. Maintenance Data: Submit manufacturer requirements for maintenance of materials and plants.

H. Warranty Documentation:

1. Submit manufacturer warranty and ensure that forms have been completed in **<<Owner>>**'s name and registered with manufacturer.
2. Submit installer's documentation that installation complies with warranty conditions for waterproof membrane.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Installer shall be a company specifically certified by the vegetated roof manufacturer to provide installation, maintenance, and warranty services for assembly specified herein.

B. Single Source Responsibility: Provide and install products from single source.

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1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in original, unopened containers or wrappings.

B. Store materials under cover and elevated above grade.

C. Store roll material lying down and on pallets fully protected from moisture.

D. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof assembly.

E. Remove damaged materials from job site, and replace damaged materials.

1.06 FIELD CONDITIONS

A. Ambient Conditions: Install vegetated roofing in accordance with local climate hardiness zones, unless otherwise indicated, or recommended in writing by manufacturer.

1.07 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Manufacturer Warranty: Provide a 50-year manufacturer warranty on components of module assembly (trays and accessories).

C. Special Warranty on Plant Growth: Provide a 2-year warranty on plantings and plant medium, covering unsatisfactory growth and plant death. Warranty shall not cover abuse or neglect by Owner or end users. Coordinate with plant maintenance contract; Installer/plant grower/supplier shall provide seasonal maintenance for the duration of the warranty period.

D. Overburden Warranty: Vegetated Roof Manufacturer shall provide a 20 year overburden removal warranty covering removal and reinstallation of vegetated roof components in order to facilitate roofing repairs.

PART 2 PRODUCTS

2.01 VEGETATED ROOF ASSEMBLY USING MODULAR ROOF TRAYS

A. Vegetated Roofing Assembly: Modular trays and protective layers installed over roof waterproofing system.

1. Structural Design Load: Provide vegetated roof assembly with superimposed dead load not greater than **<< load as indicated on Drawings; ___ lb/sq ft; or _____>>**; base calculations on the saturated weight of vegetated roof assembly components and maximum media density at saturation of growing media following test method **<<ASTM E2397/E2397M>>**.
2. Water Retention Capacity: Provide vegetated roof assembly with a water retention capacity of approximately 65-70% of water, value includes combined water retention capacities of growing media and drainage layers; growing media water retention is calculated using a difference between dry and saturated weight by following test method **<<ASTM E2399/E2399M>>**; drainage panel water retention capacity is calculated using test method **<<ASTM E2398/E2398M>>**.
3. Wind Resistance: Provide vegetated roof assembly that complies with dynamic wind uplift and wind flow resistance requirements of test method **<<CSA A123.24>>**.
4. Number of protective materials may be reduced provided equivalent protection and functionality is achieved, and approved by roof waterproofing system manufacturer.

B. Trays: Prevegetated, modular roof trays with manufacturer's standard growing media and other necessary components.

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1. Plants: Drought-resistant mix of selected plantings suitable for placement in trays with growing media. Plant grower shall select plant types and species that are native species or are specifically suited for climate at project location.
2. Size: Provide manufacturer's standard size trays.
3. Extensive System - Depth and Weight: 4.25 inches nominal soil depth, and weighing less than 30 lb/sq ft fully saturated.
    a. Extensive vegetated roof systems feature plants that can be sustained in shallow media layers with **<< 6 inches>>** or less of growing media, and typically utilize non-woody, drought-tolerant herbs, sedums and grasses.
4. Manufacturers:
    a. LiveRoof.
    b. Bioroof Systems, Inc.
    c. GreenGrid.
    d. Sika Roofing & Waterproofing.
5. Protection Layer: Provide membrane roofing manufacturer's recommended fabric or sacrificial membrane for location between trays and membrane roofing system.

2.02 ROOF PAVERS SYSTEMS

A. Pavers and Pedestals: Coordinate with Division 7 Section "Roof Pavers."

2.03 ACCESSORIES

A. Drain Inspection Box: Where roof-mounted drains are indicated, provide accessory product allowing access to drain; formed from stainless steel or powder-coated aluminum sheet with lockable lid, bottom flange, and perforated at the drainage course level
    1. Size: Not less than 12 inches square, and matching depth of vegetated roof assembly.

B. Edge Treatment: Provide dividers and edge elements to separate vegetated portion of roof from other areas as indicated on drawings.
    1. Aluminum: Natural anodized; manufacturer's standard profiles and sizes.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that roofing membrane work is complete.

B. Verify that surface of roofing membrane is ready to accept vegetated roofing components.

C. Verify that roof slope of vegetated roofing substrate is at least 2 percent.

D. Inspections and Testing Prior to Installation of Vegetated Roof Components:
    1. Verify that installed roof waterproofing system has been inspected by manufacturer's representative.
    2. Verify that installed roof waterproofing system has been tested by controlled flooding, electronic testing or other leak detection method approved by manufacturer.
    3. Provide documentation that roof waterproofing system installation has been approved by manufacturer and passed specified testing.

3.02 PREPARATION

A. Clean roof waterproofing system surfaces of ponded water, snow, ice, dirt, debris, and foreign materials.

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3.03 INSTALLATION, GENERAL

A. Dry surfaces thoroughly before vegetated roofing work begins.

B. Protect roof waterproofing system as necessary to prevent damage during installation of vegetated roofing system.

C. Provide temporary ballast in partially completed sections of vegetated roofing system to protect overburden from wind effects during installation; ensure ballast has no sharp edges, protrusions, chemical contaminants, or other compositions that could damage roof waterproofing system.

3.04 INSTALLATION - MODULAR ROOF TRAYS

A. Unroll protection fabric directly over membrane and provide minimum 2 inches side and end overlap.

B. Extend fabric up vertical surfaces, such as walls, curbs, and parapets, to height at top of growing media layer.

C. Under windy conditions, provide temporary ballast.

D. Install modular roof trays as recommended by tray manufacturer.

1. Place trays on protection layer as indicated in approved shop drawings, do not drag trays into position, and ensure that trays with interlocking or overlapping edges are fully engaged with adjacent trays.
2. After installation of water trays, comply with manufacturer standards for amount of water, rate of application and degree of saturation, and do not wash growing media out of trays by excessive watering.
3. Do not install trays over ponded water, saturated roof surfaces or under freezing conditions.
4. Fasten trays to each other in accordance with manufacturer's published or written recommendations, using approved fasteners at the manufacturer's on center spacing indicated.

E. Install vegetated roof accessories and apply edge treatment as indicated in approved shop drawings.

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3.05 FIELD QUALITY CONTROL

A. Roof Membrane Manufacturer's Inspection: Coordinate with Division 7 roof membrane manufacturer to provide inspection at the start of installation to ensure overburden requirements are met; including proper installation of protection fabric layer.

3.06 CLEANING

A. See Section **<< 017000 - Execution and Closeout Requirements>>** for additional requirements.

B. In areas where finished surfaces are soiled by work of this section, consult manufacturers of surfaces for cleaning advice and comply with their**<< documented; _____; or None - N/A>>** instructions.

C. Repair or replace defaced or damaged finishes caused by work of this section.

3.07 PROTECTION

A. Protect installed vegetated roof system from construction traffic and subsequent construction operations.

B. Provide substantial barricades or other barriers where necessary to prevent traffic across vegetation.

3.08 MAINTENANCE

A. Initial Maintenance: Maintain plants within vegetated roofing system for two years commencing on Date of Substantial Completion.

B. Provide a separate maintenance contract proposal for extended maintenance service beyond the two-year initial period.

END OF SECTION 075563

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SECTION 076200
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

C. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

E. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction.

F. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.

G. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement.

H. SMACNA (ASMM) - Architectural Sheet Metal Manual.

1.02 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used including technical material properties.
   1. Include installation instructions and manufacturer's recommendations for installation and maintenance.
   2. Include ANSI/SPRI/FM 4435/ES-1 wind pull-off performance data for systems that will be used in edge metal conditions.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

C. Selection Samples: Provide manufacturer's color charts for each product and material requiring color selection.

D. Verification Samples: Submit physical samples, manufacturer's standard size, for each selected color.

1.03 QUALITY ASSURANCE

A. Perform work in accordance with **<< SMACNA (ASMM); CDA A4050; and _____>>** requirements**<< and standard details; _____; or None - N/A>>**, except as otherwise indicated.

B. Fabricator and Installer Qualifications: Company specializing in sheet metal work, with experience in projects of size and scope similar to this Project.

1.04 MOCK-UP

A. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

B. Integrated Exterior Mockup: Attend preinstallation conference and provide metal flashing/trim work for integrated exterior mockup as indicated on Drawings and as specified in Division 1 Section "Quality Requirements."

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1.05 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

A. Pre-Finished Galvanized Steel: **<<ASTM A653/A653M>>**, with **<< G90/Z275; or ____>>** zinc coating; minimum 24 gauge (0.028-inch) thick base metal, shop pre-coated with **<< modified silicone; PVDF; or _____>>** coating.

1. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, **<<AAMA 2605>>**; multiple coat, thermally cured fluoropolymer finish system.
2. Color: To be selected by **<<Architect>>** from Manufacturer's **<< full; or standard>>** range.

B. Pre-Finished Aluminum: **<<ASTM B209/B209M>>**; **<< 18 gauge, 0.040 inch; 20 gauge, 0.032 inch; or ___ gauge, ___ inch>>** thick; **<< plain; embossed; or _____>>** finish shop pre-coated with **<< silicone modified polyester; acrylic polyester; fluoropolymer; PVDF; FEVE; or _____>>** coating.

1. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, **<<AAMA 2605>>**; pretreated metal with **<< two-coat system including primer and color coat; three-coat system including primer, color coat, and clear top coat; or _____>>** with at least 70 percent PVDF coating.
2. Color: To be selected by **<<Architect>>** from Manufacturer's **<< full; or standard>>** range.

C. Stainless Steel: **<<ASTM A666/A666M>>**, Type **<< 304; or ____>>** alloy, soft temper, 24 gauge (0.025-inch)**<< 28 gauge, 0.0156 inch; 26 gauge, ___ inch; or None - N/A>>** thick; **<< smooth; or _____ patterned>><< No. 4 - Brushed; or No. 2D>>** finish.

D. Copper: **<<ASTM B370>>**, cold rolled **<< 16 oz/sq ft, 24 gauge, 0.0216 inch; 20 oz/sq ft, 22 gauge, 0.027 inch; or ___ oz/sq ft, ___ gauge, ___ inch>>** thick; **<< natural; lacquered; or _____>>** finish.

2.02 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces **<< in longest possible lengths; in single length sheets; or _____>>**.

C. Hem exposed edges on underside **<< 1/2 inch; or ____ inch>>**; miter and seam corners.

D. Form material with **<< standing; batten; flat lock; or _____>>** seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Tin edges of copper sheet to be soldered; solder shop formed metal joints, and after soldering, remove flux, wipe and wash solder joints clean; provide weathertight joints.

F. Fabricate corners from one piece with minimum **<< 18-inch; or ____-inch>>** long legs; **<< seam; solder; or _____>>** for rigidity, seal with sealant.

1. Hem exterior corners of flashings and drip edges, in a manner that eliminates sharp, exposed cut metal edges, at locations below 6'-0" above grade (locations within reach range of building occupants).

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G. Fabricate vertical faces with bottom edge formed outward **<< 1/4 inch; or ____ inch>>** and hemmed to form drip.

2.03 GUTTERS AND DOWNSPOUTS

A. General: Provide minimum 0.040-inch aluminum extrusions for gutters and minimum **<< 0.032-inch; or 0.080-inch>>** aluminum for downspouts. Finish all parts of gutter/downspout system a single color to match, including brackets, elbows and bends, and exposed fastener heads.

B. Gutters: **<< SMACNA (ASMM) Rectangular profile; SMACNA (ASMM) Square profile; SMACNA (ASMM) Semi-circular profile; ____ Rectangular profile; ____ Square profile; ____ Semi-circular profile; Profile as indicated; or SMACNA Ogee profile (Style K)>>**; unless otherwise indicated.

C. Downspouts: **<< Rectangular profile; Square profile; Round profile; _____ profile; or Profile as indicated>>**; unless otherwise indicated.

D. Gutter and Downspout Sizing: Unless otherwise indicated, provide 4-inch deep by 5-inch wide downspouts, with gutter depth to accept 4-inch deep downspout.

E. Conductor Heads: Fabricate in accordance with **<<SMACNA (ASMM)>>** standards, Figure 1-25F box-type conductor head, or standard design of fabricator where approved by Architect. Conductor heads shall be fabricated of minimum 0.032-inch aluminum. Finish to match gutter and downspout finish.

F. Scuppers: Fabricate scuppers in accordance with **<<SMACNA (ASMM)>>** standards; scupper shall outlet directly into conductor head per Figure 1-27A. Fabricate of minimum 16 oz copper or 26 gauge (0.01875 inch) stainless steel where scupper penetrates masonry. Provide manufacturer's recommended separation barrier between dissimilar metals of scupper and conductor head fabrications.

G. Accessories: Profiled to suit gutters and downspouts. Provide additional elbows, bends, extended bracket depths, and other accessories as required for downspouts to avoid conflict with cladding profiles, masonry or precast extrusions, and other surface ornamentation on wall.

1. Anchorage Devices: **<< In accordance with SMACNA (ASMM) requirements; Type recommended by fabricator; or _____>>**.
2. Gutter Supports: **<< Brackets; Straps; Spikes and ferrules; or _____>>** and spacer bars (SMACNA figure 1-17), spaced no more than 24 inches on center.
3. Downspout Supports: **<< Brackets; Straps; or _____>>**; spaced no more than 60 inches on center.
4. Downspout Strainers: Provide ball-type mesh strainer at each downspout; pre-fabricated, non-corrosive construction compatible with gutter/downspout material.

H. Splash Blocks: Precast concrete type, of **<< size; sizes; or _____>>** and profiles indicated; minimum **<< 3000 psi; or _____ psi>>** at 28 days, with minimum 5 percent air entrainment. Lightweight "patio" blocks are not acceptable.

1. Provide a splash block at all conditions where downspout is not indicated to connect to downspout boot, and at conditions where downspout empties onto lower roof.

I. Downspout **<< Boots; Shoes; or _____>>**: **<< Steel; Cast iron; Plastic; or _____>>**, inlet sized to match downspout; outlet sized for underground drainage piping. Coordinate with Plumbing Drawings and Division 22.

J. Seal metal joints.

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2.04 ACCESSORIES

A. Fasteners: **<< Galvanized steel; Aluminum; Stainless steel; Copper; Same material and finish as flashing metal; or _____>><< , with soft neoprene washers; , _____; or None - N/A>>**.

B. Primer Type: **<< Zinc chromate; Galvanized iron; Iron oxide linseed oil; or _____>>**.

C. Concealed Sealants: Non-curing butyl sealant.

D. Exposed Sealants: **<<ASTM C920>>**; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; **<< black; white; translucent; color to match adjacent material; color as selected by Architect; or _____>>**.

E. Asphalt Roof Cement: **<<ASTM D4586/D4586M>>**, Type I, asbestos-free.

F. Reglets and Counterflashings (Masonry): Embedded type, **<< copper; or stainless steel>>**. Coordinate with Division 4 Section "Unit Masonry."

1. Existing Brick: Saw cut joint in brick joints to uniform 3/4-inch depth. Insert preformed metal receiver/reglet piece to full depth of saw cut and secure it with lead wedges at 12-inches o.c. Place continuous backer rod and elastomeric sealant in cut joint reglet. Insert the separate counterflashing piece into reglet so that bottom of flashing makes permanent spring clamping contact with base flashing.

G. Reglets and Counterflashings (Non-Masonry): **<< Surface mounted; Recessed; or _____>>** two-piece reglet and counterflashing, or one-piece counterflashing, fabricated of pre-finished aluminum or **<< galvanized steel; rigid extruded PVC; or _____>>**.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Install surface mounted reglets and one-piece counterflashings true to lines and levels, and seal tops with sealant.

C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of **<< 15 mil, 0.015 inch; or ___ mil, ___ inch>>**.

3.03 INSTALLATION

A. Comply with SMACNA installation instructions and drawing details.

B. For reglets installed into masonry veneer, furnish reglets to mason for installation as Division 4 Unit Masonry work progresses.

C. Insert flashings into reglets to form tight fit; secure in place with wedges**<< ; pack remaining spaces with lead wool; ; _____; or None - N/A>>**; seal flashings into reglets with sealant.

D. Apply plastic cement compound between metal flashings and felt flashings.

E. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

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F. Seal metal joints watertight.

G. Secure gutters and downspouts in place with concealed fasteners.

H. Slope gutters 1/4 inch per 10 feet, minimum.

I. Connect downspouts to **<< downspout boots; downspout shoes; storm sewer system; or _____>>**, and **<< grout; seal; or _____>>** connection watertight.

J. At low roof conditions, and where not indicated to connect to downspout boots, provide a bottom elbow and set splash **<< pans; pads; or blocks>>** under **<< downspouts; roof and canopy drain outlets; roof and canopy overflow outlets; and _____>><< , and set in place with _____; or None - N/A>>**.

END OF SECTION 076200

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SECTION 077100
ROOF SPECIALTIES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).

B. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems.

C. NRCA (RM) - The NRCA Roofing Manual.

D. SMACNA (ASMM) - Architectural Sheet Metal Manual.

1.02 SUBMITTALS

A. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.

1. Include test data/confirmation that copings and edge metals conform to ANSI/SPRI/FM 4435/ES-1 performance requirements.

B. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.

C. Samples for Selection: Provide manufacturer's color charts for each product and material requiring color selection.

D. Samples for Verification: Submit physical samples, manufacturer's standard size, for each selected color.

1.03 MOCK-UP ******INCLUDE IF DOING FULL MOCKUP WITH ROOF COMPONENTS******

A. Integrated Exterior Mockup: Attend preinstallation conference and provide roof specialty work for integrated exterior mockup as indicated on Drawings and as specified in Division 1 Section "Quality Requirements."

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PART 2 PRODUCTS

2.01 ROOF EDGE METALS

A. Roof Edge Metals, General: Factory fabricated to sizes required; corners ; concealed fasteners.

1. Pull-Off Resistance: Tested in accordance with **<<ANSI/SPRI/FM 4435/ES-1>>** using test methods RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable version of Maryland Building Code.
2. Manufacturers: Provide private-labeled products by one of the roofing manufacturers listed in Division 7 roofing section(s) as required to meet requirements and comply with terms of manufacturer's total system warranty.
3. Factory Fabrication: Edge metals and copings shall be factory pre-fabricated; field-fabricated brake-metal assemblies are not acceptable.

B. Copings (Cavity Walls): Fabricate to minimum 8 foot long sections, but not exceeding 10 feet long; all corners mitered. Seal and solder or weld watertight.

1. Roofing Manufacturer Approval: Primary roofing manufacturer shall provide written approval of coping in writing, including confirmation that the fabricated copings maintain the terms of manufacturer's warranty.
2. Configuration: Provide double-lock standing seam coping profile in accordance with **<<SMACNA (ASMM)>>**, Figure 3-4A.
    a. Provide concealed continuous hold-down cleats at exterior leg. Drill elongated holes for gasketed fasteners on interior leg.
    b. Provide internal splice piece at cleat joints fabricated of same material, thickness, and finish as cap; concealed stainless steel fasteners.
    c. Size copings to allow for cavity ventilation; do not block top of cavity with continuous nailers, and do not seal between coping and front veneer.
3. Pull-Off Resistance: Coping profile shall be tested in accordance with **<<ANSI/SPRI/FM 4435/ES-1>>** using test method RE-3 to positive and negative design wind pressure, as defined by applicable version of Maryland Building Code.
4. Wall Width: As indicated on Drawings.
5. Outside Face Height: 6 inches, unless otherwise indicated.
6. Inside Face Height: 4 inches, unless otherwise indicated.
7. Material: Formed aluminum sheet, 0.050-inch thick, minimum, for wall thickness up to 15 inches. Provide minimum 0.063-inch thick where total wall thickness is over 15 inches.
8. Finish: AAMA 2605, 70 percent polyvinylidene fluoride (PVDF).
    a. Color: To be selected by Owner and Architect from Manufacturer's full range.

C. Drip Edge/Gravel Stop: Factory fabricated to sizes required; all corners mitered; concealed fasteners.
1. Configuration: Concealed hold down cleats; internal splice piece at joints of same material, thickness, and finish as cap; concealed stainless steel fasteners.
    a. Provide drip edge at bottom eave edges where water will drain off roof. Unless otherwise detailed, provide gravel stop at sides and top edge of sloped roofs not subject to water runoff.
2. Pull-Off Resistance: Tested in accordance with **<<ANSI/SPRI/FM 4435/ES-1>>** using test method RE-2 to positive and negative design wind pressure as defined by applicable version of Maryland Building Code.
3. Wall Width: As indicated on Drawings.
4. Outside Face Height: 6 inches, unless otherwise indicated.
5. Material: Formed aluminum sheet, 0.040-inch thick, minimum.
6. Finish: AAMA 2605, 70 percent polyvinylidene fluoride (PVDF).
7. Color: To be selected by Owner and Architect from Manufacturer's full range.
8. Products: Provide roofing manufacturer's private labeled product to maintain terms of manufacturer's total system warranty; provide one of the following or comparable:
    a. Carlisle; SecurEdge Drip Edge and Gravel Stop.
    b. Elevate; Elevate Drip Edge and Gravel Stop.
    c. GAF; EverGuard Drip Edge and Gravel Stop.
    d. Johns Manville; Johns Manville Drip Edge and Gravel Stop.

2.02 ROOF PENETRATION SYSTEMS

A. General: Provide roof penetration systems manufactured by or approved by primary roofing manufacturer for compatibility with roofing products and to maintain conditions of manufacturer's warranty.

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B. Roof Penetration Sealing Systems: Provide premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.

C. Multiple Penetration/Pipe Housing: Where multiple penetrations are required in close proximity, provide pipe chase housing fabricated of structural aluminum or galvanized steel curb, pre-finished aluminum chase housing with removable top cover, and individual gasketed pipe seals which exit the side walls of the housing. Size housing and provide number and size of pipe seals as required for each application.
   1. Manufacturers:
      a. Alta Products, LLC; Sigrist Pipe Chase Housing.
      b. Roof Penetration Housings, LLC; the Vault.

2.03 ELASTIC ROOF EXPANSION JOINTS

A. Elastic Expansion Joints (Bellows-Type): Pre-fabricated joint assembly, consisting of a elastomeric flashing forming the primary joint membrane in a “bellows” shape, with 16 oz. copper flanges on each side; custom size and profile to suit project conditions indicated. Provide with manufacturer’s standard polymeric moisture barrier and insulation on underside of expansion joint as indicated. Provide complete assembly with splicing and accessory materials as required.
   1. Elastic-type expansion joint shall be approved by roofing manufacturer for compliance with roofing products and to maintain conditions of manufacturer’s warranty.
   2. Curb Flange Type: Metal L-shaped flange on each side of bellows, formed to curb size indicated.
   3. Wall-to-Curb Type: Metal flanged edges; 4-inch flat flange at vertical wall condition and L-shaped flange at curb side of bellows, formed to curb size indicated.

2.04 FINISHES

A. Metal surfaces shall be prepared, pre-treated, and coated in accordance with coating and resin manufacturer's instructions.

B. Superior Performing Organic Coatings System: Manufacturer's standard multi-coat superior performing organic coatings system complying with **<<AAMA 2605>>**, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of **<< 1.2 mils, 0.0012 inch>>**.

2.05 ACCESSORIES

A. Sealant for Joints in Linear Components: As recommended by component manufacturer.

B. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.
   1. Provide stainless steel fasteners for all exterior construction and for fastening aluminum and stainless steel fabrications.

C. Adhesive for Anchoring to Roof Membrane: Compatible with roof membrane and approved by roof membrane manufacturer.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions and applicable reqiurements of **<<NRCA (RM)>>**. Sheet metal components shall be fabricated in accordance with **<<SMACNA (ASMM)>>**.

B. Install components weathertight; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

C. Seal joints within components when required by component manufacturer.

D. Anchor components securely.

E. Coordinate installation of components of this section with installation of roofing membrane and base flashings.

F. Coping Installation: Install coping cleats and chair with concealed fasteners. Anchor as required to meet ANSI/SPRI performance requirements and manufacturer's instructions, but at spacing of no greater than 36 inches on center.

G. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.

END OF SECTION 077100

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SECTION 077200
ROOF ACCESSORIES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. UL (DIR) - Online Certifications Directory.

1.02 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Maintenance requirements.
   5. For smoke and heat vents, submit evidence of approval by evaluation agency specified.

B. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store products under cover and elevated above grade.

PART 2 PRODUCTS

2.01 ROOF CURBS

A. General: Coordinate with Division 22, 23, and 26 for roof curbs and equipment supports specified with specific pieces of equipment.

B. Roof Curbs Manufacturers:
   1. AES Industries Inc.
   2. Curbs Plus, Inc.
   3. The Pate Company.
   4. LMCurbs.
   5. Roof Products & Systems (RPS).
   6. Thybar Corporation.

C. Roof Curbs Mounting Assemblies: Factory fabricated hollow sheet metal construction, internally reinforced, and capable of supporting superimposed live and dead loads and designated equipment load with fully mitered and sealed corner joints welded or mechanically fastened, and integral counterflashing with top and edges formed to shed water.
   1. Roof Curb Mounting Substrate: Curb substrate consists of **<< standing seam metal roof panel system; concealed fastener metal roof panel system; exposed fastener metal roof panel system; corrugated metal roof deck with insulation; flat roof deck sheathing with insulation; or _____>>**.
   2. Sheet Metal Material: Galvanized (zinc-coated) or galvalume (aluminum-zinc alloy) steel sheet; minimum 18 gauge (0.052-inch) thick; mill finish.

D. Equipment Rail Curbs: Straight curbs on each side of equipment, with top of curbs horizontal and level with each other for equipment mounting.

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1. Provide preservative treated wood nailers along top of rails.
2. Height Above Finished Roof Surface: 8 inches, minimum.

E. Pipe, Duct, or Conduit Mounting Curbs: Vertical posts, minimum **<< 8 inches; or ___ inches>>** square unless otherwise indicated.
1. Height Above Finished Roof Surface: 8 inches, minimum.

2.02 ROOF HATCHES AND VENTS

A. Roof Hatch Manufacturers:
1. Bilco Company; Model **<< S-50TB; E-50TB; F-50TB; NB-50TB; or L-50TB>>**. ******Bilco models cover in order: 36x30, 36x36, 48x48, 30x54, and 30x96. Coordinate with size options below******
2. Milcor, Inc; Thermal Pro TP-1.
3. Nystrom, Inc; ThermalMAX RHTA.

B. Roof Hatches: Factory-assembled aluminum frame and cover, complete with operating and release hardware.
1. Mounting Substrate: Provide frames and curbs suitable for mounting on low slope roof deck.
a. Coordinate with roof insulation height, including tapered insulation design as indicated, to provide a minimum 8 inch curb height above the highest adjacent point of roof membrane.
2. Thermally Broken Hatches: Provide manufacturer's standard insulation and thermally-broken frame and cover.
3. For Ladder Access: Single leaf; 30 by 36 inches.
4. For Ladder Access: Single leaf, 36 by 36 inches.
5. For Ladder Access: Single leaf; 48 by 48 inches.
6. For Ships Ladder Access: Single leaf; 30 by 54 inches.
7. For Stair Access: Single leaf; 30 by 96 inches.
8. Operation and Hardware: Provide with manufacturer's standard gas springs with assisted lift and automatic hold open arm. Provide interior and exterior turn handles and interior padlock hasp (padlock NIC).

C. Frames and Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
1. Material: Mill finished aluminum, **<< 11 gauge, 0.0907 inch; or ___ gauge, _____ inch>>** thick.
2. Insulation: Manufacturer's standard; **<< 1 inch; 2 inches; 3 inch; or ___ inch>>** rigid **<< glass fiber; wood fiber board; polyisocyanurate; or ____>>**, located on **<< outside face of curb; inside hollow curb; or _____>>**.
3. Curb Height: Minimum 8 inches above finished surface of roof.

D. Metal Covers: Flush, insulated, hollow metal construction.
1. Capable of supporting **<< 40 psf; or __ psf>>** live load.
2. Material: Mill finished aluminum; outer cover **<< 11 gauge, 0.0907 inch; or ___ gauge, _____ inch>>** thick, liner **<< 0.04 inch; or ___ inch>>** thick.
3. Insulation: Manufacturer's standard **<< 1 inch; 2 inches; 3 inch; or ___ inches>>** rigid **<< glass fiber; fiberboard; polyisocyanurate; or ____>>**.
4. Gasket: **<< Neoprene; EPDM; Santoprene; or _____>>**, continuous around cover perimeter.

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E. Safety Railing System: Roof hatch manufacturer's standard accessory safety rail system mounted directly to curb. Do not install safety railing to roof assembly.
   1. Posts and Rails: **<< Fiberglass reinforced polymer tubing; Aluminum tubing; Steel tubing; Galvanized steel tubing; or Manufacturer's standard galvanized steel, aluminum pipe, or fiberglass pipe; pre-finished in safety yellow color>>**.
   2. Products:
      a. BILCO Company; Bil-Guard 2.0.
      b. Milcor, Inc.; SAF-T-RAIL.
      c. Nystrom, Inc.; Roof Hatch Safety Railing SRC.

2.03 SMOKE AND HEAT VENTS

A. Smoke and Heat Vent Manufacturers:
   1. BILCO Company; Type ACDSV - Automatic Smoke Vent.
   2. Milcor, Inc; Model U-LP; custom size.
   3. Nystrom, Inc; Double Door AcousticMAX; Model SVX.

B. Smoke and Heat Vents: Factory-assembled galvanized steel frame and cover, complete with operating and release hardware. Heat and smoke vents shall be UL 793 listed.
   1. Mounting Substrate: Provide frames and curbs suitable for mounting on flat or low-slope roof deck sheathing with insulation.
      a. Coordinate with roof insulation height, including tapered insulation design as indicated, to provide a minimum 8 inch curb height above the highest adjacent point of roof membrane.
   2. Sound Rated Hatches: Two sets of double leaf doors with air space between upper and lower doors; upper doors to open upward, lower doors to open downward; minimum Sound Transmission Coefficient (STC) of 48.
   3. Thermally Broken Hatches: Provide manufacturer's standard insulation and thermally-broken frame and cover.
   4. Size: **<< 48 inches by 120 inches>>** nominal. ***Verify size with project specific requirements and with manufacturers' standard options***
   5. Operation and Hardware: Provide with manufacturer's standard gas springs with assisted lift and automatic hold open arm. Provide interior and exterior pull release cables.
      a. Interior emergency release cable shall be run horizontally along roof deck and then down the wall to allow access from floor level. Provide signage indicating "Smoke Vent - Emergency Manual Release".
   6. Vent Operation: Provide both of the following operation features.
      a. Smoke Alarm Connection: Provide 24 VDC electric solenoid release device and coordinate smoke detector interconnections so that vents will automatically operate upon activation of smoke alarm system.
      b. Electro-Thermal Release Mechanism: Automatic opening on melting of replaceable **<<UL (DIR)>>** listed fusible link at 165 degrees F.

2.04 NON-PENETRATING ROOFTOP RAILING ASSEMBLIES

A. Refer to Division 5 Section "Metal Fabrications" for non-penetrating rooftop railings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

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B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

B. Roof Curbs and Equipment Supports: Install in lengths and in a manner such that curbs and equipment supports span multiple structural framing members, with adequate blocking and supports to distribute the equipment loads over metal decking and structural members without crushing.

3.04 CLEANING

A. Clean installed work to like-new condition.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 077200

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SECTION 077600
ROOF PAVERS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

B. ASTM C936/C936M - Standard Specification for Solid Concrete Interlocking Paving Units.

C. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene two weeks minimum before starting work of this section.
   1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.03 SUBMITTALS

A. Product Data: Provide data indicating paver and pedestal materials.

B. Shop Drawings: Submit shop drawings that indicate paver and pedestal layout, including overall plan and detail drawings of system components.

C. Sustainable Design Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

D. Samples of Pavers: Submit two samples for each type, color and texture indicated.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Installer's qualification statement.

1.04 CLOSEOUT SUBMITTALS

A. Warranty Documentation:
   1. Submit manufacturer warranty and ensure that forms have been completed in **<<Owner>>**'s name and registered with manufacturer.
   2. Submit documentation from installer that installation complies with warranty conditions for roof paver system.

B. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project:
   1. Provide two of manufacturer's special tool for use in lifting roofpavers.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with documented experience working on roof paver and pedestal systems of the type specified; references shall be made available upon request.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact.

B. Store materials at least **<< 4 inches>>** above ground in dry location, and covered with polyethylene sheet to protect from contact with materials that may cause staining or discoloration.

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1.07 FIELD CONDITIONS

A. Do not install roof paver components during cold or wet weather conditions.

1.08 WARRANTY

A. Manufacturer Warranty: Provide **<< 2-year; 10-year; or ____>>** manufacturer warranty to replace material that shows manufacturing defects. Complete forms in **<<Owner>>**'s name and register with manufacturer.

B. Installer Warranty: Provide **<< 2-year; 3-year; 5-year; or ____>>** warranty for defects of labor and/or workmanship commencing on the Date of Substantial Completion. Complete forms in **<<Owner>>**'s name and register with installer.

C. Roofing Warranty: Coordinate with primary roofing membrane manufacturer; provide written approval for installation of paver and pedestal system. Comply with any special requirements of roofing manufacturer in order to maintain the terms of roofing warranty.

PART 2 PRODUCTS

2.01 ROOF PAVERS

A. Roofing System: Refer to other Division 7 sections for information on roofing system where pavers are being installed.

B. Precast Concrete Roof Pavers: Precast concrete tiles, with texture and color as indicated; supported by adjustable pedestal system.

1. Comply with local wind load resistance requirements of **<<ASCE 7>>** and requirements on Structural Drawings.
2. Texture and Color: To be selected by Owner and Architect from Manufacturer's full range.
3. Length and Width: 24 inches by 24 inches, nominal. ***Verify size with manufacturers; 24 x 24 is standard***
4. Thickness: 1-3/4 to 2 inches, nominal.
5. Compressive Strength: <**<ASTM C936/C936M>>**, not less than 7,000 psi.
6. Absorption: **<<ASTM C936/C936M>>**, not greater than 5 percent.
7. Weight: 25 lbs per square foot, maximum.
8. Products:
   a. Belgard Commercial; Classic Plaza Slab.
   b. Hanover Architectural Products; Prest Pavers.
   c. Tile-Tech Pavers; Stamp-Tech Flat Design.
   d. Wausau Tile; H-Series Pavers.

2.02 PEDESTALS

A. Pedestals: High impact copolymer polypropylene components to level and adjust height of pavers by using a screw-jack base pedestal and modular couplers or PVC pipe; with minor height adjustments made by screw-adjustment or with stackable cap accessory.

1. Comply with local wind load resistance requirements of **<<ASCE 7>>**.
2. Self-Ignition Temperature: Provide plastic pedestal components with self-ignition temperature greater than 650 degrees in accordance with **<<ASTM D1929>>** test method.
3. Base Diameter: 6 inches nominal.
4. Roof Slope Correction: Zero to 8 percent, with use of base slope plates.

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5. Pedestal Height: Shall allow for at minimum a range of 2 inches to 21 inches, with use of modular screw-on couplers or 4-3/16 inch diameter SDR-35 PVC pipe, with maximum static load of 2,000 lb per pedestal in system.
    a. Provide additional reinforcing cross-bracing when pedestal heights exceed 16 inches, unless otherwise required by manufacturer.
6. Pedestal Spacing: Verify with manufacturer for paver size indicated; do not exceed manufacturer's maximum spacing.
7. Buffer Pad: Provide buffer pad component under each pedestal to provide protection to roof membrane.
8. Accessories: Provide pedestal manufacturer's standard accessories, including but not limited to spacer tabs, shims, perimeter edge restraint, flashings, and other components as indicated on Drawings and as required for a complete paver and pedestal assembly.
9. Products:
    a. Belgard; Screwjack Adjustable Pedestals.
    b. Hanover Architectural Products; Elevator Pedestal System.
    c. Tile Tech Inc; Pedestal System.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive this work.

B. Verify substrate is supported and secure.

C. Verify substrate is clean and smooth, dry and free of snow or ice, flat without depressions, waves or projections, properly sloped and suitable for installation of roof paver system.

D. Verify that roof openings, curbs, and penetrations through roof are solidly set.

E. Verify system elevations, required pedestal heights, and substrate dimensions.

3.02 PREPARATION

A. Use of pedestal system is for pedestrian traffic only and each side of deck system must be restrained containing decking panels with perimeter blocking or walls; movement of decking panels laterally is not permitted.

B. Membrane waterproofing and protection board surfaces used to support pedestals to be broom clean, free of frost, dirt, oil or any rough foreign matter that may impair substrate material manufacturer's warranty requirements.

C. Provide substrate for pedestals with slope and positive drainage in accordance with applicable building codes.

D. Substrate surface that will support paver and pedestal system must be structurally capable of carrying dead and live loads anticipated.

3.03 INSTALLATION

A. Perform work in accordance with manufacturer's written installation instructions and applicable requirements in coordination with project attributes, paver type being installed, pattern, grid layout, starting point, and finished elevation as indicated on approved shop drawings.

B. Install pavers on pedestals in accordance with manufacturer's instructions.
    1. Fully support edges; shim and adjust pavers to provide level surface.

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2. Provide approximately 1/8- to 1/4-inch space between pavers to permit surface water drainage.

3.04 FIELD QUALITY CONTROL

A. Inspect during installation to ensure that grid spacer lines are being maintained in a straight and consistent pattern and that deck roof pavers are level and not rocking.

B. Unless otherwise specified in writing to allow for expansion, inspect to ensure that spacing between pavers at perimeter walls does not exceed a tab width.

C. Inspect during installation to ensure that pedestrian entry or access points to roof paver areas are level and that pavers are not randomly raised or uneven creating a tripping or safety hazard.

D. Verify that deck pedestal heights in excess of 16 inches have been braced in accordance with manufacturers written installation instructions.

3.05 CLEANING

A. Remove markings from finished surfaces, or replace defaced components of roof pavers system if markings cannot be removed.

B. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.

C. Repair or replace defaced or damaged finishes caused by work of this section.

3.06 PROTECTION AND MAINTENANCE

A. Protect installed roof pavers from construction operations.

B. Where traffic must continue over finished roof pavers, protect surfaces using durable materials.

C. Periodically check pavers, including immediately prior to Substantial Completion, for rocking or settling; provide maintenance adjustments. Check spacer tabs and immediately replace broken tabs to limit deck movement.

3.07 DEMONSTRATION

A. Demonstration: Instruct Owner on procedures for routine maintenance of pavers, including checking for rocking pavers and performing minor adjustments, including use of special lifting tool.

END OF SECTION 077600

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SECTION 078100
APPLIED FIRE PROTECTION

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

C. ASTM E605/E605M - Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members.

D. ASTM E736/E736M - Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members.

E. ASTM E759/E759M - Standard Test Method for Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members.

F. ASTM E760/E760M - Standard Test Method for Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members.

G. ASTM E859/E859M - Standard Test Method for Air Erosion of Sprayed Fire-Resistive Materials (SFRMs) Applied to Structural Members.

H. ASTM E937/E937M - Standard Test Method for Corrosion of Steel by Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members.

I. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

J. AWCI Technical Manual 12-B - Standard Practice for the Testing and Inspection of Thin-Film Intumescent Fire-Resistive Materials; an Annotated Guide.

K. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

L. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.

M. SCAQMD 1113 - Architectural Coatings.

N. SCAQMD 1168 - Adhesive and Sealant Applications.

O. UL 263 - Standard for Fire Tests of Building Construction and Materials.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene two weeks minimum before starting work of this section.
   1. Review products to be installed, including density and bond strengths, unrestrained conditions, sequencing and schedule coordination, coordination with roofing work, surface conditions and preparation, environmental conditions, and quality-control testing and inspection.

B. Coordinate with placement of ceiling hanger tabs, mechanical component hangers, and electrical components.

C. Coordinate temporary enclosures to confine spraying operations and protect the environment and adjacent materials; and for protection of applied fire protection from environmental conditions and exposure to weather.

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D. Coordinate with roofing work; do not apply fireproofing until installation of roofing, rooftop units, and other associated work is completed.

E. Coordinate with subsequent construction operations; avoid unnecessary exposure of fire-resistive materials to abrasion and other damage likely to occur after application.

1.03 SUBMITTALS

A. Product Data: Provide data indicating product characteristics, performance criteria, and limitations of use.

B. Shop Drawings: Submit drawings that indicate extent of applied fire protection, for each type and rating.
   1. Include assembly designations by UL or other qualified test agency at each location.
   2. Include required thicknesses to achieve indicated ratings, at each location.

C. Sustainable Design Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

D. Manufacturer's Certificate: Certify that applied fireproofing products meet or exceed requirements of Contract Documents.

E. Test Reports: Reports from reputable independent testing agencies for proposed products, indicating compliance with specified criteria, conducted under conditions similar to those on project, as follows:
   1. Bond strength.
   2. Bond impact.
   3. Compressive strength.
   4. Fire tests using substrate materials similar those on project.

F. Field Quality Control Submittals: Submit field test report.

G. Manufacturer Reports: Indicate procedures followed, environmental conditions that applied fireproofing materials were installed, and supplementary instructions given.

H. Installer's Qualification Statement.

I. Warranty: Submit manufacturer warranty and ensure forms have been completed in **<<Owner>>**'s name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and certified in writing by fireproofing manufacturer.

1.05 FIELD CONDITIONS

A. Do not apply fireproofing when temperature of substrate material and surrounding air is below 40 degrees F or when temperature is predicted to be below said temperature for 24 hours after application.

B. Provide ventilation in areas to receive fireproofing during application and 24 hours afterward, to dry applied material.

C. Provide temporary enclosure to prevent spray from contaminating air.

D. Do not allow roof traffic during installation of fireproofing under roof deck, and during drying period.

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1.06 WARRANTY

A. Special Warranty - Installer: Installer shall submit warranty form agreeing to repair or replace applied fire protection that fails in materials or workmanship within the specified period.
   1. Installer's warranty shall cover cracking, spalling, flaking, peeling, or delamination of fire protection from substrates.
   2. Warranty shall not cover failure due to damage by occupants or Owner's personnel, exposure to environmental conditions outside those tested and approved, and other causes not reasonably foreseeable under conditions of normal use.
   3. Installer's Warranty Period: 2 years, from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. General Fireproofing Assembly Design:
   1. Fire-Resistance Designs: As indicated on Drawings; products specified in this section shall be certified fire-resistance designs and shall have been tested by a qualified testing agency in accordance with **<<ASTM E119>>** or **<<UL 263>>**. Provide applicable markings identifying testing agency on product containers/packaging.
   2. All design applications for this project are for unrestrained conditions unless explicitly stated otherwise in the contract documents for specific locations.
   3. Fire-resistance design thicknesses for open web steel joists shall be based on testing at a maximum allowable stress of 30 ksi matching SJI's "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Asbestos-Containing Material: All fire-resistive products and accessory products shall be certified by Contractor as containing no asbestos.

C. Low-Emitting Materials (Paints and Coatings): Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet applicable VOC limits of **<<CARB (SCM)>>** or **<<SCAQMD 1113>>**.

D. Low-Emitting Materials (Adhesives and Sealants): Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet the chemical content requirements of **<<SCAQMD 1168>>**.

2.02 MATERIALS

A. Applied Fire Protection Material for Concealed Interior Applications and Exposed Interior Applications that are Not Susceptible to Damage: Manufacturer's standard factory mixed material, which when combined with water is capable of providing indicated fire resistance, and complying with following requirements:
   1. Bond Strength: 330 pounds per square foot, minimum, when tested in laboratory in accordance with **<<ASTM E736/E736M>>**. Refer to Part 3 article "Field Quality Control" for field testing requirements.
   2. Dry Density: 15 lb/cu. ft., ("Standard" density) minimum, when tested in accordance with **<<ASTM E605/E605M>>**.
   3. Compressive Strength: 10 lbf/sq. in., minimum, when tested in accordance with **<<ASTM E761/E761M>>**.
   4. Effect of Impact on Bonding: No cracking, spalling or delamination, when tested in accordance with **<<ASTM E760/E760M>>**.

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5. Corrosivity: No evidence of corrosion, when tested in accordance with **<<ASTM E937/E937M>>**.
6. Air Erosion Resistance: Weight loss of 0.025 g/sq. ft., maximum, when tested in accordance with **<<ASTM E859/E859M>>** after 24 hours.
7. Surface Burning Characteristics: Maximum flame spread index of 0 (zero) and maximum smoke developed index of 0 (zero), when tested in accordance with **<<ASTM E84>>**.
8. Effect of Deflection: No cracking, spalling, or delamination, when tested in accordance with **<<ASTM E759/E759M>>**.
9. Fungal Resistance: No growth after 28 days when tested according to **<<ASTM G21>>**.
10. Manufacturers:
    a. GCP Applied Technologies; Monokote MK-6.
    b. Isolatek International; Cafco 300.
        1) Cafco Blaze-Shield II is acceptable for concealed locations only.
    c. Southwest Fireproofing Products Co.; Type 5GP.

2.03 ACCESSORIES

A. Primer Coating: Of type recommended by applied fire protection manufacturer.

B. Topcoat: At exposed applications, provide decorative tintable topcoat; of type approved in writing by primary fireproofing manufacturer. Topcoat color shall be selected by Architect from manufacturer's full range.

C. Water: Clean, potable.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive fireproofing. Repair existing fireproofing using same method as original installation or trowel installation techniques recommended by manufacturer.

B. Verify that clips, hangers, supports, sleeves, and other items required to penetrate fireproofing are in place.

C. Verify that ducts, piping, equipment, or other items that would interfere with application of fireproofing have not been installed.

D. Verify that voids and cracks in substrate have been filled.

E. Verify that projections have been removed where fireproofing will be exposed to view as a finish material.

3.02 PREPARATION

A. Perform tests as recommended by fireproofing manufacturer in applications where adhesion of fireproofing to substrate is in question.

B. Remove incompatible materials that could effect bond by scraping, brushing, scrubbing, or sandblasting.

C. Prepare substrates to receive fireproofing in strict accordance with instructions of fireproofing manufacturer.

D. Protect surfaces not scheduled for fireproofing and equipment from damage by overspray, fall-out, and dusting.

E. Close off and seal duct work in areas where fireproofing is being applied.

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3.03 APPLICATION

A. When required by manufacturer, apply primer coating in accordance with manufacturer's instructions.

B. Apply fireproofing in uniform thickness and density as necessary to achieve required ratings.

C. Where a protected steel member connects to another protected steel member with a greater thickness of applied fire-resistant material, provide applied fireproofing equal to the greater thickness on all members for a minimum distance of 18 inches from the point of attachment.

D. Where unprotected steel elements connect to protected steel members, the unprotected elements shall be coated with the same thickness of material applied to the protected members for a minimum distance of 18 inches from the point of attachment. Unprotected elements that shall be coated include structural steel members that do not otherwise require protection and also include any non-structural elements that connect to protected members, including CFSF members, clips, hangers, support sleeves, and similar items.

E. In concealed locations, provide manufacturer's standard spray-textured finish with no further treatment.

F. In exposed locations, provide skip-trowel finish for a smooth smooth texture and neat edges, using tools and procedures recommended by fireproofing manufacturer.

3.04 FIELD QUALITY CONTROL

A. Owner shall hire third-party special inspector to perform special inspections of installed fireproofing, and inspector shall submit field reports to Contractor and Architect.

1. Testing: All spray-applied fireproofing shall be tested after installation according to **<<ASTM E605/E605M>>** and **<<ASTM E736/E736M>>**, latest editions. Mastics shall be tested in accordance with **<<AWCI Technical Manual 12-B>>**.
    a. Standard Density SFRM: Minimum bond strength shall be 200 psf when field tested per **<<ASTM E736/E736M>>**.

B. Provide on-site inspection by applied fireproofing manufacturer's technical representative at least three times (substrate examination, in-progress, and warranty inspection) during installation of this work.

C. Repair or replace applied fireproofing at testing locations, and at locations where test results indicate fireproofing does not meet specified requirements.

D. Contractor shall be responsible for subsequent re-inspection of fireproofing, and shall provide periodic inspection for integrity of fire protection after installation of subsequent Work.

3.05 CLEANING

A. Remove excess material, overspray, droppings, and debris.

B. Remove fireproofing from materials and surfaces not required to be fireproofed.

C. At exposed fireproofing, clean surfaces that have become soiled or stained, using manufacturer's recommended procedures.

END OF SECTION 078100

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SECTION 078123
INTUMESCENT FIRE PROTECTION

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency.

B. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness.

C. ASTM D2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).

D. ASTM D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.

E. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

G. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

H. AWCI Technical Manual 12-B - Standard Practice for the Testing and Inspection of Thin-Film Intumescent Fire-Resistive Materials; an Annotated Guide.

I. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

J. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.

K. FM (AG) - FM Approval Guide.

L. SCAQMD 1113 - Architectural Coatings.

M. SCAQMD 1168 - Adhesive and Sealant Applications.

N. UL (FRD) - Fire Resistance Directory.

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1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene two weeks minimum before starting work of this section.
   1. Review products to be installed, including density and bond strengths, application thicknesses, sequencing and schedule coordination, surface conditions and preparation, environmental conditions, and quality-control testing and inspection.

1.03 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Performance characteristics and test results.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements and recommendations.
   4. Installation methods.

B. Sustainable Design Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

C. Selection Samples: For decorative top coat, color chips representing manufacturer's full range of available colors and sheens.

D. Verification Samples: For each thickness, color, sheen, and finish required, submit samples not less than 4 inches square on designated substrate illustrating finished appearance.

E. Certificates: Certify that intumescent fireproofing provided for this project meets or exceeds specified requirements in all respects.

F. Test Reports: Published fire resistive designs for structural elements of the types required for the project, indicating hourly ratings of each assembly.

G. Installer's qualification statement.

H. Warranty: Submit manufacturer warranty and ensure forms have been completed in **<<Owner>>**'s name and registered with manufacturer

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and certified in writing by manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened containers with identification labels and testing agency markings intact and legible.

B. Store products in manufacturer's unopened packaging until ready for installation.
   1. Store at temperatures not less than 50 degrees F in dry, protected area.
   2. Protect from freezing, and do not store in direct sunlight.
   3. Dispose of any materials that have come into contact with contaminants of any kind prior to application.

C. Dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.06 FIELD CONDITIONS

A. Protect areas of application from windblown dust and rain.

B. Maintain ambient field conditions, such as temperature, humidity, and ventilation, within limits recommended by manufacturer for optimum results. Do not install products under ambient conditions outside manufacturer's absolute limits.
   1. Provide temporary enclosures as required to control ambient conditions.
   2. Do not apply intumescent fireproofing when ambient temperatures are below 50 degrees F without specific approval from manufacturer.
   3. Ensure that relative humidity is between 40 and 60 percent in areas of application.
   4. Provide ventilation in enclosed spaces during application and for not less than 72 hours afterward.

1.07 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Correct defective Work within a **<< two; three; five; or ____>>** year period after Date of Substantial Completion.
   1. Include coverage for fireproofing to remain free from cracking, checking, dusting, flaking, spalling, separation, and blistering.
   2. Reinstall or repair failures that occur within warranty period.

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PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Intumescent Thin-Film Fire Protection for Metal:
   1. Albi Protective Coatings, a subsidiary of StanChem Polymers; Albi C**<< ; Albi Clad TF; or None - N/A>>**.
   2. Carboline Company; A/D Firefilm III.
   3. Hilti, Inc; Fire Finish Steel Protection Spray (CFP-SP WB Series).
   4. Isolatek International Corp; Cafco Spray Film WB.
   5. Sherwin-Williams; Firetex FX Series.

2.02 SYSTEM REQUIREMENTS

A. Fireproofing: Provide intumescent thin-film fire protection systems tested by an independent testing agency in accordance with **<<ASTM E119>>** and acceptable to authorities having jurisdiction (AHJ).
   1. Provide assemblies listed by **<< FM (AG); ITS (DIR); UL (FRD); or _____>><< and bearing listing agency label or mark; _____; or None - N/A>>**.
   2. Coordinate with Life Safety Drawings for components to be protected and required fire resistance ratings.

B. Low-Emitting Materials (Paints and Coatings): Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet applicable VOC limits of **<<CARB (SCM)>>** or **<<SCAQMD 1113>>**.

C. Low-Emitting Materials (Adhesives and Sealants): Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet the chemical content requirements of **<<SCAQMD 1168>>**.

2.03 MATERIALS

A. Fire Resistive Coating System: Thin-film intumescent fire protection system for **<< aluminum; concrete; concrete masonry units (CMU); gypsum board; oriented strand board (OSB); spray polyurethane foam (SPF); structural steel; wood; and _____>>**.
   1. Surface Burning Characteristics: Class A, flame spread/smoke developed index of 25/50, maximum, when tested in accordance with **<<ASTM E84>>**.
   2. For Interior Use: Provide products formulated specifically for both interior general purpose and interior conditioned space usage.
      a. Use only **<< water-based; solvent-based; epoxy-based; latex-based; or _____>>** products.
      b. Use only products without fiber content.
      c. VOC Content: Less than 25 g/L, when tested in accordance with **<<40 CFR 59, Subpart D>>** (EPA Method 24).
      d. Direct Impact Resistance: 40 in-lb, minimum, when tested per **<<ASTM D2794>>**.
      e. Abrasion Resistance: 0.65 gram/1000 cycles, maximum, when tested per**<<ASTM D4060>>**.
      f. Bond Strength: Minimum laboratory tested bond strength of 500 psi, when tested per **<<ASTM D4541>>**.
      g. Durometer Hardness, Type D: **<< 65; 45; or ___>>**, minimum, in accordance with **<<ASTM D2240>>**.

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B. Protective and Decorative Top Coating: As recommended by fireproofing manufacturer for exposure and substrate conditions.
   1. Color and Gloss: To be selected by Owner and Architect from Manufacturer's full range.
   2. Coordinate with paint for color and sheen to match intumescent fireproof coating and adjacent painted surfaces; refer to Division 9 "Painting".

C. Sealers and Primer: As required by tested and listed assemblies, and recommended by fireproofing manufacturer to suit specific substrate conditions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates to determine if they are in satisfactory condition to receive intumescent fire protection; verify that substrates are clean and free of oil, grease, incompatible primers, or other foreign substances capable of impairing bond to fireproofing system.

B. Do not begin installation until substrates have been properly prepared.

C. If substrate preparation is responsibility of another installer, notify **<<Architect>>** of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Thoroughly clean surfaces to receive fireproofing.

B. Repair substrates to remove surface imperfections that could effect uniformity of texture and thickness of fireproofing system, and remove minor projections and fill voids that could telegraph through finished work.

C. Cover or otherwise protect other work that might be damaged by fallout or overspray of fireproofing system, and provide temporary enclosures as necessary to confine operations and maintain required ambient field conditions.

3.03 APPLICATION

A. Comply with manufacturer's instructions for each particular intumescent fire protection system installation application as indicated.

B. Apply manufacturer’s recommended primer to required coating thickness.

C. Apply fireproofing to full thickness over entire area of each substrate to be protected.

D. Apply coats at manufacturer’s recommended rate to achieve dry film thickness (DFT) as required for fire resistance ratings designated for each condition.

E. Apply intumescent fire protection by spraying to maximum extent possible, and as necessary complete coverage by roller application or other method acceptable to manufacturer.

3.04 FIELD QUALITY CONTROL

A. Owner shall hire third-party special inspector to perform special inspections and testing of installed fireproofing, and inspector shall submit field reports to Contractor and Architect.

B. Third-party special inspector shall inspect installed fire protection and test installed dry film thickness of intumescent fire protection in accordance with **<<AWCI Technical Manual 12-B>>**.

C. Repair or replace intumescent fire protection at locations where test results indicate fireproofing does not meet specified requirements.

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3.05 CLEANING

A. Immediately after installation of fireproofing in each area, remove overspray and fallout from other surfaces and clean soiled areas.

3.06 PROTECTION

A. Protect installed intumescent fire protection from damage due to subsequent construction activities, so fireproofing is without damage or deterioration before Date of Substantial Completion.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 078123

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SECTION 078400
FIRESTOPPING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.

C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

D. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems.

E. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-Story Test Apparatus.

F. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.

G. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed between Rated Wall Assemblies and Nonrated Horizontal Assemblies.

H. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

I. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

J. FM (AG) - FM Approval Guide.

K. FM 4991 - Approval Standard of Firestop Contractors.

L. ITS (DIR) - Directory of Listed Products.

M. SCAQMD 1113 - Architectural Coatings.

N. UL (DIR) - Online Certifications Directory.

O. UL (FRD) - Fire Resistance Directory.

P. UL 1479 - Standard for Fire Tests of Penetration Firestops.

Q. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems.

1.02 SUBMITTALS

A. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.

B. Product Data: Provide data on product characteristics, performance ratings, and limitations.

C. Test Reports: Include test reports from a qualified testing agency for each firestopping system submitted.

D. Sustainable Design Submittal: Submit VOC content documentation for nonpreformed materials.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements. Manufacturer's certificate shall include a compatibility statement that firestopping materials shall be compatible with all indicated substrate materials.

F. Installer's qualification statement.

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1.03 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the **<< specified; or scheduled>>** fire ratings when tested in accordance with **<< methods indicated; ASTM E119; ASTM E814; and _____>>**.
   1. Listing in **<< UL (FRD); FM (AG); ITS (DIR); or ___>>** will be considered as constituting an acceptable test report.
   2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
   3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.

B. Labeling: Provide permanent labels adjacent to each firestopping assembly. Labels shall be durable metal or plastic and fastened mechanically or with a self-adhering backing. Labels shall include the tested assembly/system number, fire rating of the adjacent building element/ firestopping, the firestopping installer and certification, date of installation, and specific instructions to "Do Not Disturb" and "Alert Building Personnel of Damage."
   1. Coordinate with Division 09 "Painting" for stenciled painted labeling of fire-rated walls and partitions.

C. Installer Qualifications: Company specializing in performing the work of this section and certified per the following:
   1. Installer shall be approved by Factory Mutual Research Corporation under **<<FM 4991>>**.
      a. Installer shall have a minimum of three years of documented experience installing firestopping comparable in size and scope to this Project.
      b. Installer shall have a minimum of five satisfactorily completed projects comparable in size and scope to this Project.
      c. Installer shall be licensed by local authorities having jurisdiction (LAHJ).
      d. Installer shall be a UL Qualified Firestop Contractor.
   2. Firestop manufacturer's willingness to sell products to Contractor or to an installer engaged by the Contractor does not confer qualifications to the buyer.
   3. Installation of firestopping systems shall be performed by a single qualified installer.

D. Source Limitations: Obtain each type of firestopping system from a single manufacturer, through a single supplier or source.

1.04 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Firestopping Manufacturers:
   1. 3M Fire Protection Products.
   2. A/D Fire Protection Systems Inc.
   3. Hilti, Inc.
   4. HoldRite; an RWC brand.
   5. RectorSeal, a CSW Industrials Company.

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6. Specified Technologies Inc.
7. Tremco Commercial Sealants & Waterproofing.

2.02 MATERIALS

A. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero (0) in accordance with **<<ASTM G21>>**.

B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

C. Low-Emitting Materials:

1. Paints and Coatings: Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet applicable VOC limits of **<<CARB (SCM)>>** or **<<SCAQMD 1113>>**.
2. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet the chemical content requirements of **<<SCAQMD 1168>>**.

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. Perimeter Fire Containment Firestopping: Use system that has been tested according to **<<ASTM E2307>>** to have fire resistance F Rating equal to required fire rating of floor assembly. ******Provide when there is void between floor slab and exterior wall construction such as at multi-story curtainwall assemblies******

1. Movement: Provide systems that have been tested to show movement capability as indicated.
2. Temperature Rise: Provide systems that have been tested to show T Rating as indicated, but not less than 1 hour.
3. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
4. Where floor assembly is not required to have a fire rating, provide systems that have been tested to show L Rating as indicated.

B. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to **<<ASTM E2837>>** to have fire resistance F Rating equal to required fire rating of wall assembly.

1. Movement: Provide systems that have been tested to show movement capability as indicated.

C. Floor-to-Floor (FF), Floor-to-Wall (FW), Head-of-Wall (HW), and Wall-to-Wall (WW) Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to **<<ASTM E1966>>** or **<<UL 2079>>** to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.

1. Movement: Provide systems that have been tested to show movement capability as indicated.
2. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
3. Watertightness: Provide systems that have been tested to show W Rating as indicated.
4. Listing by **<<FM (AG)>>**, **<<ITS (DIR)>>**, **<<UL (DIR)>>**, or **<<UL (FRD)>>** in their certification directories will be considered evidence of successful testing.

D. Through Penetration Firestopping: Use system that has been tested according to **<<ASTM E814>>** to have fire resistance F Rating equal to required fire rating of penetrated assembly.

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1. Basis-of-Design: Montgomery County Public Schools preference for penetration sleeves is HoldRite "HydroFlame" series Firestop Sleeve.
2. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
3. Air Leakage (Smoke Barriers): Provide systems that have been tested to show L Rating of no more than 5.0 cfm/sq. ft., both at ambient and elevated 400 deg F temperatures in accordance with **<<UL 1479>>**.
4. Watertightness: Provide systems that have been tested to show W Rating as indicated.
5. Listing by **<<FM (AG)>>**, **<<ITS (DIR)>>**, **<<UL (DIR)>>**, or **<<UL (FRD)>>** in their certification directories will be considered evidence of successful testing.

2.04 FIRESTOPPING SYSTEMS

A. Firestopping: **<< Any material meeting requirements.; Foam.; Caulk or putty.; Manufactured device.; _____ .; or None - N/A>>**

1. Fire Ratings: Use system that is listed by **<< FM (AG); ITS (DIR); UL (FRD); or _____>>** and tested in accordance with **<< ASTM E814; ASTM E119; UL 1479; or _____>>** with F Rating equal to fire rating of penetrated assembly and**<< minimum; or None - N/A>>** T Rating **<< of ____; or Equal to F Rating>>** and in compliance with other specified requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.

B. Remove incompatible materials that could adversely affect bond.

C. Install **<< backing; damming; or _____>>** materials to prevent liquid material from leakage.

3.03 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

B. Do not cover installed firestopping until inspected by Owner's Independent Testing Agency.

C. Install labeling required by code.

1. Coordinate with Division 09 Painting contractor to ensure that all fire-rated walls and partitions are properly labeled.

3.04 FIELD QUALITY CONTROL

A. Independent Testing Agency: Inspection agency employed and paid by Owner, will inspect penetration firestopping in accordance with **<<ASTM E2174>>** and **<<ASTM E2393>>**.

1. Inspection of completed firestopping installations shall take place in successive stages as installation of firestopping systems proceeds. Do not proceed with installation of firestopping in the next area until the inspection agency determines that completed work shows compliance with requirements.
2. Inspection agency shall provide report after each stage indicating firestopping systems that comply and deviate from requirements.

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3. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.
4. Additional inspections to verify compliance with replaced or additional work shall be performed at Contractor's expense.

3.05 CLEANING

A. Clean adjacent surfaces of firestopping materials. Coordinate with manufacturer of substrate material to ensure that proper cleaning materials and procedures are used to prevent damage.

3.06 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 078400

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SECTION 078426
THERMAL BARRIERS FOR PLASTICS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concealed thermal barrier applied over foam plastics that are exposed to the interior of the building, exposed to open plenum, or exposed in cavity wall construction.

1.02 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

C. ASTM E605/E605M - Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members.

D. ASTM E736/E736M - Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members.

E. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.

F. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems.

G. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.

H. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

I. AWCI Technical Manual 12-B - Standard Practice for the Testing and Inspection of Thin-Film Intumescent Fire-Resistive Materials; an Annotated Guide.

J. FM (AG) - FM Approval Guide.

K. FM 4880 - Examination Standard for Class 1 Fire Rating of Building Panels or Interior Finish Materials.

L. FM 4991 - Approval Standard of Firestop Contractors.

M. ITS (DIR) - Directory of Listed Products.

N. NFPA 275 - Standard Method of Fire Tests for the Evaluation of Thermal Barriers.

O. UL (FRD) - Fire Resistance Directory.

P. UL 1040 - Standard for Safety Fire Test of Insulated Wall Construction.

Q. UL 1479 - Standard for Fire Tests of Penetration Firestops.

R. UL 1715 - Standard for Safety Fire Test of Interior Finish Material.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting at the Project site one week before starting work of this section. Include other relevant installers including installers of any foam plastic materials over which thermal barriers are to be installed.

1.04 SUBMITTALS

A. Product Data: Provide data on **<< product characteristics; performance ratings; limitations; and _____>>**.

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B. Product Test Reports: Provide test data indicating compliance with both Temperature Transmission Test and Integrity Fire Test.

C. Evaluation/Compatibility Reports: Provide data indicating tested compatibility with submitted foam plastic material, for each assembly required.

D. Sustainable Design Submittal: Submit VOC content documentation for nonpreformed materials.

E. Installer's qualification statement.

F. Inspection Reports: Provide inspection reports certified by thermal barrier manufacturer's technical representative, indicating that thermal barrier has been installed in accordance with manufacturer's requirements.

1.05 QUALITY ASSURANCE

A. Fire Testing: Provide assemblies that provide 15-minute thermal barrier protection when tested in accordance with both the Temperature Transmission Fire Test and the Integrity Fire Test required by **<<NFPA 275>>**.
   1. Temperature Transmission Test: The thermal barrier product shall be tested for standard fire exposure in accordance with **<<ASTM E119>>** or ANSI/**<<UL 263>>**.
   2. Integrity Fire Test: The thermal barrier assembly, including the specific thermal barrier and foam plastic products submitted for this project, shall be tested as an assembly in accordance with NFPA 276, **<<FM 4880>>**, ANSI/**<<UL 1040>>**, or ANSI/**<<UL 1715>>**.
   3. Evidence of passing both test requirements shall be required.
      a. Listing in **<< UL (FRD); FM (AG); ITS (DIR); or ___>>** will be considered as constituting an acceptable test report.
      b. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
      c. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.

B. Surface-Burning Characteristics: Thermal barrier product shall be tested in accordance with**<<ASTM E84>>** and shall be rated for plenum exposure with maximum flame-spread index of 25 and maximum smoke-developed index of 50.

C. Installer Qualifications: Coordinate with Division 7 Section "Firestopping." A single qualified installer may provide the work of both sections. Thermal barrier installer shall specialize in performing the work of this section and:
   1. Installer shall be approved by Factory Mutual Research Corporation under **<<FM 4991>>**.
      a. Installer shall have a minimum of three years of documented experience installing thermal barriers comparable in size and scope to this Project.
      b. Installer shall have a minimum of five satisfactorily completed projects comparable in size and scope to this Project.
      c. Installer shall be licensed by local authorities having jurisdiction (LAHJ).
      d. Installer shall be a UL Qualified Firestop Contractor.
   2. Thermal barrier manufacturer's willingness to sell products to Contractor or to an installer engaged by the Contractor does not confer qualifications to the buyer.
   3. Installation of firestopping systems shall be performed by a single qualified installer.

D. Manufacturer's Inspection: Manufacturer's technical representative shall inspect foam plastic substrates prior to installation and in-progress work to ensure compliance with manufacturer's requirements, and shall provide inspection reports after each visit.

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1. Thermal barrier installer shall coordinate with manufacturer to provide anticipated installation dates.

1.06 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for **<< three; or ____>>** days after installation of materials.

B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Thermal Barrier Manufacturers and Products:
   1. Fire-Resistive, Water-Based, Intumescent Mastic Coating for Cellular Foam:
      a. Thermal Product Research (TPR^2); Fireshell F10E.
      b. Flame Seal Products, Inc.; Flame Seal TB.
      c. International Fireproof Technology, Inc.; DC315.
      d. No-Burn, Inc; No-Burn Plus ThB.

2.02 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealants, and other accessory materials as required by manufacturer, that are compatible with the other materials in the thermal barrier assembly and that maintain the thermal barrier rating of the assembly.

B. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by **<<SCAQMD 1168>>**.

C. Mold and Mildew Resistance: Provide thermal barrier and accessory materials with mold and mildew resistance rating of zero (0) in accordance with **<<ASTM G21>>**.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.

B. Remove incompatible materials that could adversely affect bond.

C. Install backing materials to prevent liquid material from leakage.

3.03 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

B. Do not cover installed thermal barriers until special inspections are complete.

C. Install labeling required by code.

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3.04 FIELD QUALITY CONTROL

A. Special Inspections: Inspection agency employed and paid by Owner, will examine all spray-applied fireproofing, including thermal barriers, in accordance with the IBC edition applicable to this Project.

1. Testing Services: All fireproofing/thermal barriers shall be tested according to **<<ASTM E605/E605M>>** and **<<ASTM E736/E736M>>**. Mastics shall be tested according to **<<AWCI Technical Manual 12-B>>**.
2. Inspection and testing of completed thermal barrier installations shall take place in successive stages as installation of thermal barriers proceeds. Do not proceed with installation of thermal barriers in the next area until the inspection agency determines that completed work shows compliance with requirements.
3. Inspection agency shall provide report after each stage indicating firestopping systems that comply and deviate from requirements.
4. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.
5. Additional inspections to verify compliance with replaced or additional work shall be performed at Contractor's expense.

3.05 CLEANING

A. Clean adjacent surfaces of thermal barrier overspray, clean all adjacent surfaces after application.

3.06 PROTECTION & REPAIR

A. Protect adjacent surfaces from damage by material installation.

B. If installed thermal barrier must be cut due to subsequent penetrations or other work, provide additional patching work as required to restore thermal barrier to a continuous, complete assembly at the time of Substantial Completion.

C. Repair damage to thermal barriers caused by construction activities; verify that repaired work maintains a continuous, complete thermal barrier assembly.

END OF SECTION 078426

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SECTION 079200
JOINT SEALANTS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.

B. ASTM C834 - Standard Specification for Latex Sealants.

C. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications.

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.

E. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.

F. ASTM C1193 - Standard Guide for Use of Joint Sealants.

G. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants.

H. ASTM C1311 - Standard Specification for Solvent Release Sealants.

I. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.

J. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

K. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.

L. SCAQMD 1113 - Architectural Coatings.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:

1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
2. List of backing materials approved for use with the specific product.
3. Backing material recommended by sealant manufacturer.
4. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
5. Substrates the product should not be used on.

B. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.

C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

D. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

E. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.

F. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within **<< 10 days; or _____>>** after completion of tests; include bagged test samples and photographic records.

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G. Executed warranty.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section, and is approved and/or certified by manufacturer.

B. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
   1. Adhesion Testing: In accordance with **<<ASTM C794>>**.
   2. Compatibility Testing: In accordance with **<<ASTM C1087>>**.
   3. Allow sufficient time for testing to avoid delaying the work.
   4. Deliver sufficient samples to manufacturer for testing.
   5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.

C. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
   1. Identification of testing agency.
   2. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
      a. Test date.
      b. Copy of test method documents.
      c. Age of sealant upon date of testing.
      d. Test results, modeled after the sample form in the test method document.
      e. Indicate use of photographic record of test.

D. Field Adhesion Test Procedures:
   1. Allow sealants to fully cure as recommended by manufacturer before testing.
   2. Have a copy of the test method document available during tests.
   3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
   4. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
   5. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to **<<Owner>>**.
   6. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to **<<Architect>>**.

E. Destructive Field Adhesion Test: Test for adhesion in accordance with **<<ASTM C1521>>**, using Destructive Tail Procedure.
   1. Sample: At least **<< 18 inches; or ___ inches>>** long.
   2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply **<< 1 inch; or ___ inch>>** by that percentage; if adhesion failure occurs before the 1-inch mark is that distance from the substrate, the test has failed.
   3. If either adhesive or cohesive failure occurs before minimum elongation, take necessary measures to correct conditions and retest; record each modification to products or installation procedures.

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1.04 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Manufacturer Warranty: Provide **<< 2-year; or 5-year>>** manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in **<<Owner>>**'s name and register with manufacturer.

PART 2 PRODUCTS

2.01 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
      a. Joints between door, window, and other frames and adjacent construction.
      b. Wall and ceiling joints.
      c. Joints between plumbing fixtures and floor or wall construction.
      d. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
         1) Exception: Intentional gaps and openings in gypsum board finished stud walls and suspended ceilings.
         2) Exception: Through-penetrations in sound-rated assemblies that are also fire-rated.
      e. Other joints indicated below.
   2. Do Not Seal:
      a. Intentional weep holes in masonry.
      b. Joints indicated to be covered with expansion joint cover assemblies or other covering devices.
      c. Joints where sealant is specified to be furnished and installed by manufacturer of product to be sealed.
      d. Joints where sealant installation is specified in other sections.

B. Exterior Joints: Use non-sag non-staining silicone sealant (Type **<< ES-1>>**), unless otherwise indicated.
   1. Type **<< ES-5>>** - Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant.
   2. Type **<< ES-1 or ES-2>>** - Joints between walls and frames of doors, windows, and louvers.
   3. Type **<< STS-1>>** - Butyl for bedding joints, and for lap joints in sheet metal fabrications and fabricated metal panels, unless sealant is factory-provided in laps.

C. Interior Joints: Use non-sag polyurethane sealant (**<< ES-4>>**), unless otherwise indicated.
   1. Type **<< ES-3>>** - Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; **<< white; clear; or _____>>**.
      a. Exception: Refer to Division 9 Section "Tiling" for sealants to be used for floor and wall tiles, including joints between tile and plumbing fixtures.
   2. Type **<< ES-5>>** - Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.

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3. Type **<< AS-1>>** - Joints at sound-rated or acoustic assemblies, and at full-height panel wall and partition assemblies indicated to have sound attenuation batts.
4. Type **<< LS-1>>** - Joints around perimeters of interior doors, windows, elevator entrances, and similar framed openings.

D. Interior Wet Areas: **<< Bathrooms; restrooms; kitchens; food service areas; food processing areas; and _____>>**; fixtures in wet areas include **<< plumbing fixtures; food service equipment; countertops; cabinets; other similar items; and _____>>**.

E. Sound-Rated Assemblies: Walls and ceilings identified as STC-rated, sound-rated, or acoustical.

2.02 JOINT SEALANTS - GENERAL

A. Low-Emitting Materials:
1. Paints and Coatings: Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet applicable VOC limits of **<<CARB (SCM)>>** or **<<SCAQMD 1113>>**.
2. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet the chemical content requirements of **<<SCAQMD 1168>>**.

2.03 NONSAG JOINT SEALANTS

A. Type **<< ES-1>>** - Low-Modulus Non-Staining Silicone Sealant: **<<ASTM C920>>**, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: **<< Plus 100 percent and minus 50 percent; Plus and minus 50 percent; Plus and minus 35 percent; Plus and minus 25 percent; or Plus and minus 50 percent>>**, minimum.
2. Nonstaining to Porous Stone: Nonstaining to light-colored natural stone when tested in accordance with **<<ASTM C1248>>**.
3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
4. Color: To be selected by Owner and Architect from manufacturer's **<< full; standard; custom; or _____>>** range.
5. Products:
   a. Master Builders Solutions; MasterSeal NP 100.
   b. Momentive Performance Materials, Inc/GE Silicones**<< ; SCS9000 SilPruf NB - Non-Staining Silicone Weatherproofing Sealant; ; SCS 2000 SilPruf; or None - N/A>>**.
   c. Pecora Corporation**<< ; Pecora 890 NST (Non-Staining Technology); ; _____; or None - N/A>>** or 890 FST (Field Tint).
   d. Polymeric Systems, Inc.; PSI-641.
   e. Tremco Commercial Sealants & Waterproofing**<< ; Spectrem 3; ; ____; or None - N/A>>** or Spectrem 4-TS (Field Tint).
   f. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Type **<< ES-2>>** - Medium-Modulus Non-Staining Silicone Sealant: **<<ASTM C920>>**, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: **<< Plus 100 percent and minus 50 percent; Plus and minus 50 percent; Plus and minus 35 percent; Plus and minus 25 percent; or Plus and minus 50 percent>>**, minimum.

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2. Non-Staining To Porous Stone: Non-staining to light-colored **<< natural stone; marble; or _____>>** when tested in accordance with **<<ASTM C1248>>**.
3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
4. Color: To be selected by **<<Architect>>** from manufacturer's **<< full; standard; custom; or _____>>** range.
5. Manufacturers:
   a. Dow Chemical Company**<< ; DOWSIL 795 Silicone Building Sealant; ; ____; or None - N/A>>**.
   b. Momentive Performance Materials, Inc/GE Silicones**<< ; SCS9000 SilPruf NB - Non-Staining Silicone Weatherproofing Sealant; ; SCS 2000 SilPruf; or None - N/A>>**.
   c. Pecora Corporation**<< ; Pecora 864 NST (Non-Staining Technology); ; Pecora 895 NST (Non-Staining Technology); ; _____; or None - N/A>>**.
   d. Tremco Commercial Sealants & Waterproofing**<< ; Spectrem 2; ; ____; or None - N/A>>**.
   e. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

C. Type **<< ES-3>>** - Mildew-Resistant Silicone Sealant: **<<ASTM C920>>**, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic. Neutral- or acid-curing per manufacturer standard.
1. Color: **<< White; Clear; Aluminum; Black; or _____>>**.
2. Products:
   a. Dow; DOWSIL 786 Mildew Resistant.
   b. Pecora Corporation**<< ; Pecora 898 NST (Non-Staining Technology); ; _____; or None - N/A>>**.
   c. Tremco Commercial Sealants & Waterproofing; Tremsil 600 or Tremsil 200.
   d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

D. Type **<< ES-4>>** - Polyurethane Sealant: **<<ASTM C920>>**, Grade NS, Uses M and A; **<< single or multi-component; single-component; multi-component; or _____>>**; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: **<< Plus 100 percent, minus 50 percent; Plus and minus 50 percent; Plus and minus 35 percent; Plus and minus 25 percent; Plus and minus 12.5 percent; Plus and minus ____ percent; or _____>>**, minimum.
2. Color: To be selected by **<<Architect>>** from manufacturer's **<< full; standard; custom; or _____>>** range.
3. Products:
   a. ITW Polymers Sealants; Permathane SM 7200.
   b. Master Builders Solutions by BASF**<< ; MasterSeal NP1; ; MasterSeal NP2; or None - N/A>>**.
   c. Pecora Corporation**<< ; DynaTrol II; ; ____; or None - N/A>>**.
   d. Sika Corporation**<< ; Sikaflex-2c NS; ; _____; or None - N/A>>**.
   e. Tremco Commercial Sealants & Waterproofing**<< ; Dymeric 240 FC; ; ____; or None - N/A>>** or Vulkem 227.
   f. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

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E. Type **<< LS-1>>** - Acrylic Emulsion Latex: Water-based; **<<ASTM C834>>**, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
   1. Color: To be selected by **<<Architect>>** from manufacturer's **<< full; standard; custom; or _____>>** range.
   2. Grade: **<<ASTM C834>>**; **<< Grade Minus 18 Degrees C (0 Degrees F); Grade 0 Degrees C (32 Degrees F); Grade NF; or _____>>**.
   3. Products:
      a. Bostik, Inc; Chem-Calk 600.
      b. ITW Polymers Sealants; SM 8200.
      c. Master Builders Solutions**<< ; MasterSeal NP 520; ; _____; or None - N/A>>**.
      d. Pecora Corporation**<< ; AC-20 +Silicone; ; AIS-919; ; AVW-920; ; Tilt-Seal; ; ____; or None - N/A>>**.
      e. Tremco Commercial Sealants & Waterproofing**<< ; Tremflex 834; ; ____; or None - N/A>>**.
      f. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

F. Type **<< AS-1>>** - Acrylic Emulsion Latex: Water-based; **<<ASTM C834>>**, single component, non-staining, non-bleeding, non-sagging acoustical sealant.
   1. Color: **<< Standard colors matching finished surfaces; As shown on drawings; As scheduled; or _____>><< , Type OP (opaque); , Type C (clear or translucent); , _____; or None - N/A>>**.
   2. Grade: **<<ASTM C834>>**; **<< Grade 0 Degrees F (Minus 18 Degrees C); Grade 32 Degrees F (0 Degrees C); Grade NF; or _____>>**.
   3. Manufacturers:
      a. Accumetric LLC; BOSS 826 Acoustical Sound Sealant.
      b. Franklin International, Inc**<< ; Titebond GREENchoice Acoustical Smoke & Sound Sealant; ; Titebond Painter's Plus Caulk; ; Titebond Painter's Caulk; ; ____; or None - N/A>>**.
      c. Hilti, Inc**<< ; CP 506 Smoke and Acoustical Sealant; ; _____; or None - N/A>>**.
      d. Master Builders Solutions**<< ; MasterSeal NP 520; ; _____; or None - N/A>>**.
      e. Momentive Performance Materials, Inc/GE Silicones; RCS20 Acoustical.
      f. Pecora Corporation; AC-20 FTR or AIS-919.
      g. Specified Technologies Inc**<< ; Smoke N' Sound Acoustical Sealant; ; Smoke N' Sound Acoustical Spray; ; _____; or None - N/A>>**.
      h. Tremco Commercial Sealants & Waterproofing**<< ; Tremstop Smoke and Sound; ; ____; or None - N/A>>**.
      i. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

G. Type **<< SRS-1>>** - Butyl Sealant: Solvent-based; **<<ASTM C1311>>**; single component, nonsag; not expected to withstand continuous water immersion or traffic.
   1. Products:
      a. Bostik, Inc; Chem-Calk 300.
      b. Pecora Corporation**<< ; Pecora BC-158 Butyl Rubber Sealant; ; _____; or None - N/A>>**.
      c. Tremco Inc.; Tremco Butyl Sealant.
      d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

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2.04 SELF-LEVELING JOINT SEALANTS

A. Type **<< ES-5>>** - Self-Leveling Polyurethane Sealant for Traffic: Polyurethane; **<<ASTM C920>>**, Grade P, Uses T, M and A; **<< single or multi-component; single component; multi-component; or _____>>**; explicitly approved by manufacturer for traffic exposure.
   1. Movement Capability: **<< Plus and minus 25 percent; Plus and minus ____ percent; or _____>>**, minimum.
   2. Products:
      a. Bostik, Inc.; Chem-Calk 550.
      b. Pacific Polymers, Inc; Elast-Thane 227 Type 1 (Self-Leveling).
      c. Pecora Corporation; Dynatrol II-SL.
      d. Polymeric Systems, Inc; PSI-270SL.
      e. Tremco Commercial Sealants & Waterproofing; Vulkem 445SSL.
      f. W. R. MEADOWS, Inc; POURTHANE SL.
      g. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.05 ACCESSORIES

A. Sealant Backing Materials, General: Materials placed in joint before applying sealants; assists sealant performance and service life by developing optimum sealant profile and preventing three-sided adhesion; type and size recommended by sealant manufacturer for compatibility with sealant, substrate, and application.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Masking Tape: Self-adhesive, nonabsorbent, nonstaining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Joint Cleaner: Noncorrosive and nonstaining type, type recommended by sealant manufacturer; compatible with joint forming materials.

E. Primers: Type recommended by sealant manufacturer to suit application; nonstaining.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
   1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
   2. Notify **<<Architect>>** of date and time that tests will be performed, at least **<< seven days; or _____ days>>** in advance.
   3. Record each test on Preinstallation Adhesion Test Log as indicated.
   4. If any sample fails, review products and installation procedures, consult manufacturer, or take other measures that are necessary to ensure adhesion; retest in a different location; if unable to obtain satisfactory adhesion, report to **<<Architect>>**.
   5. After completion of tests, remove remaining sample material and prepare joints for new sealant installation.

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3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and **<<ASTM C1193>>**.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in an inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Provide joint sealant installations complying with **<<ASTM C1193>>**.

C. Install acoustical sealant application work in accordance with **<<ASTM C919>>**.

D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.

E. Install bond breaker backing tape where backer rod cannot be used.

F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

H. Nonsag Sealants: Tool surface **<< concave; flush; slightly recessed; or _____>>**, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 FIELD QUALITY CONTROL

A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.

B. Destructive Adhesion Testing: If there are any failures in first **<< 1,000 linear feet; or ___ linear feet>>**, notify **<<Architect>>** immediately.

C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

D. Repair destructive test location damage immediately after evaluation and recording of results.

3.05 CLEANING AND PROTECTION

A. Protect installed joint sealants from soiling or damage.

B. Where joint sealants have become soiled or damaged due to construction activities, the Contractor shall be responsible for cleaning joint sealants at the time of Substantial Completion.

C. Where cleaning does not restore finish to an acceptable level upon Owner's inspection, the Contractor shall be responsible for removing and replacing joint sealant.

END OF SECTION 079200

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SECTION 079500
EXPANSION CONTROL

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ITS (DIR) - Directory of Listed Products.

B. UL (DIR) - Online Certifications Directory.

C. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Installation Templates: For frames and anchors to be embedded in concrete or masonry, furnish templates to relevant installers; include installation instructions and tolerances.

1.03 SUBMITTALS

A. Product Data: Provide joint assembly profiles, profile dimensions, **<< anchorage devices; available colors and finish; and _____>>**.

B. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, **<< affected adjacent construction; anchorage locations; and _____>>**.

C. Selection Samples: Provide manufacturer's color charts, for exposed finish options for each expansion joint product.

PART 2 PRODUCTS

2.01 EXPANSION JOINT COVER ASSEMBLIES, GENERAL

A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.

1. Source Limitations: Provide each type of joint through a single source from a single manufacturer.
2. Joint Dimensions and Configurations: Provide expansion joint covers sized for **<< 1-inch; 2-inch; 3-inch; 4-inch; or _____>>** joint widths, unless otherwise indicated.
   ******Architect/Structural Engineer to verify joint size on job-to-job basis******
3. Joint Movement Capability: If not indicated, provide minimum 50 percent (+25/-25) joint movement capability .
4. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
5. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.
6. Finish: Color for all joints shall be selected from manufacturer's full range of available colors.
   a. Where length of expansion joint spans multiple finishes (for example, exterior wall assembly with face brick 1, precast sill/water table, and face brick 2), provide different finish joint color at each building finish material.

B. Floor Joint Covers: Coordinate with indicated floor coverings.

C. Exterior Joints at Cavity/Masonry Veneer Walls: Provide a "double" preformed foam joint at exterior joints, with aesthetic joint at face of veneer masonry, and a functional joint (manufacturer's standard neutral color) in the plane of insulation to maintain continuity of insulation and water and air barriers.

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D. Covers in Gypsum Board Assemblies: Provide style with anchoring wings that can be completely covered by joint compound.

E. Covers in Fire Rated Assemblies: Provide manufacturer's standard fire barrier product, for a complete cover assembly having fire rating equivalent to that of assembly into which it is installed.
   1. Acceptable Evaluation Agencies: **<<UL (DIR)>>** and **<<ITS (DIR)>>**.

F. Roof Expansion Joints: Refer to Division 7 Section "Roof Specialties."

2.02 INTERIOR FLOOR JOINTS

A. Interior Floor Joints (Metal; Surface Mounted): Serrated, satin anodized aluminum plate with exposed fasteners.
   1. Products: (Floor-to-floor and floor-to-wall models)
      a. Balco; RPA-*x* and RPAL-*x*.
      b. Construction Specialties; PCS2G-*xxx* and PCWS2G-*xxx*.
      c. Erie Metal Specialties; ALCP-*xxx* and ALCPW-*xxx*.
      d. Inpro; 808-A01-*xxx* and 808-A02-*xxx*.
      e. MM Systems; X-U-*x* and X-W-*x*.

2.03 INTERIOR WALL JOINTS

A. Interior Wall Joints (Metal; Surface Mounted): Smooth, satin anodized aluminum; with mounting flange on one side of joint and "snap-on" cover installation; no exposed fasteners.
   1. Products: (Wall-to-wall and wall-to-corner models)
      a. Balco; WD-*x* and WDC-*x*.
      b. Construction Specialties; ASM-*xxx* and ASMC-*xxx*.
      c. Erie Metal Specialties; EBWF-*xxx* and EBWF-*xxx*W.
      d. Inpro; 811-A07-*xxx* and 811-A09-*xxx*.
      e. MM Systems; EX-K*x* and EX-L*x*.

2.04 INTERIOR CEILING JOINTS

A. Interior Ceiling Joints (Flush, with Resilient Infill, at Drop-In Ceilings): Coordinate with Division 9 Section "Acoustical Ceilings". ******Joint for use with acoustical ceiling panels******
   1. Products: (Ceiling-to-ceiling and ceiling-to-wall models)
      a. Balco; ACWW-*x* and ACWC-*x*.
      b. Construction Specialties; FCS-*xxx* and FCSC-*xxx*.
      c. Erie Metal Specialties; ELCE-*xxx* and ELCE-*xxx*W.
      d. Inpro; 115-A24-*xxx* and 115-A18-*xxx*.
      e. MM Systems; VSG-*xxx* and VSGL-*xxx*.

B. Interior Ceiling Joints (Surface Mounted, with Resilient Infill, at Gypsum Ceilings): Flanges shall be mud-in type to be covered by drywall finisher and shall not be exposed in finished work. ******Joint for use with gypsum board ceilings******
   1. Products: (Ceiling-to-ceiling and ceiling-to-wall models)
      a. Balco; GCWW-*x* and GCWC-*x*.
      b. Construction Specialties; FWF-*xxx* and FWFC-*xxx*.
      c. Inpro; 114-A07-*xxx* and 114-A09-*xxx*.
      d. MM Systems; VSW-*xxx* and VSWL-*xxx*.

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2.05 EXTERIOR JOINTS

A. Exterior Wall Joints (Preformed Foam): Pre-compressed and self-expanding, open-cell urethane foam. Pre-coated with water repellant coating on exterior surface, and with adhesive coating on sides to fit in opening. Joint shall allow for minimum 50% total movement (25% expansion, 25% contraction).
   1. Products:
      a. Construction Specialties; Model VF.
      b. EMSEAL Joint Systems, Ltd.; Colorseal.
      c. Erie Metal Specialties; CSS-Series.
      d. MM Systems; Series ESS.
      e. Schul International Company, Inc.; Color Econoseal.
      f. Watson Bowman Acme Corp; WeatherSeal II.

B. Fire-Rated Wall and Floor Joints (Preformed Foam): Pre-compressed and self-expanding, open-cell urethane foam; suitable for exterior or interior joints. Pre-coated with water repellant coating on exterior surface, and with adhesive coating on sides to fit in opening. Material shall be 2 hour fire barrier, tested to **<<UL 2079>>**.
   1. Products:
      a. Construction Specialties; Model 2VFR (walls) and 2HFR (floors).
      b. EMSEAL Joint Systems, Ltd.; Emshield WFR2 (walls) and DFR2 (floors).
      c. Erie Metal Specialties; CSS(2FRV) (walls) and CST(2FRH) (floors).
      d. MM Systems; Model SIF-FR (walls) and EIS-FR (floors).
      e. Schul International Company, Inc.; Sealtite 2FR-V (walls) and 2FR-H (floors).
      f. Watson Bowman Acme Corp; Wabo FireShield FSV (walls) and FSH (floors).

2.06 ACCESSORIES

A. Anchors and Fasteners: As recommended by cover manufacturer.
   1. Metal Anchors: Provide galvanized anchors where embedded in concrete or in contact with cementitious materials.

B. Aluminum Components in Contact with Cementitious Materials: Provide protective coating of type recommended by manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.

B. Verify that frames and anchors installed by others are in correct locations and suitable for installation of remainder of assembly.

3.02 INSTALLATION

A. Install components and accessories in accordance with manufacturer's instructions.

B. Align work plumb and level**<< , flush with adjacent surfaces; or None - N/A>>**.

C. Rigidly anchor to substrate to prevent misalignment.

3.03 PROTECTION

A. Do not permit traffic over unprotected floor joint surfaces.

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B. Where applicable, provide strippable coating or tape to protect finish surface; remove immediately prior to Substantial Completion.

END OF SECTION 079500

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SECTION 081113
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 REQUIREMENTS OF REGULATORY AGENCIES

A. Hollow Metal and installation shall comply with provisions and standards listed. The latest published edition of each standard applies.

B. ASTM - American Society for Testing and Materials
   1. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   2. ASTM A 924 - Standard Specification for General Requirements for Steel Sheet, Metallic Coated by the Hot Dip Process.
   3. ASTM A1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, High Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
   4. ASTM A1011 - Standard Specification for Steel, Sheet and Strip, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy, High Strength Low-Alloy with Improved Formability, and Ultra-High Strength
   5. ASTM E90 - Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
   6. ASTM E413 - Classification for Rating Sound Insulation.
   7. ASTM E1332 - Classification for Rating Outdoor-Indoor Sound Attenuation.
   8. ASTM C1363 - Standard Test Method for Temperature Calibration of Thermomechanical Analyzes by means of hot box apparatus.

C. ANSI - American National Standards Institute
   1. ANSI/ASA A117.1 - Accessible and Useable Building and Facilities
   2. ANSI/BHMA A156.115 - American National Standard for Hardware Preparations in Steel Doors and Steel Frames.
   3. ANSI A156.7 - Hinge Template Dimensions.
   4. ANSI/SDI A250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames.
   5. ANSI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcing.
   6. ANSI A250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames.
   7. ANSI/S**<<ANSI/SDI A250.10>>** - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
   8. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames

D. SDI - Steel Door Institute
   1. SDI 111 - Recommended Details and Guidelines for Standard Steel Doors and Frames and Accessories.
   2. SDI 112 - Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames.
   3. SDI 113 - Standard Practice for Determining the Steady-State Thermal Transmission of Steel Door and Frame Assemblies
   4. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames.
   5. SDI 118 - Basic Fire Door Requirements.

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6. SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
7. SDI 124 - Maintenance of Standard Steel Doors and Frames.

E. NAAMM/HMMA - Hollow Metal Manufacturers Association
1. HMMA 810 TN01-03 - Defined Undercuts
2. HMMA 820 TN01-03 - Grouting Hollow Metal Frames
3. HMMA 820 TN02-03 - Continuously Welded Frames
4. HMMA 820 TN03 - Guidelines for Glazing of Hollow Metal Doors and Frames
5. HMMA 830 TN01-18 - Electrified Hardware Preparations
6. HMMA 840 - Guide Specification for Installation and Storage of Hollow Metal Doors and Frames

F. Building Code references
1. IBC - International Building Code
2. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
3. NFPA 101 - Life Safety Code
4. NFPA 105 - Standard for the Installation of Smoke Door Assemblies and Other Opening Protectives
5. NFPA 252 - Standard Method of Fire Tests of Door Assemblies
6. ANSI/ASA S12.60 - Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools
7. ANSI/UL 10C - Standard for Safety for Positive Pressure Fire Tests of Door Assemblies
8. UL 1784 - Air Leakage Tests of Door Assemblies
9. UL - Building Materials Directory; Underwriters Laboratories Inc
10. Intertek Testing Services (WH/Warnock Hersey)

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1.02 SUPPLIER QUALIFICATIONS

A. Hollow Metal Supplier shall maintain at the location which will be managing the project, a credentialed Architectural Hardware Consultant (AHC), Certified Door Consultant (CDC) or Door and Hardware Consultant (DHC) as a full time employee, and member in good standing of DHI - Door Security + Safety Professionals.

B. Door Consultant on the project shall be available throughout the project to meet with the Contractor, Architect or Owner as requested.

C. The Door Supplier shall have completed a minimum of three education facilities over the last five years which were similar in size, material, design and extent to that indicated for the project as determined by the Architect. If requested by the Architect, submit a list of projects listing the project name, location, Owner, Architect and Contractor.

D. As a requirement, the Door and Frame Supplier shall maintain an office and warehouse complete with a hollow metal inventory within a one hundred (100) mile radius of the jobsite. Supplier shall further have a qualified field service staff available to service the project.

E. Failure to meet the above requirements will disqualify the bidder.

1.03 SUBMITTALS

A. Submit digital copies of the hollow metal shop drawing submittals with complete details for the project, including copies of technical information and other pertinent data required to indicate compliance with the specification.
1. Submit Shop Drawings which reference designations noted on the door schedule drawings. Shop Drawings shall include opening size, handing of doors, details of each

frame type, elevations of door types, location, hardware set numbers, details of splice connections, fire label requirements, temperature rise requirements, grout guard detail, hardware mounting locations, glass moldings, welding details, internal reinforcing, anchor details, high frequency hinge reinforcement, full width frame head reinforcement channel, top caps and other pertinent information.

B. Data submitted shall be job specific and shall include product data and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. Where contents of submitted literature from manufacturers include data NOT job specific, clearly identify products being submitted for review.

C. Provide copies of Certificate of Compliance for all fire rated door assemblies, all smoke and draft assemblies and all temperature fire rated assemblies.

D. The shop drawing submittal shall include copies of the latest edition of the following documents:
   1. ANSI/A250.11 - Recommended Erection Instructions for Steel Frames
   2. HMMA 810 TN01-03 - Defined Undercuts
   3. HMMA 820 TN01-03 - Grouting Hollow Metal Frames
   4. HMMA 820 TN02-03 - Continuously Welded Frames
   5. HMMA 820 TN03 - Guidelines for Glazing of Hollow Metal Doors and Frames
   6. HMMA 830 TN01-18 - Electrified Hardware Preparations
   7. HMMA 840 - Guide Specification for Installation and Storage of Hollow Metal Doors and Frames

E. If requested by the Architect, furnish two (2) hard copies of the submittals.

F. Contractor to stamp shop drawings verifying they have been coordinated and reviewed for completeness and compliance with the contract documents.

G. Shop drawings submitted without the above information will be considered incomplete and will be rejected.

H. Follow the same procedures for re-submittal as the initial submittal indicating the revised dates.

1.04 ENVIRONMENTAL SUBMITTAL

A. Provide data to ensure compliance with International Energy Conservation Code (IECC) regarding U-value of 0.61 or less at exterior swinging doors.

B. When required to be registered with the US Green Buildings Council and certified under the LEED Green Buildings Program, provide products and procedures necessary to obtain LEED credits required in this Section. Although other Sections may specify some requirements that contribute to LEED credits, the Contractor shall determine additional materials and procedures necessary to obtain LEED credits indicated. Contractor to determine a combination of credit options best suited for achieving credits required.

C. Building Product Disclosure and Optimization
   1. MRc2, Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Option 1. Specified product(s) must demonstrate a LEED v4, v4.1 compliant Environmental Product Declaration for permanently installed products which meet one of the disclosure criteria below:
      a. Product-Specific Declaration: Valued as one quarter (1/4) of a product.
      b. Industry-Wide (Generic) EPD: Valued as one half (1/2) of a product.
      c. Product-Specific Type III EPD: Valued as one whole product.
   2. MRc3, Building Product Disclosure and Optimization, Sourcing of Raw Materials: Option 1, Raw Material Source and Extraction Reporting. Specified Product Manufacturers must

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be able to provide a GRI or ISO 26000 Sustainability Report which includes the Specified Product(s) raw material extraction location by country for at least 95% of the materials ingredients. The Sustainability Report should also explain the biodiversity impacts associated with the stated raw material extraction locations. The Report should be Third Party Assured.

3. MRc4, Building Product Disclosure and Optimization, Material Ingredients, Option 1: Material Ingredient Reporting. Specified Product(s) must be able to demonstrate the chemical inventory of the Specified Product(s) to at least 0.1% (1000 ppm), using one of the following disclosure criteria. Third Party Verified Material Ingredient Reports are preferred.
   a. Manufacturer Inventory (MI).
   b. Health Product Declarations (HPDs).
   c. Cradle to Cradle (C2C) Material Health Certificates or Certification.
   d. Declare Labels.

1.05 QUALITY ASSURANCE

A. Conform to applicable codes for fire ratings. It is the intent of the specification that doors and frames comply or exceed the standards for labeled openings. In case of conflict between types required for fire protection, furnish type required by NFPA, UL and ITS.

B. Supplier shall be responsible for the proper coordination, function and details of the doors and frames required for all openings.

C. In the case of conflict between the drawings and specifications, provide doors and frames of equal quality to that specified required to meet the intent of the specifications. The Contractor shall notify the Architect of discrepancies before materials are fabricated.

D. The Contractor shall field verify existing door opening conditions where existing doors or frames are to remain or be replaced in part, for coordination with the specified hardware and notify the Architect of conflicts prior to proceeding. The Contractor is responsible for details and accuracy and correlating all quantities and dimensions. Failure to notify the Architect of conflicts that result in additional work or material is the responsibility of the Contractor, with no cost to the Owner.

E. Work performed and materials furnished shall be in compliance with the intent of the design.

F. In the event the Architect finds the materials or the finished product in which materials used are not in complete conformity with the contract requirements and have resulted in an inferior or unsatisfactory product, the materials shall be removed and replaced.

G. Underwriters' Laboratories and Intertek Testing Services / Warnock Hersey, labeled fire doors and frames:
   1. Label fire doors and frames listed in accordance with Underwriters Laboratories standard UL 10C, and Positive Pressure Fire Tests of Door Assemblies.
   2. Construct and install doors and frames in accordance with NFPA 80.
   3. Manufacture fire rated doors under the UL or ITS/WH factory inspection program providing the degree of fire protection capability indicated by the door schedule drawings.
   4. Metal fire labels shall be permanently affixed to the door and frame in compliance with NFPA 80. Mylar or stamped labels are not permitted.
   5. No field modifications shall be made to the fire door assembly that would void the label. Field modifications to a fire door shall be in accordance with NFPA 80. Work shall be done by a licensed labeling service approved by the manufacturer.
   6. Labels are not to be removed, defaced or made illegible while the door is in service per NFPA 80.

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7. Door and frame labels are not to be factory or field primed or painted. The Contractor shall be responsible for all costs incurred to clean labels.
8. Apply labels in locations that are clearly visible and convenient for identification by the AHJ, Owner and Architect after installation.
9. Fire doors and frames provided with continuous hinges shall have the physical label for the frame located on the rabbet of the head jamb and on the top channel of the door.

H. Oversize Construction Certification: For door assemblies required to be fire rated and exceeding limitations of labeled assemblies, submit certification of a testing agency acceptable to authorities having jurisdiction that each door and frame assembly has been constructed to comply with design, materials, and construction equivalent to requirements for labeled construction.

1.06 WARRANTY

A. Provide Manufacturer's standard warranty, signed by the Manufacturer, in which Manufacturer agrees to repair or replace doors that are defective in material or workmanship.

1.07 SAMPLES

A. If requested by the Architect, submit a cut-away sample door with provisions for lockset, hinge and corner section of frame.
1. Construct door sample to show vertical edge construction, top and bottom construction, insulation, face stiffeners and hardware reinforcements. Include louver sections and glazing stop where applicable.
2. Construct frame sample to show frame profile, welded corner joint, welded hinge reinforcement, dust cover boxes, floor anchors and wall anchors. Include panel and louver sections and glazing stops where applicable.
3. All samples submitted must represent, in all respects, the quality of work to be furnished.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Storage of Doors:
1. Store doors vertically in a dry area, under proper cover. Place the units on 4" high wood sills on floors in a manner that will prevent rust and damage. Any wraps or covers shall be removed from doors upon receipt at the jobsite. Provide ample air circulation between the doors. Proper storage shall meet the requirements of ANSI/SDI A250.10 and HMMA 840.

B. Storage of Frames:
1. Store frames in an upright position with heads uppermost under cover on wood sills on floors in a manner that will prevent rust and damage. Remove any wraps or covers upon receipt at the jobsite. Store assembled frames in a vertical position, five units maximum in a stack. Provide a 2" space between frames to permit air circulation.
2. Store all hollow metal products in a manner to prevent exposure to adverse environmental elements and maintain the requirements of ANSI/SDI A250.10 and HMMA 840.
3. Sand, touch up and clean prime painted surfaces prior to finish painting in accordance with the manufacturer’s instructions. Zinc base primer is to be used on all doors and frames.

1.09 COORDINATION

A. Coordinate Work with other sections involving manufacture or fabrication of internal cutouts and reinforcement for door hardware and electrified items.

B. Coordinate hardware mounting heights as specified under Section 087100.

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C. Coordinate frame undercuts and door clearances with sill and floor details. Interior doors to have 3/8” clearance. Clearance is distance between the bottom of the door and the top of the material directly below the door. Contractor shall verify field conditions to ensure proper clearances.

D. Factory prep hollow metal frames to receive security components. Refer to security drawings for details, diagrams and locations.

E. The Contractor shall field verify existing door opening conditions where existing doors or frames are to remain or be replaced in part, for coordination with the specified hardware and notify the Architect of conflicts prior to proceeding. Failure to notify the Architect of conflicts that result in additional work or material is the responsibility of the Contractor, with no cost to the Owner.

F. Field dimensions need to be verified and approved prior to fabrication.

G. The supplier shall be responsible for proper coordination, templating, dimensions and all details required for doors, frames and hardware application.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable manufacturers for doors and frames specified are listed below. Only the products of the listed manufacturers will be accepted. No other alternates will be accepted.
   1. Curries.
   2. Metal Products Inc.
   3. Steelcraft.

B. The Manufacturers listed herein are capable of providing products that meet or exceed the specified requirements. Products that do not comply with specified requirements will be rejected.

C. Provide hollow metal doors and frames from a SDI certified manufacturer.

2.02 DOORS

A. Thermally Rated Door Assemblies:
   1. Fabricate exterior doors with U factor maximum to comply with ASHRAE 90.1 and the IECC for the project's specific geographic location and in accordance with ASTM C1363.

B. Construct exterior/interior doors as follows:
   1. Exterior Doors: Zinc-Iron Alloy-Coated galvannealed steel, ASTM A653/A653A Class A60, 16 gauge (0.053-inch)
      a. Include galvannealed components and internal reinforcements with galvannealed doors.
      b. Provide galvannealed top and bottom screw in caps on all exterior doors.
      c. Provide weep-holes in bottom of doors to permit entrapped moisture to escape.
      d. Coordinate door mid-rail location with mounting height of exit device per Section 087100.
   2. Interior Doors: Cold-rolled steel, 18 gauge (0.042) cold rolled steel. Provide door core to meet STC rating where required.
   3. Factory prime paint doors and frames to meet the requirements per ANSI/SDI A250.10.
   4. Hardware Reinforcements:
      a. Hinge reinforcements for full mortise hinges: minimum 7 gauge.
      b. Lock reinforcements: minimum 16 gauge.

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c. Closer reinforcements: minimum 14 gauge.
d. Galvannealed doors: include galvannealed hardware reinforcements.
e. Projection weld hinge and lock reinforcements to the edge of the door.
f. Provided adequate reinforcements for hardware as required.

5. Glass moldings and stops (both labeled and non-labeled doors):
   a. Fabricate glass trim from 24 gauge steel conforming to:
      1) ASTM A 924 Zinc-Iron Alloy-Coated galvannealed steel (A60) at exterior openings.
      2) ASTM A 1008 cold rolled steel at interior openings
      3) Install glass trim into the door as a four sided welded assembly identical on both sides of the door with mitered, reinforced and welded corners. Provide same trim for both fire rated and non-fire rated doors.
      4) Exposed fasteners are not permitted.

C. Full Flush Type Doors Construction:
   1. Doors shall have been tested and certified meeting ANSI/SDI A250.4.
   2. Approved door core constructions:
      a. Honeycomb Core: Reinforced, stiffened, sound deadened and insulated with Kraft honeycomb core completely filling the inside of the doors and laminated to inside faces of both panels with contact adhesive applied to both panels.
      b. Polystyrene Core: Reinforced, stiffened, sound deadened and insulated with a rigid closed cell polystyrene core bonded to the inside faces of both panels. Core shall meet the requirements of ASTM C578.
      c. Steel Stiffened Core: Doors shall be stiffened by continuous vertically formed steel sections which, upon assembly, shall span the full thickness of the interior space between door faces. Vertical stiffeners shall be minimum 22 gauge thickness, spaced so that the vertical interior webs shall be not more than 6 inches apart and spot welded to both face sheets at a maximum of 5 inches on center vertically. Spaces between stiffeners shall be filled with sound deadening and heat retarding mineral fiber insulating material for full height of door.
         1) Temperature Rise Core: Fire door assemblies in interior exit stairways, exit passageways and ramps shall have a maximum transmitted temperature rise rating of not more than 250° F above ambient at the end of 30 minutes of standard fire test exposure.
      d. Door cores shall meet the STC provisions of ANSI/ASA S12.60 where required.
   3. Reinforce top and bottom of doors with 14 gauge inverted channel welded to both face sheets. Channels to be galvannealed at exterior and CRS at interior.
   4. Bevel hinge and lock door edges 1/8-inch in 2 inches**<< 2 inches>>**. Square edges on hinge or lock stiles are not acceptable.
   5. Vertical edge seams: Provide doors with continuous vertical mechanical inter-locking joints at lock and hinge edges with visible edge seams, or a one piece full height 12 gauge channel. Apply a continuous bead of structural epoxy in the internal vertical connection.
   6. Provide Z type metal astragal at double egress cross corridor doors.

D. Electrical Requirements:
   1. General: Make provisions for installation of electrical items specified in Section 087100.
      a. Provide cutouts and reinforcements required for hollow metal doors and frames to accept electrical door hardware and security system components. Coordinate with Security Drawings.

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2.03 ACOUSTICAL DOORS

A. Acoustical Doors shall conform to the American National Standard Acoustical Performance Criteria, Design Requirements and Guidelines for Schools, ANSI/ASA S12.60.
   1. These spaces include, but are not limited to, classrooms, instructional pods or activity areas, group instruction rooms, conference rooms, libraries, speech clinics, offices used for educational purposes and music rooms for instruction, practice and performance.

B. The STC rating for hollow metal interior entry doors at multi-purpose, dining, gym, classrooms and other core learning spaces shall conform to the requirements of ANSI/ASA S12.60, with a minimum STC 30 operable rating. Doors to music rooms and doors between two classrooms shall be a minimum STC 40 operable rating. Comply with additional requirements as noted on the door schedule drawings.

C. Provide at STC rated doors Anemostat LoPro-STC vision lite system consisting of acoustical glass, lite kit and glazing tape of the proper size and thickness to meet or exceed the STC acoustical rating of the door and frame assembly.

D. Provide gasketing and door bottoms as specified under Section 087100.

E. Gasketing and door seals are not to be painted.

F. Door manufacturer shall provide a Letter of Certification (or copy of test report) from an independent testing laboratory accredited as an acoustical laboratory, verifying that conformance to the STC acoustical performance has been met with the specified gasketing, under Section 087100. Testing shall be performed at laboratories that are fully accredited under the National Voluntary Laboratory Accreditation Program (NVLAP).

G. Doors shall have a 3/8” clearance. Coordinate undercuts accordingly. Refer to "Coordination" article in Part 1 above.

H. Coordinate adjustable mortise door bottom as specified in Section 087100 with bottom door channel.

2.04 DOOR FRAMES

A. Construct exterior and interior metal door frames to profiles, designs and gauges
   1. Exterior Frames: Zinc-Iron Alloy-Coated galvannealed steel, ASTM A653 Class A60, 14 gauge (0.067-inch).
   2. Interior Frames in Masonry: Zinc-Iron Alloy-Coated galvannealed steel, ASTM A653 Class A60, 16 gauge (0.053-inch) galvannealed steel.
   3. All Frames in masonry are welded construction.
   4. Interior frames in masonry wider than 6'-0" shall be 14 gauge.
   5. Include galvannealed components and internal reinforcements with galvannealed frames.
   6. Interior KD Drywall Frames: 16 gauge cold rolled steel.

B. Flush Frames: knocked down for field assembly or set-up and welded with temporary spreader bars. Factory die-mitered corner connections reinforced with integral corner tabs tack welded to secure and interlock at jambs to head. Unless otherwise indicated, frame will have 2 inch faces and 5/8-inch stops. Frame depths per the architectural door schedule.
   1. Provide frames with a minimum of six wall anchors and two adjustable base anchors of manufacturer's standard design. Furnish anchors to meet wall conditions.
      a. Acceptable manufacturers:
         1) Curries.
         2) Metal Products Inc.
         3) Steelcraft.

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2. Provide welded 3 sided frames:
    a. Face welded: Weld miter joints between head and jamb faces completely along their length either internally or externally. The remaining elements of the frame profile (soffit, stop and rabbets) are not welded unless otherwise specified. Grind and finish face joints smooth. Prime paint with zinc rich rust inhibitive primer.
3. All frames in masonry walls eight (8) inches or less shall be wrap around type frames.

C. Drywall Frames: 16 gauge
1. Form frames with double return backbends to prevent cutting into drywall surface. Design knock down frames to be securely installed in the rough opening after wallboard is applied.
    a. Drywall frames: knocked down for field assembly. Factory die-mitered corner connections reinforced at miters, including soffit tabs to secure and interlock at jambs to head
2. Locate adjustable anchors in each jamb 4” from the top of the door opening to hold frame in rigid alignment.
    a. Provide security anchor at strike jambs on all frames 7'-6" high and over.
3. Base anchors:
    a. Weld-in base anchor attaching plate in each jamb for field installation of loose base anchors to allow proper anchoring at base of frame.
    b. Acceptable Products:
        1) Curries: C with P0087.
        2) Metal Products, Inc; DW.
        3) Steelcraft; DW.
    c. Countersunk holes with face mounted screws at the base of the jamb is unacceptable.
    d. Contractor to provide at each jamb a piece of wood to be inserted in metal floor channel of size to accept adjustable lock-in base anchor screws.

D. Prepare frames to receive field inserted type door silencers (3) per strike jamb on single doors, and (2) per head for pair of doors. Stick-on silencers are not permitted.

E. Frame Hardware Reinforcements:
1. Mortise hinge reinforcement: minimum 7 gauge.
    a. Provide high frequency full mortise hinge reinforcement for top hinge in accordance with SDI 111-H, Example “A” Application on all frames for doors 3'-6" wide and greater.
2. Strike reinforcements: minimum 16 gauge and prepared for an ANSI-A 115.1-2 strike. Reinforcement to include a mortar box welded to the reinforcement.
3. Closer reinforcement: minimum 14 gauge steel.
4. Provide head reinforcement for frames more than 48 inches wide in masonry wall openings, provide continuous steel channel, 12 gauge thick for full width of opening, welded to back of frame at head, Head reinforcements shall not be used as a lintel or load bearing member for masonry.
5. Projection weld hinge and strike reinforcements to the door frame.
6. Provide metal mortar guards for mortised cutouts.
7. Provide adequate reinforcements for hardware as required.
8. Include galvanized hardware reinforcements in galvannealed frames.
9. Provide full height 16 gauge frame reinforcement at continuous hinges for doors more than 3'-6" wide.

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10. Provide grout guard at grouted frames that are to receive continuous hinges.
    a. Grout guards shall be full height, 18 gauge, galvanized, welded in door rabbet, 3/4-inch depth with top and bottom capped. Provide detail.

F. Electrical Requirements:
1. Coordinate all electrical requirements for doors and frames.
    a. Provide cutouts and reinforcements required for metal door frames to receive electrical hardware and security components.
    b. Provide welded UL listed junction back boxes with 3/4-inch metal conduit or raceway to permit wiring from electrical door hardware.
    c. Junction/grout guard cover boxes are to be caulked by installation contractor.
    d. Refer to Section 087100 for electrified hardware.
2. Provide mortar box welded in head of door frame at exterior frames for future door security system components. Coordinate type, location and requirements provided by Owner and Security Drawings.

2.05 CONSTRUCTION OF ARCHITECTURAL STICK COMPONENTS

A. Fabricate architectural stick frame assemblies from standard frame components, fabricated from 14 gauge galvannealed steel A60 for exterior, and 16 gauge cold rolled steel for interior.

B. Construct architectural stick frame assemblies of standard frame components, fabricated as specified.
1. Exterior Frames: Zinc-Iron Alloy-Coated galvannealed steel, ASTM A653 Class A60, 14 gauge.
2. Interior Frames in Masonry: Zinc-Iron Alloy-Coated galvannealed steel, ASTM A653 Class A60, 16 gauge galvannealed steel.
3. Include galvannealed components and internal reinforcements with galvannealed frames.
4. Interior Frames in drywall construction: 16 gauge cold rolled steel frames.

C. Frame component requirements:
1. Prepare required components at door openings and frame assemblies for specified hardware.
2. Fabricate frame assemblies from three basic components:
    a. Open Sections (perimeter members) identical in configuration to standard frames.
    b. Closed sections (intermediate members) with identical jamb depth, face dimensions, and stops as open sections.
    c. Sill sections: Fabricated from galvanized steel, flush with both faces of adjacent vertical members. Cut individual components to length and notched to assure square joints and corners.
3. Externally welded face joints at meeting mullions or between mullions and other frame members on the face surfaces only. Grind and finish face joints smooth.
4. Ship frame assemblies to the jobsite completely welded. Field splice joints permissible only when the size of the total assembly exceeds shipping limitations. Fabricate oversized frames in sections designated for splicing in the field. Provide frames with joint reinforcements 14 gauge, 8 inch long. Field weld joint reinforcement inside and tack weld outside joint at both faces, grind, and finish smooth and uniform in appearance, after installation.
5. Frames shall be prime painted using zinc rich rust inhibitive primer.
6. All frame glass stops are to be furnished with manufacturers' standard fasteners.
7. Provide necessary anchors for jambs, heads, and sills of assemblies.

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D. Verification of field dimensions required. Do not begin fabrication until all dimensions have been verified, submitted, and approved by the Architect.

2.06 FABRICATION

A. Face Welded Frames:
   1. Continuous face weld the joint between the head and jamb faces along their length either internally or externally. Grind, prime paint, and finish smooth face joints with no visible face seams.
   2. Externally weld, grind, prime paint, and finish smooth face joints at meeting mullions or between mullions and other frame members per ANSI/SDI A250.8.
   3. Provide two (2) temporary steel spreaders welded to the jambs at each rabbet of door openings on welded frames during shipment and handling. Remove temporary steel spreaders prior to installation of the frame.

2.07 FINISH

A. Doors, frames and frame components are required to be cleaned, phosphatized, and finished with one coat of baked-on rust inhibiting prime paint in accordance with ANSI/SDI A250.10 “Test Procedures and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.”

PART 3 EXECUTION

3.01 INSTALLATION

A. Install doors and frames in accordance with the latest edition of the Steel Door Institute’s recommended erection instructions for steel frames ANSI A 250.11.

B. Install fire rated doors and frames in accordance with NFPA 80. Clearances between the top and vertical edges of the door and the frame and the meeting edges of doors swinging in pairs shall meet the requirements of NFPA 80.

C. Drill and tap hollow metal frames to receive manufacturer’s approved machine screws for attachment of all closer arms, soffit shoe and shoe support, reference Section 087100. Use of self-reaming and self-tapping screws is unacceptable.

D. Spreader bars are for shipping and handling purposes only and must be removed before installing the frame.

E. Set frames accurately in position; plumb, align and brace until permanent anchors are set. After wall construction is complete, remove temporary wood spreaders.
   1. Field splice only at approved locations indicated on the shop drawings. Weld, grind, and finish as required to conceal evidence of splicing on exposed faces. Prime paint with zinc rich rust inhibitive primer.

F. Grouting Requirements:
   1. Hollow Metal Frames to receive grouting shall comply with ANSI/SDI A250.8 and HMMA 820 TN01-03, Grouting Hollow Metal Frames.
   2. Contractor to provide a metal mortar box at all hollow metal frames in masonry walls to receive electrical hardware and security components. Grout only the vertical jambs after mortar boxes and conduit are in place and field caulked. Do not grout frame heads.
   3. Provide and install temporary bottom and intermediate wood spreaders to maintain proper width and avoid bowing of jambs or deforming of frame members. Reference ANSI/SDI A250.11.

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G. Glaze and seal exterior transom, sidelight and window frames in accordance with HMMA 820 TN03.

H. Contractor to inspect doors and frames prior to installation for any damage, manufacturing defects or any factory prime painting inconsistency.

I. Should there be any door or frame issues, do not proceed with installation. Contact supplier to correct unsatisfactory condition and proceed only after corrections have been made.

J. Install hardware in accordance with hardware manufacturers' instructions and Section 087100. Adjust door installation to provide uniform clearance at head and jambs, to achieve maximum operational effectiveness and appearance.

3.02 ADJUSTING

A. Adjust and check each operating item of door hardware and each door to ensure proper operation or function of each hardware component. Replace hardware components that cannot be adjusted to operate as intended.

B. The Contractor is to contact the Door and Hardware Supplier to coordinate the fire door inspection and advise MCPS of inspection schedule.

C. Fire Door Assembly Inspection and Testing: Upon completion of the installation, provide functional testing and inspection of each fire door assembly on the project to confirm proper operation and that it meets all criteria of a fire door assembly as per NFPA 80 - Inspection and Testing. Inspections shall be performed by individuals with knowledge and understanding of the operating components of the door being subjected to testing and who are certified by Intertek as a Fire Door Assembly Inspector (FDAI), a credentialed Architectural Hardware Consultant (AHC) or a Door and Hardware Consultant (DHC). Submit a written report to the Contractor, Architect and Owner and make available to the Authority Having Jurisdiction (AHJ). The report shall list each fire door assembly throughout the project, and include door number, location, hardware set and summary of deficiencies at each opening.
   1. Contractor shall correct all deficiencies and schedule a re-inspection of fire door assemblies noted as deficient on the inspection report. All deficiencies must be repaired without delay.
   2. Inspector shall re-inspect fire door assemblies after repairs are made.
   3. Additional re-inspections which are required due to incomplete repairs will be performed by the inspector at the expense of the Contractor.

D. Prime Coat Touch-Up: Immediately after erection, sand smooth rusted or damaged areas of prime coat, and apply touch-up with zinc rich rust inhibitive primer. Comply with HMMA-840-TN01.

3.03 PROTECTION

A. Provide protective measures required throughout the construction period to ensure that door and frame units will be without damage or deterioration, other than normal weathering, at time of acceptance.

END OF SECTION 081113

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SECTION 081416
FLUSH WOOD DOORS

PART 1 GENERAL

1.01 REQUIREMENTS OF REGULATORY AGENCIES

A. Wood Doors and installation shall comply with provisions and standards listed. The latest published edition of each standard applies.

B. ASTM - American Society for Testing and Materials
   1. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements. (All doors tested shall be fully operable)
   2. ASTM E413 - Classification for Rating Sound Insulation.
   3. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies, Section 18 - Security Test of Swinging Door Assemblies - Door Impact Test.

C. ANSI - American National Standards Institute
   1. ANSI/BHMA A156.115W - Specifications for Hardware Preparation in Wood Doors and Frames.
   2. ANSI/BHMA A156.7 - Hinge Template Dimensions.
   3. ANSI/HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood.
   4. ANSI A208.1 - Particleboard.
   5. ANSI-ASA S12.60 - Standard Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools.
   6. ANSI/A117.1 - Accessible and Useable Buildings and Facilities.
   7. ANSI/UL 10C - Standard for Safety for Positive Pressure Fire Tests of Door Assemblies.

D. ANSI/WDMA - Window and Door Manufacturers Association
   1. WDMA I.S. 1A-21 - Industry Standard for Architectural Flush Wood Doors.

E. Building Code references
   1. IBC - International Building Code.
   2. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
   3. NFPA 101 - Life Safety Code.
   4. NFPA 105 - Standard for the Installation of Smoke Door Assemblies and Other Opening Protectives.
   5. NFPA 252 - Standard Method of Fire Tests of Door Assemblies.
   6. UL 1784 - Air Leakage Tests of Door Assemblies.
   7. ITS/WH Certification - Certification Listings for Fire Doors.
   8. Consumer Products Safety Commission (CPSC) 16 CFR 1201 - Standard for Architectural Glazing US Green Building Council (USGBC).
   9. Green Globes Certification.
   10. LEED Leadership in Energy and Environmental Design rating system.

1.02 SUPPLIER QUALIFICATIONS

A. Wood Door Supplier shall maintain at the location which will be managing the project, a credentialed Architectural Hardware Consultant (AHC), Certified Door Consultant (CDC) or

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Door and Hardware Consultant (DHC) as a full time employee and member in good standing of DHI - Door Security + Safety Professionals.

B. The Door Supplier shall have completed a minimum of three education facilities over the last five years which were similar in size, material, design and extent to that indicated for the project as determined by the Architect. If requested by the Architect, submit a list of projects listing the project name, location, Owner, Architect and Contractor.

C. As a requirement, the Wood Door Supplier shall maintain an office and warehouse complete with a wood door inventory within a one hundred (100) mile radius of the jobsite. The Supplier shall further have a qualified field service staff available to service the project.

D. Door Consultant on the project shall be available throughout the project to meet with the Contractor, Architect or Owner as requested.

E. Failure to meet the above requirements will disqualify the bidder.

1.03 SUBMITTALS

A. Submit digital copies of the wood door shop drawing submittals with complete details for the project, including copies of technical information and other pertinent data required for compliance with the specification.

1. Submit Shop Drawings which reference designations noted on the door schedule drawings. Shop Drawings shall include opening size, handing, door elevations, location, fire label requirements, temperature rise rating, hardware group numbers, hardware mounting height, locations, glass beads/moldings, accoustical STC glass kits, internal blocking, vertical edge detail, top and bottom rail details, underuts/clearance, beveling, wiring diagrams and other information specific to the project.

B. Data submitted shall be job specific and shall include product data and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. Where contents of submitted literature from manufacturers include data not pertinent to the submittal, clearly identify product being submitted for review. Submit only product data specific to the project.

C. Provide door construction details/drawings of vertical edges, top rail and SWE details for all doors.

D. Indicate location of cutouts for hardware and blocking to ensure doors are properly prepared and coordinated to receive hardware. Hardware mounting heights in accordance with Section 087100.

E. As part of the Shop Drawing submittal, provide copy of WDMA J1and J2, Job Site Information, "How to store, handle, finish, install and maintain wood doors."

F. Contractor to stamp Shop Drawings to certify they have been coordinated and reviewed for completeness and compliance with the contract documents.

G. The same procedures for re-submittal as the initial submittal shall apply with the revised dates noted in the shop drawings.

H. Shop drawings submitted without the above documentation will be considered incomplete, and will be rejected.

1.04 ENVIRONMENTAL SUBMITTAL

A. When required to be registered with the US Green Buildings Council and certified under the LEED Rating System the following shall apply:

B. LEED Requirements:

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1. MR Credit: Building Product Disclosure and Optimization - Environmental Product Declarations. Option 1. For each product submit:
   a. If available, provide a product-specific Type III EPD - third-party certified EPD including external verification in accordance with ISO 14025.
   b. Alternatively, submit an industry-wide (generic) EPD - products with third-party certified EPD including external verification in accordance with ISO 14025 in which the manufacturer is explicitly recognized as a participant by the program operator.
   c. Alternatively, submit product specific declaration - publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that has at least a cradle to gate scope.
2. Materials and Resources: Product Disclosure and Optimization - Sourcing of Raw Materials. Option 2. Leadership Extraction Practices.
   a. Chain-of-Custody Certificates: For certified wood products. Include statements of costs.
   b. For each product submit:
      1) A letter stating the dollar value of the sum of post-consumer recycled content plus one-half the pre-consumer recycled content based on weight.
3. Products shall meet EPA (TSCA); Title VI for formaldehyde requirements for ultra-low-emitting formaldehyde.
4. For composite wood products, documentation indicating that products comply with the testing and product requirements of the current California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers." Provide products that are third party certified through SCS Indoor Advantage Gold or UL GREENGUARD.
   a. All composite wood and agrifiber products shall meet this requirement.
   b. In addition, provide products that are third party certified through SCS Indoor Advantage Gold or UL GREENGUARD.
5. EQ Prerequisite: Minimum Acoustic Performance: Building shell, classroom partitions, and other core learning space partitions meet STC (Sound Transmission Classification) requirements of ANSI/ASA S12.60.

1.05 QUALITY ASSURANCE

A. Quality Standard: WDMA I.S. 1A, Latest edition, Industry Standard for Architectural Flush Wood Flush Doors.

B. Comply with the requirements of the referenced standards. Submit manufacturers letter of compliance.

C. Underwriters' Laboratories or Intertek Testing Services / Warnock Hersey, Positive Pressure Category A labeled wood fire doors:
   1. Label fire doors listed in accordance with Underwriters Laboratories standard UL 10C, Positive Pressure Fire Tests of Door Assemblies and Air Leakage Tests of Door Assemblies - UL 1784.
   2. Construct and install doors in accordance with the standards of NFPA 80.
   3. Manufacture fire rated doors under the UL or ITS/WH factory inspection program providing the degree of fire protection capability indicated by the door schedule drawings.
   4. Provide metal labels permanently affixed to each fire door at an authorized and licensed facility as evidence of compliance with procedures of the labeling agency.

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5. No field modifications shall be made to the fire door assembly that would void the label. Field modifications to a fire door shall be in accordance with NFPA 80. Work shall be done by a licensed labeling service approved by the manufacturer.
6. Labels are not to be removed, defaced or made illegible while the door is in service per NFPA 80. Fire labels are NOT to be painted or pre-finished.
7. Fire doors with continuous hinges shall have the physical label located on the top rail of the door.
8. Conform to applicable codes for fire ratings. It is the intent of this specification that wood doors comply or exceed the standards for labeled openings. In case of conflict between door types required for fire protection, furnish the type required by NFPA and UL.
9. Validate the Smoke and Draft Control ("S") Label for hardware sets that include Category H smoke and draft control seals.
10. All Category G seals required will be concealed in the door or applied to the top rail. No Category G seals will be allowed on the door frame.

1.06 WARRANTY

A. Provide Manufacturer's standard warranty form, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship for the life of the original installation of the door.

B. Manufacturers do not warrant doors where self-tapping or combination wood/metal screws to attach surface applied hardware. Provide manufacturer's proper fasteners.

1.07 SAMPLES

A. Provide color swatches with factory pre-finishing shall consist of four (4) finish samples. Samples to be manufacturer's standard size with specified veneer species. The sample should reasonably represent the color range of the veneer species expected in the finished work. Samples shall be protected from oxidation and light to preserve original color approvals. These samples shall be project specific.

B. If requested by the Architect, provide three (3) fire rated wood door samples demonstrating door construction with provisions for vertical stiles and top rails as specified herein.

C. If requested by the Architect, provide three (3) non-fire rated wood door samples demonstrating door construction with provisions for vertical stiles and top rails as specified herein.

D. All samples submitted must represent, in all respects, the quality of work to be furnished.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Provide protective measures throughout the construction period to safeguard doors from damage or deterioration from the time of acceptance.

B. Store and protect doors in accordance with manufacturer's recommendations and Section J-1 and J-2 of WDMA I.S. 1A - "How to Store, Handle, Finish, Install and Maintain Wood Doors."
   1. Store doors flat and off the floor on a level surface in a dry, well-ventilated building. Do not store on edge. Protect doors from dirt, water and abuse and allow for air circulation.
   2. Protect all doors from exposure to direct sunlight and artificial light after delivery.
   3. Do not subject interior doors to extremes of either heat or humidity. HVAC systems must be operational and balanced, providing a temperature range of 50 to 90 degrees Fahrenheit and 25% to 55% relative humidity.
   4. When handling doors, lift and carry when moving. Do not drag across other doors or surfaces. Handle with clean, dry hands or while wearing clean dry gloves.

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5. Manufacturer shall mark each door on the top rail and top hinge pocket with the door opening number. In addition, the top rail shall be marked with manufacture's name, factory order number, and other additional markings to properly identify the door.

1.09 COORDINATION

A. Coordinate work with other sections involving manufacture or fabrication of internal cutouts and internal blocking for door hardware, electrified and mortised items. Provide necessary blocking in mineral core doors to prevent door failure from surface applied hardware.

B. Coordinate frame undercuts and door clearances with sill and floor details. Interior doors to have 3/8-inch clearance. Clearance is distance between the bottom of the door and the top of the material directly below the door. The Contractor shall verify field conditions to ensure proper clearances.

C. The Contractor shall field verify existing door opening conditions, where existing doors or frames are to remain or be replaced in part, for coordination with the specified hardware and notify the Architect of conflicts prior to proceeding. Failure to notify the Architect of conflicts that result in additional work or material is the responsibility of the Contractor, with no cost to the Owner.

D. The supplier shall be responsible for proper coordination, templating, dimensions and all details required for doors, frames and hardware application.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable manufacturers for wood doors specified are listed below. Only the products of the listed manufacturers will be accepted. No alternates will be accepted. The manufacturers listed are acceptable providing they adhere to the quality standards as noted herein.
   1. Masonite Architectural: Aspiro Series.
   2. Lambton Doors.
   3. V.T. Industries: Heritage Collection.

B. The manufacturers listed herein are capable of providing products that meet or exceed the specified requirements. Products that do not comply with the specified requirements and construction will be rejected.

C. If doors are rejected, replacement doors shall be furnished expeditiously, at no cost to the Owner.

2.02 DOORS

A. Quality Assurance Requirements: Flush Wood Doors: Comply with the ANSI/WDMA I.S. 1A Industry Standard for Architectural Wood Flush Doors.

B. Non-Fire Rated Wood Doors - All solid core flush wood doors shall meet WDMA Door Grade and WDMA Performance Duty Level specified.
   1. WDMA Aesthetic Grade: Custom "A grade" veneer per HPVA Summary Tables.
   2. WDMA Performance Duty Level: Extra Heavy Duty. All doors shall meet specified WDMA Performance Duty Level, including face screw holding requirement. Surface applied hardware shall be installed in accordance with Section 087100.
   3. Door Type - PC-5: Bonded Wood Based Particle Core, Stiles and rails securely bonded to the core and entire unit abrasively planed prior to application of faces to assure uniform thickness of all components.

C. Fire Rated Wood Doors:

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1. Provide fire classifications with particleboard or mineral core as required to provide fire rating indicated. Doors shall carry UL or ITS (Warnock-Hersey) label based on testing for positive pressure in accordance with NFPA 252 and UL 10C.
2. New wood doors shall have the glazing and light kit installed at the door manufacturer or under label services approved by the door manufacturer. Wood glazing beads are allowed on 20 and 45 minute fire doors with particleboard core construction. Doors with 45, 60 or 90 minute mineral core construction shall have a LoPro metal vision kit/frame.
3. Provide Positive Pressure Doors Category A with intumescent included in door construction where required.
4. Temperature-Rise doors shall have a maximum transmitted temperature end point of not more than 250 degrees above ambient after 30 minutes of fire test.
5. Stiles (Vertical Edges) - Provide manufacturer's standard solid or laminated edge construction approved for each fire protection level with improved screw holding capability of 550 lbs in accordance with WDMA TM-10, Extra Heavy Duty.
    a. Outer stile to be minimum thickness of 1/4-inch after trim. Provide detail/cross section drawing of door edge construction.
6. Rails (Horizontal Edges) - Rails are fire resistive composite or other material contained in manufacturer's fire door approvals.
7. Blocking for fire doors must meet WDMA face screw pull values for surface hardware.
    a. All fire doors shall have a 6 inch minimum top rail after trim. Particleboard construction core 45 minute wood fire doors are not required to have a 6 inch combined blocking top rail provided assembly meets Extra Heavy Duty performance criteria.
8. Provide fire rated pairs with manufacturers approved stiles which match face veneer constructed as Category A. Veneered edges allowed where required to match face veneer. Exposed intumescent at door meeting edges or applied to frames is not acceptable.

D. Electrical Requirements:
    1. General: Make provisions for installation of electrical items specified in Section 087100.
        a. Provide all cutouts and blocking required for wood doors to accept electrical door hardware. Provide cutouts required by the security system vendor and all pre-wiring security system devices.

E. Acoustical Doors:
    1. Acoustical Doors shall conform to the latest edition of the American National Standard Acoustical Performance Criteria, Design Requirements and Guidelines for Schools, ANSI/ASA S12.60.
        a. These spaces include, but are not limited to, classrooms, instructional pods or activity areas, group instruction rooms, conference rooms, libraries, offices, speech clinics, offices used for educational purposes and music rooms for instruction, practice and performance.
    2. Doors into classrooms and other core learning spaces shall conform to the requirements of ANSI/ASA S12.60 with a minimum of a STC 30 operable rating. Doors to music rooms and doors between two classrooms shall be a minimum STC 40 operable rating. Comply with additional requirements as noted in the door schedule.
    3. Provide vision lite system consisting of acoustic glass, lite kit and glazing tape of the proper size and thickness to meet or exceed the STC acoustical rating of the door and frame assembly. Provide Anemostat LoPro-STC vision lite system. The vision lite system shall be factory installed on doors with a STC rating of 40 or greater.

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4. Provide door manufacturer's Letter of Certification (or copy of test report) from an independent testing laboratory accredited as an acoustical laboratory verifying that conformance to the acoustical performance has been met. Testing shall be performed at laboratories that are fully accredited under the National Voluntary Laboratory Accreditation Program (NVLAP).
5. Coordinate door preparation for adjustable mortise door bottom as specified under Section 087100. Mortise prep to end 1/4-inch before edge of door at lock edge, Solid Wood Edge (SWE) prep configuration. Bottom rail shall be hardwood or structural composite lumber. Doors are to be factory prepped to receive the door bottom.
6. Doors shall have a 3/8-inch clearance. Coordinate undercuts with flooring or thresholds. The Contractor shall be responsible for providing the Door Supplier with the final floor thickness for each door opening requiring STC rating.
7. Sound seals and gasketing are not to be painted.

F. Veneer And Veneer Matching:
1. Architect to specify Veneer Species and Cut: **<< Plain Sliced Red Oak; or Plain Sliced White Maple>>**.
   a. Veneer Face Grade “A” as described in WDMA I.S. 1A and HPVA Door Veneer tables ANSI/HPVA-1.
2. Matching Between Leaves: Book match between leaves.
3. Veneer Match: Assembly of Spliced Veneer: Running match on door face.
4. Pair match all pairs and set of pairs separated only by mullions.
5. Set match all groups of pairs and/or individual doors indicated on the door schedule or plans.

G. Non Fire Rated Door:
1. Provide wood based particleboard core. Core to be securely bonded to the stiles and rails with Type I Adhesive.
2. Crossbands shall be a minimum thickness of 1/16-inch and extend the full width of the door and have no seams. Composite crossbands of high density fiberboard are permitted provided they meet or exceed the physical and mechanical properties as described in ANSI A208.2.
3. Vertical Edges to be same species as face veneer, constructed of two plies consisting of hardwood lumber outer layer (outer stile) and hardwood lumber or SCL inner layer (inner stile). The net stile width to be minimum 1 inch before trimming. Veneered edge banding is not acceptable. Provide detail/cross section drawing of door edge construction.
4. Horizontal Edges: Rails must be present on all doors. SCL is allowed for rails. Minimum rail after trim to be 7/8-inch. MDF is unacceptable.
5. Side Panels: Fabricate matching panels with same construction as the door. Side panels will be pair matched to the associated door and receive the same finish.

H. Fire-Rated Doors: Provide Positive Pressure Label Doors.
1. Positive Pressure labeled doors to be Category A.
2. Core material shall be dictated by manufacturer's fire door approvals.
   a. Provide 20 and 45 minute fire resistant particleboard core, bonded construction doors in accordance with manufacturers approvals. Mineral core construction is acceptable when requirements exceed particleboard core label procedures.
   b. All mineral core 45, 60 and 90 min doors shall have a 6 inch minimum top rail after trimming. Blocking must compy with Extra Heavy Duty performance.

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3. Stiles (Vertical Edges) - Provide manufacturer's standard solid or laminated edge construction approved for each fire protection level with improved screw holding for capability of 550 lbs in accordance with WDMA TM-10, Extra Heavy Duty performance.
   a. Outer stile to be minimum thickness of 1/4-inch after trim. Provide detail/cross section drawing of door edge construction.
4. Rails (Horizontal Edges) - Rails shall be fire resistive composite or other material contained in manufacturer's fire door approvals.
5. Provide fire rated pairs with manufacturers approved stiles which match face veneer constructed as Category A. Veneered edges allowed where required to match face veneer and Category A construction. Exposed intumescent at door meeting edges or applied to frames is not acceptable.

2.03 DOOR FABRICATION

A. Factory pre-fit and pre-machine doors to receive hardware as specified under Section 087100.
   1. All doors shall be machined in accordance with manufacturer's procedures in order to maintain manufacturer's warranty and to avoid any machining conflicts.
   2. Doors are to be beveled at both hinge and lock edges.
   3. Factory pre-drill all hinge screw pilot holes for full mortise hinges.
   4. Doors shall have a 3/8-inch clearance. Refer to Coordination article in Part 1.
   5. Coordinate door undercuts per architect's details and hardware specified under Section 087100.
   6. All fire doors shall be in accordance with NFPA 80 for clearances and undercutting requirements.

B. Factory preparation for light openings:
   1. Factory preparation for new wood doors glazing materials in vision panels shall be installed in labeled glass light kits in accordance with the fire door listing and shall be installed in accordance with inspection service procedure and under label service per NFPA 80.
   2. Glass in new wood fire doors shall be installed by the door manufacturer or in a licensed door shop, approved by the door manufacturer.
   3. Fire protection glazing and fire resistance glazing shall meet all applicable impact safety standards.
   4. Provide metal vision kits at all fire labeled doors. Vision kits shall be Anemostat LoPro, 20 gage, with tamperproof screws and beige baked enamel finish. Install tamperproof screw heads on secure side of door. Vision kits shall have UL or W/H classification markings visible for inspection.
   5. Provide wood beads for lite openings in non-fire rated and 20 minute wood doors
      a. Provide manufacturer's standard solid wood straight beads flush design, matching veneer species of door faces. Include finish nails for removable stops in accordance with manufacturers recommendations. Architect to select wood bead design from maufacturer's standard options.

2.04 FACTORY FINISHING

A. All doors, including light beads and moldings, to be factory finished where indicated in schedules or on drawings as factory finished.

B. Finish Requirements:
   1. Manufacturer's standard UV Cured Acrylated Polyester/Urethanes, equal to WDMA TR-8.
      a. Coating - Clear.

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b. Satin Gloss (Gloss range 30-40).

C. Package factory finished doors with manufacturers standard packaging to protect doors from damage during shipment.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install all wood doors in accordance with door manufacturer's instructions and all tolerances outlined in ANSI/WDMA I.S. 1A.

B. Do not install doors in buildings where wet work is still being conducted, such as the taping and floating of drywall or cement.

C. Install label doors in accordance with NFPA 80. Labels are not to be removed, defaced or made illegible while the door is in service.

D. Inspect doors prior to installation for any damage, manufacturing defects or pre-finish inconsistency. Notify supplier of any deficiencies prior to installation.

E. Remove and replace doors that are damaged or defective prior to fire door inspection.

F. Correct unsatisfactory conditions and proceed with installation only after corrections have been made.

3.02 ADJUSTING

A. Adjust and check each operating item of door hardware and each door to ensure proper operation or function of each hardware component. Replace hardware components that cannot be adjusted to operate as intended.

B. The Contractor is to contact the Door and Hardware Supplier to coordinate the fire door inspection and advise the Owner of inspection schedule.

C. Fire Door Assembly Inspection and Testing: Upon completion of the installation, provide functional testing and inspection of each fire door assembly on the project to confirm proper operation and that it meets all criteria of a fire door assembly in accordance with NFPA 80 - Inspection and Testing. Inspections shall be performed by individuals with knowledge and understanding of the operating components of the door being subjected to testing and who are certified by Intertek as a Fire Door Assembly Inspector (FDAI) or a credentialed Architectural Hardware Consultant (AHC) or a Door and Hardware Consultant (DHC). Submit a written report to the Owner, Contractor, Architect and made available to the Authority Having Jurisdiction (AHJ). The report shall list each fire door assembly throughout the project, and include each door number, location, hardware set and summary of deficiencies at each opening.

1. Contractor shall correct all deficiencies and schedule a re-inspection of fire door assemblies noted as deficient on the inspection report. All deficiencies must be repaired without delay.
2. Inspector shall re-inspect fire door assemblies after repairs are made.
3. Additional re-inspections required due to incomplete repairs will be performed by the inspector at the expense of the Contractor.

3.03 PROTECTION

A. Provide protective measures required throughout the construction period to ensure that doors will be without damage or deterioration at time of acceptance.

END OF SECTION 081416

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SECTION 083100
ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ITS (DIR) - Directory of Listed Products.

B. UL (FRD) - Fire Resistance Directory.

1.02 SUBMITTALS

A. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

B. Shop Drawings: Indicate exact position of each access door and/or panel unit.

1. Include a schedule indicating wall/ceiling type, door types, sizes, and hardware for each access door required.

C. Sustainability Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

1.03 COORDINATION

A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in “Submittals” Article.

1. This (083100) material specification includes access doors required for Divisions 21 (Fire Suppression), Division 22, (Plumbing), 23 (HVAC) and Division 26 (Electrical) work and any other access doors indicated on Drawings.
2. All doors for all trades shall be keyed alike. Coordinate with "Latch/Lock" paragraph below for additional information.

PART 2 PRODUCTS

2.01 WALL- AND CEILING-MOUNTED ACCESS UNITS

A. Manufacturers:

1. Activar Construction Products Group, Inc. - JL Industries.
2. ACUDOR Products Inc.
3. Babcock-Davis.
4. Best Access Doors.
5. Cendrex, Inc.
6. Karp Associates, Inc.
7. Larsen's Manufacturing Company.
8. Milcor, Inc.
9. Nystrom, Inc.
10. Williams Brothers Corporation of America.

B. Wall- and Ceiling-Mounted Units (Interior): Factory-fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.

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1. Material: **<< Steel; Steel, hot-dipped zinc or zinc-aluminum-alloy coated; Stainless steel; Stainless steel, Type 304; Aluminum; Aluminum extrusions with gypsum board inlay; or _____>>**.
2. Style (Gypsum Board locations): **<< Exposed frame with door surface flush with frame surface; Frame concealed by door panel; Recessed door panel for infill with wall/ceiling finish; or _____>>**.
   a. Gypsum Board Mounting Criteria: Use drywall bead type frame.
3. Style (Masonry locations): Exposed frame, with door surface flush with frame surface.
4. Door Style: **<< Single thickness with rolled or turned in edges; Double-skinned hollow panel; or _____>>**.
5. Frames: 16-gauge, 0.0598-inch minimum thickness.
6. Double-Skinned Hollow Steel Sheet Door Panels: 16-gauge, 0.0598-inch minimum thickness, on both sides and along each edge.
7. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
   a. Provide products listed by **<< ITS (DIR); UL (FRD); or _____>>** as suitable for purpose indicated.
   b. Provide certificate of compliance from authorities having jurisdiction indicating approval of fire rated doors.
   c. Fire-rated door assemblies shall conform with and be installed in accordance with (1) NFPA 80, (2) door and frame manufacturer's installation instructions, and (3) listing requirements of qualified testing agency.
   d. Provide manufacturer's standard mineral fiber insulation and gasketing.
8. Steel Finish: Factory-primed; for field topcoat to match that used for hollow metal steel doors and frames. Refer to Division 9 Section "Painting" for topcoat information.
9. Hardware:
   a. Hardware for Fire-Rated Units: As required for listing.
   b. Hinges for Non-Fire-Rated Units: **<< Concealed, constant force closure spring type; Continuous piano hinge; Concealed, hinged-arm guide at top and bottom of panel; Heavy duty butt hinges; or ___>>**.
   c. Latch/Lock (Ceiling Units): Screw driver slot for quarter turn cam latch.
   d. Latch/Lock (Wall Units): Cylinder lock-operated cam latch, two keys for each unit. All access doors shall be master keyed to each other (shall not be keyed to the building Door Hardware keying system).

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PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings are correctly sized and located.

B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to proceeding with this work.

B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install frames plumb and level in openings, and secure units rigidly in place.

C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION 083100

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SECTION 083313
COILING COUNTER DOORS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

B. ITS (DIR) - Directory of Listed Products.

C. NEMA MG 00001 - Motors and Generators.

D. UL (DIR) - Online Certifications Directory.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's standard literature showing materials and details of construction and finish. **<< Include data on electrical operation.; or None - N/A>>**

B. Shop Drawings: Indicate rough and actual opening dimensions, anchorage methods, hardware locations, and installation details.

C. Samples: Submit manufacturer's color charts indicating standard range of powder coat finishes.

D. Operation and Maintenance Data: Indicate modes of operation, lubrication requirements and frequency, and periodic adjustments required.

E. Project Record Documents: Include as-built electrical diagrams for electrical operation and connection to fire alarm system.

1.03 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by **<< ITS (DIR); UL (DIR); testing firm acceptable to authorities having jurisdiction; or _____>>** as suitable for the purpose specified in this section and indicated on the drawings.

B. Manufacturer Logo/Label: Manufacturer's logo and/or label shall not be visible on exposed surfaces of door or hood.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Coiling Counter Doors:
1. Alpine Overhead Doors, Inc.
2. Amarr.
3. C.H.I. Overhead Doors.
4. Clopay Building Products.
5. Cornell Iron Works, Inc.
6. McKeon Rolling Steel Door Co., Inc.
7. Overhead Door Corporation.
8. Raynor Garage Doors.
9. The Cookson Company.
10. Wayne-Dalton, a Division of Overhead Door Corporation.

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2.02 COILING COUNTER DOORS

A. Coiling Counter Doors, Non-Fire-Rated: **<< Galvanized steel; Stainless steel; Aluminum; or _____>>** slat curtain.

1. Mounting: **<< Between jambs, within prepared opening; Exterior face mounted; Interior face mounted; As indicated on drawings; or _____>>**.
2. Nominal Slat Size: **<< 1-1/4 inches; 2 inches; or ____ inches>>** wide.
3. Slat Profile: **<< Flat; Curved; or _____>>**.
4. Finish, Galvanized Steel: **<< No additional finish; Factory primed; Factory baked enamel; Factory powder coated; or _____>>**.
5. Color: To be selected by Owner and Architect from manufacturer's **<< full; standard; or custom>>** range.
6. Guides: Formed track; same material and finish unless otherwise indicated.
7. Hood Enclosure: **<< Manufacturer's standard; As indicated on drawings; or _____>><< ; primed steel; ; galvanized steel; ; aluminum; or ; _____>>**. Finish to match slats.
8. **<< Manual>>** push-up operation. ******Verify motorized vs manual operation******
9. **<< Electric>>** operation.

2.03 COMPONENTS

A. Metal Curtain Construction: Interlocking, single-thickness slats.

1. Slat Ends: **<< Alternate slats; or Each slat>>** fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
2. Curtain Bottom: Fitted with **<< angles; tube; or _____>>** to provide reinforcement and positive contact in closed position**<< None - N/A; ; neoprene astragal along bottom edge; ; vinyl astragal along bottom edge; or ; _____ along bottom edge>>**.
3. Steel Slats: **<<ASTM A653/A653M>>** galvanized steel sheet, with minimum **<< G60/Z180; G90/Z275; or ____>>** coating; minimum thickness **<< 22 gauge, 0.03 inch; 20 gauge, 0.04 inch; 18 gauge, 0.05 inch; 16 gauge, 0.06 inch; or ___ gauge, ___ inch>>**.

B. Guide Construction: Continuous, of profile to retain door in place, with mounting brackets of same metal.

C. Hood Enclosure: Internally reinforced to maintain rigidity and shape.

D. Lock Hardware: ******Verify with motorized vs manual operation******

1. For **<< motor operated>>** units, additional lock or latching mechanisms are not required.
2. For **<< manual>>** units, provide slide bolt on single-jamb side, extending into slot in guides, with padlock hasp (padlock is NIC).

E. Roller Shaft Counterbalance: Steel pipe and torsion steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.

2.04 ELECTRIC OPERATION

A. Operator, Controls, Actuators, and Safeties: Listed and classified by **<< ITS (DIR); UL (DIR); testing agency acceptable to authorities having jurisdiction (AHJ); or _____>>** as suitable for purpose specified and indicated.

1. Provide interlock switches on motor operated units.

B. Electric Operators:

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1. Mounting: **<< Side mounted; Center mounted; or _____>>**.
2. Motor Enclosure: **<<NEMA MG 00001>>**.
3. Motor Rating: **<< As recommended by manufacturer; 1/3 hp; 1/2 hp; 3/4 hp; or ____ hp>>**; continuous duty.
4. Motor Voltage: **<< Manufacturer's standard; 110-120 VAC, single phase, 60 Hz; 220-240 VAC, 3 phase, 60 Hz; 440-480 VAC, 3 phase, 60 Hz; or _____>>**.
5. Opening Speed: **<< 6 inches per second; 12 inches per second; or ____ inches per second>>**.
6. Manual override in case of power failure.

C. Control Station: Surface mounted, key-operated three button (OPEN-STOP-CLOSE) momentary control for each electrical operator.
   1. Controls: **<< 24 VAC; 24 VDC; 115 VAC; or _____>>** circuit.

D. Safety Edge: Located at bottom of curtain, full width, **<< electro-mechanical; pneumatic; or _____>>** sensitized type, wired to **<< stop; or reverse>>** operator upon striking object, hollow **<< neoprene; rubber; or _____>>** covered.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that adjacent construction is suitable for door installation.

B. Verify that electrical services have been installed and are accessible.

C. Verify that door opening is plumb, header is level, and dimensions are correct.

D. Notify **<<Architect>>** of any unacceptable conditions or varying dimensions.

E. Commencement of installation indicates acceptance of substrate and door opening conditions.

3.02 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

C. Securely and rigidly brace components suspended from structure. **<< Secure guides to structural members only.; or None - N/A>>**

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

E. Coordinate installation of electrical service with Division 26 electrical specifications and requirements on Electrical Drawings.

F. Complete wiring from disconnect to unit components.

3.03 TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.

B. Maximum Variation From Plumb: 1/16-inch.

C. Maximum Variation From Level: 1/16-inch.

D. Longitudinal or Diagonal Warp: Plus or minus 1/8-inch per 10 ft straight edge.

3.04 ADJUSTING

A. Adjust operating assemblies for smooth and noiseless operation.

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3.05 CLEANING

A. Clean installed components.

B. Remove labels and visible markings.

3.06 FIELD QUALITY CONTROL, DEMONSTRATION, AND INITIAL MAINTENANCE SERVICE

A. Field Testing and Demonstration: Field testing shall be performed by manufacturer's authorized service representative.
   1. Complete final installation, testing, and adjustment procedures in accordance with manufacturer's instructions.
   2. Provide a minimum of 2 hours training and demonstration to Owner's maintenance personnel for operation, adjustment, and maintenance of doors.

B. Provide an Initial Maintenance Contract for maintenance of coiling door system and components for a period of 12 months. Maintenance shall include maximum quarterly intervals (minimum of 4 visits for initial contract), and shall include adjustment, lubrication, and other preventive maintenance, and repair or replacement of defective or worn parts or equipment.
   1. Provide service during regular working hours throughout period of this maintenance contract.

END OF SECTION 083313

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SECTION 083323
OVERHEAD COILING DOORS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

D. ITS (DIR) - Directory of Listed Products.

E. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

F. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.

G. NEMA MG 00001 - Motors and Generators.

H. UL (DIR) - Online Certifications Directory.

I. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of coiling doors with size, location and installation of service utilities, including electrical, access control, and smoke/fire alarm, as required.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.03 SUBMITTALS

A. Product Data: Provide **<< general construction; electrical equipment; component connections and details; and _____>>**.

1. Include product data for automatic closing device for fire shutter application, with testing and resetting instructions.

B. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.

1. Include diagrams indicating motors, controls, and electrical wiring.
2. Indicate coordination with smoke and/or fire alarm systems, and show locations of detectors, replaceable fusible links, and release devices.

C. Selection Samples: Manufacturer's color charts, showing full range of factory finishes.

D. Verification Samples: Manufacturer's standard size sample on curtain slat material indicated.

E. Installer's qualification statement.

F. Maintenance Data: Indicate **<< lubrication requirements and frequency; periodic adjustments required; and _____>>**.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of type specified, approved by manufacturer for installation of specified products. Installer shall be located no more than two hours from Project site to allow for maintenance callbacks.

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B. Products Requiring Electrical Connection: Listed and classified by **<< ITS (DIR); UL (DIR); testing firm acceptable to authorities having jurisdiction; or _____>>** as suitable for purpose specified and indicated.

C. Source Limitations: Provide coiling doors from a single manufacturer, sourced through a single supplier. Obtain operators and controls from door manufacturer or from a manufacturer that is approved by door manufacturer for compatibility.

1.05 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Manufacturer Warranty: Provide two (2) year manufacturer warranty for materials and workmanship for all components of coiling doors. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Overhead Coiling Metal Doors:
1. Alpine Overhead Doors, Inc.
2. Amarr.
3. C.H.I. Overhead Doors.
4. Clopay Building Products.
5. Cornell Iron Works, Inc.
6. McKeon Rolling Steel Door Co., Inc.
7. Overhead Door Corporation.
8. Raynor Garage Doors.
9. The Cookson Company.
10. Wayne-Dalton, a Division of Overhead Door Corporation.
11. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.02 COILING DOORS

A. Exterior Coiling Doors: **<< Steel; Stainless steel; Aluminum; or _____>>** slat curtain.
1. Capable of withstanding positive and negative wind loads of **<< 20 psf; or ____ psf>>** without undue deflection or damage to components.
2. Sandwich Slats: Manufacturer's standard, with core of **<< foamed-in-place polyurethane; or _____>>** insulation; minimum **<< R-value of 4.88; R-value of 8.1; or R-value of ___>>**.
   a. Surface Burning Characteristics: Provide insulation with flame spread index of **<< 25 or less; or 75 or less>>** and smoke developed index of **<< 450 or less; or _____>>**, when tested in accordance with **<<ASTM E84>>**.
3. Slat Size: Manufacturer's standard height and thickness to meet performance requirements; length as required for rough opening width indicated.
4. Guide, Angles: **<< Galvanized steel; Primed steel; Stainless steel; or Powder coated steel>>**.
5. Hood Enclosure: **<< Manufacturer's standard; As indicated on drawings; or _____>>**; **<< primed steel; galvanized steel; aluminum; or powder coated steel>>**.
6. Electric operation.

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7. Mounting: **<< Surface mounted; Within framed opening; As indicated on drawings; or _____>>**.
8. Finish: As selected by Architect from manufacturer's full range of powder coat finishes.

2.03 MATERIALS

A. Metal Curtain Construction: **<< Interlocking; Hinged; or _____>>** slats.
1. Curtain Bottom for Slat Curtains: Fitted with steel **<< angles; or _____>>** to provide reinforcement and positive contact in closed position; powder coated to match curtain slats.
2. Weatherstripping for Exterior Doors: Moisture and rot proof, resilient type, located at **<< jamb edges; bottom of curtain; where curtain enters hood enclosure; and _____>>** of **<< all doors; exterior doors; doors indicated; or _____>>**.
3. Steel Slats: Minimum thickness, **<< 22 gauge, 0.0299 inch; 20 gauge, 0.0359 inch; 18 gauge, 0.0478 inch; or _____>>**; **<<ASTM A653/A653M>>** galvanized steel sheet, unless otherwise indicated.
   a. Galvanizing: Minimum **<< G90; or G___ >>** coating at all doors.

B. Guide Construction: Continuous, of profile to retain door in place**<< with snap-on trim; _____; or None - N/A>>**, mounting brackets of same metal.

C. Guides - Angle: Two **<<ASTM A36/A36M>>** metal angles, size **<< as indicated; as required for wind loading; or _____>>**, but not less than 1-1/2 by 1-1/2 by 1/8 inch.
1. **<< Prime painted; Powder coated; or _____>>** to match curtain slats.

D. Hood Enclosure and Trim: Internally reinforced to maintain rigidity and shape.
1. Minimum Thickness: 0.028-inch; **<<ASTM A653/A653M>>** galvanized steel sheet with G90 coating.
2. Provide with end mounting brackets and with intermediate reinforcing brackets to prevent sagging.
3. **<< Prime painted; Prepare for site painted finish; or Powder coated to match curtain slats>>**.

E. Lock Hardware:
1. For **<< motor operated>>** units, additional lock or latching mechanisms are not required.
2. For **<< manual units with push-up operation>>**, provide slide bolt on single-jamb side, extending into slot in guides, with padlock hasp (padlock is NIC).
3. For **<< manual units with chain operation>>**, provide padlockable chain keeper on guide (padlock is NIC).

F. Roller Shaft Counterbalance: Steel pipe and**<< helical; _____; or None - N/A>>** steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.

2.04 ELECTRIC OPERATION

A. Operator, Controls, Actuators, and Safeties: Comply with **<<UL 325>>**; provide products listed by **<< ITS (DIR); UL (DIR); testing agency acceptable to authorities having jurisdiction; or _____>>**.
1. Provide interlock switches on motor operated units.
2. Operation Cycles: Provide operators and components that are tested and rated for a minimum of 20,000 cycles, unless otherwise indicated.

B. Electric Operators:

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1. Mounting: **<< Side mounted; Center mounted; or _____>>**.
2. Motor Enclosure:
   a. Exterior Coiling Doors: **<<NEMA MG 00001>>**, **<< Type 4; Type 4X; or Type ___>>**; **<< open drip proof; totally enclosed fan cooled (TEFC); or _____>>**.
   b. Interior Coiling Doors: **<<NEMA MG 00001>>**, **<< Type 1; Type 4; or Type ___>>**; **<< open drip proof; totally enclosed fan cooled (TEFC); or _____>>**.
3. Motor Rating: **<< 1/3 HP; 1/2 HP; 3/4 HP; 1 HP; 2 HP; or ____ HP>>**; continuous duty.
4. Motor Voltage: **<< 120; 208; or ___>>** volts, **<< single; three; or _____>>** phase, 60 Hz.
5. Motor Controller: **<<NEMA ICS 2>>**, full voltage, reversing magnetic motor starter.
6. Controller Enclosure: **<<NEMA EN 10250>>**, **<< Type 4; Type 4X; or Type ___>>**.
7. Brake: **<< Manufacturer's standard; Adjustable friction clutch; or _____>>** type, activated by motor controller.
8. Manual override in case of power failure.
9. Refer to Division 26 and electrical drawings for electrical connections.

C. Control Station: Provide key-operated three button, 'Open-Close-Stop' momentary-contact control device for each operator complying with **<<UL 325>>**.
   1. Surface mounted, adjacent to interior door jamb, unless otherwise indicated.
   2. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with **<<UL 325>>**.
      a. Primary Device: Provide NEMA 4x photo eye sensor as required with momentary-contact control device; sensor shall be mounted no more than 6 inches above finish floor level.
      b. Secondary Device: Provide non-monitored pneumatic sensing edge; may also serve as weatherstripping for bottom of door.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that adjacent construction is suitable for door installation.

B. Verify that electrical services have been installed and are accessible.

C. Verify that door opening is plumb, header is level, and dimensions are correct.

D. Notify **<<Architect>>** of any unacceptable conditions or varying dimensions.

E. Commencement of installation indicates acceptance of substrate and door opening conditions.

3.02 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

C. Securely and rigidly brace components suspended from structure.**<< Secure guides to structural members only.; _____ .; or None - N/A>>**

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

E. Coordinate installation of electrical service with Division 26 electrical sections.

F. Complete wiring from disconnect to unit components.

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G. Install enclosure and perimeter trim.

3.03 TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.

B. Maximum Variation From Plumb: 1/16 inch.

C. Maximum Variation From Level: 1/16 inch.

D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 feet straight edge.

3.04 ADJUSTING

A. Adjust operating assemblies for smooth and noiseless operation.

B. Adjust seals around entire perimeter to ensure a weather-tight installation.

3.05 CLEANING

A. Clean installed components.

B. Remove labels and visible markings.

3.06 FIELD QUALITY CONTROL, DEMONSTRATION, AND INITIAL MAINTENANCE SERVICE

A. Field Testing and Demonstration: Field testing shall be performed by manufacturer's authorized service representative.
   1. Complete final installation, testing, and adjustment procedures in accordance with manufacturer's instructions.
   2. Provide a minimum of 2 hours training and demonstration to Owner's maintenance personnel for operation, adjustment, and maintenance of doors.

B. Provide an Initial Maintenance Contract for maintenance of coiling door system and components for a period of 12 months. Maintenance shall include maximum quarterly intervals (minimum of 4 visits for initial contract), and shall include adjustment, lubrication, and other preventive maintenance, and repair or replacement of defective or worn parts or equipment.
   1. Provide service during regular working hours throughout period of this maintenance contract.

END OF SECTION 083323

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SECTION 083326
OVERHEAD COILING GRILLES

OVERHEAD COILING GRILLES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ITS (DIR) - Directory of Listed Products.

B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.

D. NEMA MG 00001 - Motors and Generators.

E. UL (DIR) - Online Certifications Directory.

F. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.

1.02 SUBMITTALS

A. Product Data: Provide general construction component connections and details**<< , and electrical equipment; or None - N/A>>**.

B. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.

C. Installer's qualification statement.

D. Evaluation Report: Provide an ICC-ES evaluation report covering the provisions of **<< Section 1008.1.9.8 of the 2012 IBC; or Section 1010.1.9.8 of the 2015 IBC>>** for electrical operated access-controlled egress coiling grilles.

1.03 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by **<< ITS (DIR); UL (DIR); testing firm acceptable to authorities having jurisdiction; or _____>>** as suitable for purpose specified.

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PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Overhead Coiling Grilles:

1. Alpine Overhead Doors, Inc.
2. C.H.I. Overhead Doors.
3. Cornell Iron Works, Inc.
4. The Cookson Company.
5. Raynor Garage Doors.
6. Wayne-Dalton, a Division of Overhead Door Corporation.

2.02 GRILLES AND COMPONENTS

A. Grille: **<< Aluminum; Galvanized steel; Stainless steel; or Bronze>>**; horizontal bar curtain, coiling on overhead counterbalanced shaft.

1. Finish: Clear anodized, AAMA 611, AA-M12C22A41, Class I, 0.018 mm.

2. Electric operation.
3. Mounting: **<< Surface mounted; Within framed opening; As indicated on drawings; or _____>>**.

B. Curtain: Round horizontal bars connected with vertical links.
1. Horizontal bars: **<< 5/16 inch; or ____ inch>>** diameter.
2. Bar spacing: **<< 1-1/2 inch; 3-1/4 inch; or ____ inch>>** on center.
3. Tube spacers: **<< 1/2 inch; or ____ inch>>** diameter.
4. Spacer spacing: **<< 3-1/4 inch; or ____ inch>>** on center.
5. Link spacing: **<< 6 inch; 9 inch; or ____ inch>>** on center.
6. Bar Ends: Provide with **<< nylon; or polypropylene pile>>** runners for quiet operation.
7. Bottom Bar: Back-to-back angles**<< with tubular resilient cushion; _____; or None - N/A>>**.

C. Guides: **<< Extruded aluminum; Galvanized steel; Stainless steel; or Bronze>>** angles, of profile to retain grille in place, mounting brackets of same metal.
1. Guide Supports/Mounting: As detailed and per the below. Guides and guide support assembly shall be coordinated such that face of guides are flush to face of wall as indicated.
a. Steel Tube Support: Provide steel tubes at each jamb, sized for door width, but not less than 3 inch by 3 inch by 3/16 inch. At Contractor's option, steel tubes shall be provided by coiling grille manufacturer or in coordination with Division 5 Metal Fabrications miscellaneous steel supplier.

D. Lock Hardware:
1. Emergency Response Grille Concealed Self Locking Mechanism: Provide manual lifting jamb lock assemblies that will prevent forced opening of a closed grille. Lock mechanism shall not interfere with normal electric operation, fail-safe, or emergency response self opening features.
2. For motor operated units, additional lock or latching mechanisms are not required.

E. Roller Shaft Counterbalance: Steel pipe and**<< helical; _____; or None - N/A>>** steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring **<< 25 lb; or ____ lb>>** nominal force to operate.

2.03 MATERIALS

A. Aluminum: **<<ASTM B221>>** (**<<ASTM B221M>>**).

2.04 ELECTRIC OPERATION

A. Operator, Controls, Actuators, and Safeties: Comply with **<<UL 325>>**; provide products listed by **<< ITS (DIR); UL (DIR); testing agency acceptable to authorities having jurisdiction; or _____>>**.
1. Provide interlock switches on motor operated units.

B. Electric Operators:
1. Mounting: **<< Side mounted; or Center mounted>>**.
2. Motor Enclosure:
a. Interior Coiling Grilles: **<<NEMA MG 00001>>**, Type **<< 1; 4; or ____>>**; **<< open drip proof; totally enclosed fan cooled (TEFC); or _____>>**.
3. Motor Rating: **<< 1/3 hp; 1/2 hp; 3/4 hp; or ____ hp>>**; continuous duty.

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4. Motor Voltage: **<< 120; or ___>>** volts, **<< single; or three>>** phase, 60 Hz.
5. Motor Controller: **<<NEMA ICS 2>>**, full voltage, reversing magnetic motor starter.
6. Controller Enclosure: **<<NEMA EN 10250>>** Type **<< 1; 4; or ____>>**.
7. Opening Speed: **<< 6 inches per second; 12 inches per second; 24 inches per second; or ____ inches per second>>**.
8. Brake: Adjustable friction clutch type, activated by motor controller.
9. Manual override in case of power failure.
10. Refer to Division 26 sections and Electrical Drawings for electrical connections.

C. Control Station: Provide standard **<< three button; key-operated; or _____>>** (Open-Close-Stop) **<< momentary-contact; or continuous-contact>>** control device for each operator complying with **<<UL 325>>**. Provide a control station on each side of each grille, unless otherwise indicated.
1. **<< 24; or ____>>** volt circuit.
2. **<< Surface; Recess; or _____>>** mounted, at **<< interior door jamb; exterior location as indicated on drawings; or _____>>**.
3. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with **<<UL 325>>**.
   a. Primary Device: Provide **<< electric sensing edge; wireless sensing; NEMA 1 photo eye sensors; NEMA 4X photo eye sensors; or _____>>** as required with momentary-contact control device.

D. Emergency Opening Mechanism: Provide manufacturer's standard grille mechanism to automatically open grille when activated by fire alarm, emergency push button, or power failure. Mechanism shall be fail-safe and shall open without the need for power or battery backup. Coordinate with Division 26/28 Contractor as follows:
1. Division 26/28 electrical subcontractor shall:
   a. Provide flush outlet boxes at push button locations and operator locations, and empty conduit concealed in wall or ceiling between them.
   b. Provide electrical service and connections for powered operators and accessories. These emergency egress door applications shall be connected to emergency generator circuits.
   c. Provide fire alarm control interface to door operator and to signal door operator to open upon fire alarm condition.
2. Division 8 overhead coiling grille subcontractor shall:
   a. Provide approved mushroom type emergency push button and device plated mounted on each side of door (to permit egress from either direction), and shall provide 6-inch egress sign reading "PUSH TO EXIT - ALARM WILL SOUND" at each push button.
   b. Provide control wiring between push button and operator.
   c. Provide local horn/strobe alarm for emergency exit push-button station, and all control wiring between local horn/strobe alarm and push button.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that adjacent construction is suitable for door installation.

B. Verify that electrical services have been installed and are accessible.

C. Verify that door opening is plumb, header is level, and dimensions are correct.

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D. Notify **<<Architect>>** of any unacceptable conditions or varying dimensions.

E. Commencement of installation indicates acceptance of substrate and door opening conditions.

3.02 INSTALLATION

A. Install grille unit assembly in accordance with manufacturer's instructions.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

C. Securely and rigidly brace components suspended from structure.**<< Secure guides to structural members only.; _____ .; or None - N/A>>**

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

E. Coordinate installation of electrical service with Division 26 and Electrical Drawings.

F. Complete wiring from disconnect to unit components.

3.03 TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.

B. Maximum Variation From Plumb: **<< 1/16 inch; or ___ inch>>**.

C. Maximum Variation From Level: **<< 1/16 inch; or ___ inch>>**.

D. Longitudinal or Diagonal Warp: Plus or minus **<< 1/8 inch per 10 ft; or ____ inch per 10 ft>>** straight edge.

3.04 ADJUSTING

A. Adjust grille, hardware and operating assemblies for smooth and noiseless operation.

3.05 CLEANING

A. Clean grille and components.

B. Remove labels and visible markings.

3.06 INITIAL MAINTENANCE CONTRACT

A. Provide an Initial Maintenance Contract for maintenance of coiling grille system and components for a period of 12 months. Maintenance shall include maximum quarterly intervals (minimum of 4 visits for initial contract), and shall include adjustment, lubrication, and other preventive maintenance, and repair or replacement of defective or worn parts or equipment.

1. Provide service during regular working hours throughout period of this maintenance contract.

END OF SECTION 083326

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SECTION 084313
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems.

B. AAMA 611 - Specification for Anodized Architectural Aluminum.

C. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.

D. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site.

B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

F. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

G. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

H. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

I. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.

J. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting a miminum of two weeks, but not more than four weeks, before starting work of this section; require attendance by all affected installers.

1.03 SUBMITTALS

A. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.

B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.

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C. Selection Samples: Submit manufacturer's color charts representing manufacturer's full range of available colors, for each type of product required.

D. Verification Samples: Submit physical samples in manufacturer's standard size indicating actual panel material and selected colors, for each type of product required.

E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

F. Field Quality Control Submittals: Report of field testing for water penetration**<< and air leakage; or None - N/A>>**.

G. Installer's qualification statement.

H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of type specified and with at least **<< three; or _____>>** years of**<< documented; _____; or None - N/A>>** experience**<< and approved by manufacturer; _____; or None - N/A>>**.

1.05 MOCK-UPS

A. Integrated Exterior Mockup: Attend preinstallation conference and provide storefront work for integrated exterior mockup as indicated on Drawings and as specified in Division 1 Section "Quality Requirements."

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with **<<AAMA CW-10>>**.

B. Protect finished aluminum surfaces with **<< wrapping; strippable coating; or _____>>**. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.07 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.08 WARRANTY

A. Material/Labor Warranty: Provide a 2-year material and workmanship warranty, beginning on the date of Substantial Completion, covering failures including but not limited to, structural and performance failures, excessive material deterioration, failure of operating components, and water or air infiltration. Complete forms in Owner's name and register with warrantor.

B. Finish Warranty: Provide 10 year manufacturer warranty, beginning on the date of Substantial Completion against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Aluminum-Framed Storefront - Exterior High-Performance - Double Thermal Break - Center Set - 2" x 4.5":

1. EFCO Corp; 403X.

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2. Kawneer North America; 451UT.
3. Oldcastle Building Envelope; 3000 XT.
4. Tubelite, Inc; TU 24000 Therml=block.
5. YKK AP America, Inc; YES 45 XT.

B. Aluminum-Framed Storefront - Interior - Non-Thermal - Center Set - 2" x 4.5":
1. EFCO Corp; 402.
2. Kawneer North America; Trifab VG 451.
3. Oldcastle Building Envelope; FG 3000.
4. Tubelite, Inc; E14000 Non-Thermal.
5. YKK AP America, Inc; YES 45 FI.

C. Aluminum-Framed Entrance - Exterior - Thermally Broken/Insulated - Wide Stile. Thickness varies by manufacturer; coordinate hardware requirements with submitted product depth:
1. EFCO Corp; 2" ThermaStile Aluminum Swing Entrance Doors. (2")
2. Kawneer North America; 500T Insulpour. (2-1/4")
3. Oldcastle Building Envelope; WS-500TC. (2-1/4")
4. Tubelite, Inc; Therml=Block Entrance. (1-3/4")
5. YKK AP America Inc; 50T. (2")

D. Aluminum-Framed Entrance - Interior - Standard - Uninsulated - 1.75-inch Thick - Wide Stile:
1. EFCO Corp; D500.
2. Kawneer North America; 500.
3. Oldcastle Building Envelope; 500.
4. Tubelite, Inc; Standard Wide Stile Doors.
5. YKK AP America, Inc; 50D.

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2.02 ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
1. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
2. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
3. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
4. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
5. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
6. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement. Coordinate with rough opening sizes to provide sealant joints on all sides of 3/8-inch to 1/2-inch.

B. Performance Requirements:

1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with **<<ASTM E330/E330M>>**, using loads **<< 1.5 times; or _____>>** the design wind loads and **<< 10 second; or _____>>** duration of maximum load.
   a. Design Wind Loads: Comply with requirements of **<<ASCE 7>>** and as indicated on Structural drawings.
   b. Member Deflection: Limit member deflection to **<< flexure limit of glass; 1/175; or _____>>** in any direction, with full recovery of glazing materials.
2. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with **<<ASTM E331>>** at pressure differential of 10 psf.
3. Air Leakage: 0.06 cfm/sq ft maximum leakage of fixed storefront wall area and 1.00 cfm/sq ft maximum leakage at swinging entrance doors, when tested in accordance with **<<ASTM E283/E283M>>** at 1.57 psf pressure difference.
4. Condensation Resistance Factor of Framing: 56, minimum, measured in accordance with **<<AAMA 1503>>**.
5. Overall U-value Including Glazing (Fixed Fenestration): 0.36 Btu/(hr sq ft deg F), maximum. ******U-values and SHGC are based on 2021 Maryland Energy Code (Climate Zone 4A Mixed-Humid******
6. Overall U-value Including Glazing (Entrance Doors): 0.63 Btu/(hr sq ft deg F), maximum.
7. Solar Heat Gain Coefficient (SHGC) Including Glazing: 0.36, maximum, measured in accordance with **<<NFRC 200>>**.

2.03 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, double-thermally broken between interior and exterior sections, with drainage holes and internal weep drainage system.
   1. Framing members for interior applications need not be thermally broken.
   2. Glazing Stops: Flush.
   3. Glazing Position: Center-set.
   4. Cross-Section: 2 inches wide by 4-1/2 inches deep, unless otherwise indicated on drawings.

B. Glazing: Refer to Division 8 Section "Glazing".

C. Insulating Metal Infill Panels (Glazing Type **<< _____>>**): Insulated, **<< aluminum; steel; or _____>><< , with edges formed to fit glazing channel; or None - N/A>><< and sealed; unsealed to permit air movement; or _____>>**.
   1. Total Nominal Thickness: 1 inch.
   2. Surface Burning Characteristics: Provide assemblies with Class A rating, with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with **<<ASTM E84>>**.
   3. Face Sheets (Front and Back): Equal 0.024-inch smooth aluminum faces bonded to nominal 1/8-inch exterior grade hardboard or high-density corrugated polypropylene.
   4. Core: Rigid polyisocyanurate insulation core; minimum total panel R-value of R-6.
   5. Finish: Same as storefront.
   6. Products:
      a. Citadel Architectural Products; GlazeGuard 1000 WR+.
      b. Laminators, Inc; Thermolite/Omega Foam-Ply.
      c. Mapes Architectural Products; Mapes-R Infill.

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D. Swing Doors: **<< Glazed aluminum; Flush aluminum; or _____>>**.
   1. Exterior Door Thickness: Varies by manufacturer; refer to product list above.
   2. Interior Door Thickness: 1-3/4 inches.
   3. Top Rail: 7 inches wide, unless otherwise indicated.
   4. Vertical Stiles: **<< 4-1/2 inches; or 5 inches>>** wide (wide stile).
   5. Bottom Rail: 12 inches wide, unless otherwise indicated.
   6. Glazing Stops: Beveled.
   7. Finish: Same as storefront.

2.04 MATERIALS AND ACCESSORIES

A. Extruded Aluminum: **<<ASTM B221>>** (**<<ASTM B221M>>**).

B. Fasteners: **<< Stainless; Galvanized; or _____>>** steel.

C. Metal Extrusions and Accessories:
   1. Metal Trim, Filler, and Closures (Brake Metal): Form interior filler panels for closing ends of partition systems, concealing adjacent structural elements, and for other applications as indicated on Drawings. Form from minimum 0.050-inch aluminum sheet coil, producing a panel of same thickness as partitions or mullions unless otherwise indicated. Incorporate reveals, trim, and concealed anchorages for attaching to adjacent surfaces. Finish trim to match storefront unless otherwise indicated.
   2. Offset Anchorage System: Provide frame anchorage incorporating L-shaped offset anchors or strap anchor component, and finished extruded interlocking L-shaped cover trim matching storefront framing. Anchorage "clip and cover" system shall be engineered by storefront manufacturer.
   3. Enhanced (High Performance) Sill Flashing: Provide thermally-broken extruded aluminum sill flashing with 2-inch tall back leg and bottom profile with outboard trough and weep holes to direct water to exterior. Provide full-frame-depth end dams mechanically attached to sill flashing extrusion and sealed with silicone. Provide silicone sill flashing splice sleeves and sealant as required at end dams and penetrations for anchorage. Provide finish to match framing.

D. Sill Flashing Sealant: Elastomeric silicone; compatible with flashing material.

E. Sealant for Setting Thresholds: Non-curing butyl type.

F. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements. Coordinate with Division 8 Section "Glazing."

2.05 FINISHES

A. Metal surfaces shall be prepared, pre-treated, and coated in accordance with coating and resin manufacturer's instructions.

B. Class I Natural Anodized Finish: **<<AAMA 611>><< AA-M12C22A41; _____; or None - N/A>>** Clear anodic coating not less than **<< 0.7 mils>>** thick.

C. Superior Performing Organic Coatings System: Manufacturer's standard multi-coat superior performing organic coatings system complying with **<<AAMA 2605>>**, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of **<< 1.2 mils, 0.0012 inch>>**.

D. Color: To be selected by Owner and Architect from manufacturer's full range.

E. Touch-Up Materials: As recommended by coating manufacturer for field application.

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2.06 HARDWARE

A. For each door, include weatherstripping, sill sweep strip, and threshold.

B. Other Door Hardware: Refer to Division 8 Section "Door Hardware".

C. Weatherstripping: Manufacturer's standard synthetic pile, continuous and replaceable; provide on all doors.

D. Sill Sweep Strips: Resilient seal type,**<< retracting,; None - N/A; or _____>>** of **<< neoprene; or _____>>**; provide on **<< all doors; all exterior doors; or _____>>**.

E. Threshold: Extruded aluminum, one piece per door opening, **<< ribbed; non-slip; or _____>>** surface; provide at all exterior doors.

F. Other Door Hardware: Refer to and coordinate with Division 8 Section "Door Hardware".

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

3.02 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances**<< , aligning with adjacent work; , _____; or None - N/A>>**.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install **<< sill; and _____ >>** flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

I. Set thresholds in bed of sealant and secure.

J. Install glass**<< and infill panels; _____; or None - N/A>>** using **<< glazing method required to achieve performance criteria; exterior wet/dry glazing method; exterior dry glazing method; _____ glazing method; or _____>>**; refer to Division 8 Section "Glazing."

K. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: **<< 0.06 inch per 3 feet; or ____ inch per 3 feet>>** non-cumulative or **<< 0.06 inch per 10 feet; or ____ inch per 10 feet>>**, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: **<< 1/32 inch; or ____ inch>>**.

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3.04 FIELD QUALITY CONTROL

A. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.

B. Provide field testing of installed storefront system by**<< AAMA accredited; _____; or None - N/A>>** independent laboratory in accordance with **<<AAMA 503>>** during construction process and before installation of interior finishes.

1. Perform a minimum of **<< two; three; or _____>>** tests in each designated area **<< as indicated on drawings; as directed by Architect; or _____>>**.
2. Conduct tests in each area prior to **<< 10 percent; 35 percent; 50 percent; 70 percent; and ___ percent>>** completion of this work.
3. Field test for water penetration in accordance with **<<ASTM E1105>>** with uniform static air pressure difference (Procedure A) not less than **<< 4.18 psf; or ___ psf>>**.
    a. Maximum allowable rate of water penetration in 15-minute test is **<< 0.5 ounce>>** that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.

C. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 ADJUSTING

A. Adjust operating components and hardware for smooth operation. Coordinate with Division 8 Door Hardware for hardware adjustments.

3.06 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 084313

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SECTION 084413
GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems.

B. AAMA 501.4 - Recommended Static Test Method for Evaluating Window Wall, Curtain Wall and Storefront Systems Subjected to Seismic and Wind-Induced Inter-Story Drift.

C. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems.

D. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.

E. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site.

B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

E. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

H. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

J. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

K. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

L. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors.

M. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.

N. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.

O. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).

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1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting a miminum of two weeks, but not more than four weeks, before starting work of this section; require attendance by all affected installers.

1.03 SUBMITTALS

A. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, and infill.

B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.

C. Selection Samples: Submit manufacturer's color charts representing manufacturer's full range of available colors, for each type of product required.

D. Verification Samples: Submit physical samples in manufacturer's standard size indicating actual panel material and selected colors, for each type of product required.

E. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.

F. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations; include load calculations at points of attachment to building structure. Structural data shall be signed and sealed by the Professional Structural Engineer responsible for their preparation.

G. Field Quality Control Submittals: Report of field testing for water penetration**<< and air leakage; _____; or None - N/A>>**.

H. Designer's Qualification Statement.

I. Installer's Qualification Statement.

J. Warranty: Submit manufacturer warranty and ensure forms have been completed in **<<Owner>>**'s name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Designer Qualifications: Design curtain wall and its structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Maryland.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least **<< three; or _____>>** years of**<< documented; _____; or None - N/A>>** experience**<< and approved by manufacturer; or None - N/A>>**.

1.05 MOCK-UPS

A. Integrated Exterior Mockup: Attend preinstallation conference and provide curtain wall work for integrated exterior mockup as indicated on Drawings and as specified in Division 1 Section "Quality Requirements."

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with **<<AAMA CW-10>>**.

B. Protect finished aluminum surfaces with **<< wrapping; strippable coating; or _____>>**. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

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1.07 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.08 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Material/Labor Warranty: Provide a two (2) year material and workmanship warranty, beginning on the date of Substantial Completion, covering failures including but not limited to, structural and performance failures, excessive material deterioration, failure of operating components, and water or air infiltration. Complete forms in Owner's s name and register with warrantor.

C. Finish Warranty: Provide 10 year manufacturer warranty, beginning on the date of Substantial Completion, against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Glazed Aluminum Curtain Wall - Exterior High-Performance - Fiberglass Pressure Plates - Front Set:
   1. EFCO Corp; 5600 XTherm.
   2. Kawneer North America; 1600UT.
   3. Oldcastle Building Envelope; Reliance Thermal.
   4. Tubelite, Inc; 400T Curtainwall.
   5. YKK AP America, Inc; YCO 750 XT.

B. Aluminum-Framed Entrance - Exterior - Thermally Broken/Insulated - Wide Stile. Thickness varies by manufacturer; coordinate hardware requirements with submitted product depth:
   1. EFCO Corp; 2" ThermaStile Aluminum Swing Entrance Doors. (2")
   2. Kawneer North America; 500T Insulpour. (2-1/4")
   3. Oldcastle Building Envelope; WS-500TC. (2-1/4")
   4. Tubelite, Inc; Therml=Block Entrance. (1-3/4")
   5. YKK AP America Inc; 50T. (2")

2.02 CURTAIN WALL

A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Outside glazed, with pressure plate and mullion cover**<< , where indicated on drawings; , _____; or None - N/A>>**.
   2. Fabrication Method: **<< Either shop/factory or field fabricated system; Shop/factory unitized system; Field fabricated stick system; Shop/factory unit and mullion system; or _____>>**.
   3. Glazing Method: **<< Either shop/factory or field glazed system; Shop/factory glazed system; Field glazed system; or _____>>**.
   4. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.

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5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
7. Maintain continuous air barrier and/or vapor retarder seal throughout assembly, primarily in line with**<< inside; _____; or None - N/A>>** pane of glazing**<< and inner sheet of infill panel; _____; or None - N/A>>** and heel bead of glazing compound.
8. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
1. Design Wind Loads: Comply with **<< the following:; the applicable code.; the requirements of _____ code.; the requirements of ASCE 7; or _____ .>>** and as indicated on Structural drawings.
   a. Member Deflection: For spans less than **<< 13 feet 6 inches; or _____ feet>>**, limit member deflection to **<< flexure limit of glass; 1/175; or _____>>** in any direction, and maximum of **<< 1/175 of span; or _____>>** or **<< 3/4 inch; or _____ inch>>**, whichever is less and with full recovery of glazing materials.
   b. Member Deflection: For spans over **<< 13 feet 6 inches; or _____ feet>>** and less than **<< 40 feet; or ____ feet>>**, limit member deflection to **<< flexure limit of glass; 1/175; or _____>>** in any direction, and maximum of **<< 1/175 of span; 1/240 of span plus 1/4 inch; or _____>>**, with full recovery of glazing materials.
2. Interstory Differential Lateral Movement: Meeting pass/fail criteria of **<<AAMA 501.4>><< for Use Group I, Standard Occupancy; for Use Group II, High Occupancy Assembly; for Use Group III, Essential Facilities; _____; or None - N/A>>**, when tested at design displacement of **<< 0.010; 0.020; or _____>>** times greater adjacent story height, maximum, and 1.5 times design displacement**<< , through three complete cycles; , ____; or None - N/A>>**.
3. Movement: Accommodate the following movement without damage to components or deterioration of seals:
   a. Expansion and contraction caused by **<< 180 degrees F; or ____ degrees F>>** surface temperature.
   b. Expansion and contraction caused by cycling temperature range of **<< 170 degrees F; or ____ degrees F>>** over a **<< 12; or ____>>** hour period.
   c. Movement of curtain wall relative to perimeter framing.
   d. Deflection of structural support framing**<< , under permanent and dynamic loads; or None - N/A>>**.

C. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
1. Test Pressure Differential: **<< 12; or 15>>** psf.
2. Test Method: **<<ASTM E331>>**.

D. Air Leakage: **<< 0.06 cfm/sq ft; or ___ cfm/sq ft>>** maximum leakage of wall area when tested in accordance with **<<ASTM E283/E283M>>** at **<< 6.24 psf; or ___ psf>>** pressure difference across assembly.

E. Thermal Performance Requirements:

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1. Condensation Resistance Factor of Framing: 56, minimum, measured in accordance with **<<AAMA 1503>>**.
2. Overall U-Factor Including Glazing (Fixed Fenestration): 0.36 Btu/(hr sq ft deg F), maximum.
3. Overall U-value Including Glazing (Entrance Doors): 0.63 Btu/(hr sq ft deg F), maximum.
4. Solar Heat Gain Coefficient (SHGC) Including Glazing: 0.36, maximum, measured in accordance with **<<NFRC 200>>**.

2.03 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections**<< , thermally broken with interior section insulated from exterior; , _____; or None - N/A>>**, drainage holes and internal weep drainage system.
   1. Framing members for interior applications need not be thermally broken.
   2. Cross-Section: As indicated on drawings. ******Verify cross-sectional depth required based on curtainwall size and height. Coord with manufacturer if necessary******
   3. Structurally Reinforced Members: **<< Extruded; Formed sheet; or _____>>** aluminum with internal reinforcement of structural steel member.

B. Glazing: Refer to and coordinate with Division 8 Section "Glazing."

C. Infill Spandrel Panels (Glazing Type **<< _____>>**): Insulated, aluminum sheet face and back, with edges formed to fit glazing channel and sealed. ******Verify glazing type******
   1. Surface Burning Characteristics: Provide assemblies with Class A rating, with flame spread index of 25 or less and smoke developed index of **<< 450 or less; or _____>>**, when tested in accordance with **<<ASTM E84>>**.
   2. Total Panel Thickness: 1 inch.
   3. Face Sheets (Front and Back): Equal 0.024-inch smooth aluminum faces bonded to nominal 1/8-inch exterior grade hardboard or high-density corrugated polypropylene.
   4. Core: Rigid polyisocyanurate insulation core; minimum total panel R-value of R-6.
   5. Finish: Same as curtain wall.
   6. Products:
      a. Citadel Architectural Products; GlazeGuard 1000 WR+.
      b. Laminators, Inc; Thermolite/Omega Foam-Ply.
      c. Mapes Architectural Products; Mapes-R Infill.

D. Shadow Box Panels: Insulated back pan, with edges of pan formed to fit dimensions between mullions both horizontally and vertically. Front face of shadow box shall be 0.125-inch plate aluminum face panel; color selected from aluminum panel manufacturer's full range.
   1. Surface Burning Characteristics: Provide assemblies with Class A rating, with flame spread index of 25 or less and smoke developed index of **<< 450 or less; or _____>>**, when tested in accordance with **<<ASTM E84>>**.
   2. Ventilation: Provide ventilation from cavity between insulated glass unit and back pan; ventilation shall be to the exterior. Seal around perimeter of back pan to ensure a complete air and vapor barrier to the interior.
   3. Firestopping: Where shadow box/back pan at break between floor levels, coordinate with Section **<< 078400 - Firestopping; or _____>>** to provide a complete perimeter containment system that includes insulated back pan as part of a tested and approved perimeter assembly.
   4. Total Panel Thickness: As indicated on Drawings.
   5. Core: Mineral wool insulation core; minimum total panel **<< R-value of 8>>**.

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6. Aluminum Face Panel Finish: **<< Class I natural anodized; Class II natural anodized; Class I color anodized; Class II color anodized; Natural anodized with organic seal; Color anodized with organic seal; Pigmented organic coatings; High performance organic coatings; High performance silicone-modified polyester (SMP) organic coatings; Superior performing organic coatings; or _____>>**; color as selected by Architect from manufacturer's full range.

2.04 MATERIALS

A. Extruded Aluminum: **<<ASTM B221>>** (**<<ASTM B221M>>**).

B. Sheet Aluminum: **<<ASTM B209/B209M>>**.

C. Structural Steel Sections (Reinforcing): **<<ASTM A36/A36M>>**; galvanized in accordance with requirements of **<<ASTM A123/A123M>>**.

D. Structural Supporting Anchors Attached to Structural Steel: Design for **<< bolted; welded; or _____>>** attachment.

E. Fasteners: **<< Stainless; Galvanized; or _____>>** steel; type as required or recommended by curtain wall manufacturer.

F. Concealed Flashings: Stainless steel, **<< 26 gauge, 0.0187 inch; or ___ gauge, ___ inch>>** minimum thickness or sheet aluminum, 22 gauge, 0.026 inch minimum thickness.

G. Firestopping: Refer to and coordinate with Division 7 Section "Firestopping."

H. Weatherseal Sealant: Silicone, with adhesion in compliance with **<<ASTM C794>>**; **<< compatible with glazing accessories; compatible with structural sealant glazing (SSG) adhesive; type recommended by structural sealant glazing (SSG) adhesive manufacturer; or _____>>**.

I. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, and compatible with flashing material.

J. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements. Coordinate with Division 8 Section "Glazing."

K. Touch-Up Primer for Galvanized Steel Surfaces: **<< SSPC-Paint 20, zinc rich; or _____>>**.

2.05 FINISHES

A. Metal surfaces shall be prepared, pre-treated, and coated in accordance with coating and resin manufacturer's instructions.

B. Superior Performing Organic Coatings System: Manufacturer's standard multi-coat superior performing organic coatings system complying with **<<AAMA 2605>>**, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of **<< 1.2 mils, 0.0012 inch>>**.

C. Color: To be selected by Owner and Architect from manufacturer's full range.

D. Touch-Up Materials: As recommended by coating manufacturer for field application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other related work.

B. Verify that curtain wall openings and adjoining water-resistive and air barrier seal materials are ready to receive work of this section.

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C. Verify that anchorage devices have been properly installed and located.

3.02 INSTALLATION

A. Install curtain wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances**<< , aligning with adjacent work; , _____; or None - N/A>>**.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install **<< sill; head; eave edge; and _____>>** flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. **<< Install; Coordinate installation of; or _____>>** firestopping at each floor slab edge in accordance with tested assembly.

H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

I. Pressure Plate Framing: Install glazing using exterior dry glazing (gasketed) method, unless otherwise required to meet performance requirements. Refer to and coordinate with Division 8 Section "Glazing."

J. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet noncumulative or 0.5 inches per 100 feet, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32-inch.

C. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4-inch and minimum of 1/4-inch.

3.04 FIELD QUALITY CONTROL

A. Provide services of curtain wall manufacturer's technical representative to inspect for proper installation of system and submit report.

B. Water-Spray Test: Provide water spray quality test of installed curtain wall components in accordance with **<<AAMA 501.2>>** during construction process and before installation of interior finishes.

1. Perform a minimum of **<< two; three; or _____>>** tests in each designated area **<< as indicated on drawings; as directed by Architect; or _____>>**.
2. Conduct tests in each area prior to **<< 10 percent; 35 percent; 50 percent; 70 percent; and ___ percent>>** completion of this work.

C. Provide field testing of installed curtain wall system by**<< AAMA accredited; _____; or None - N/A>>** independent laboratory in accordance with **<<AAMA 503>>** during construction process and before installation of interior finishes.

1. Perform a minimum of **<< two; three; or _____>>** tests in each designated area **<< as indicated on drawings; as directed by Architect; or _____>>**.
2. Conduct tests in each area prior to **<< 10 percent; 35 percent; 50 percent; 70 percent; and ___ percent>>** completion of this work.

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3. Field test for water penetration in accordance with **<<ASTM E1105>>** with uniform static air pressure difference (Procedure A) not less than **<< 4.18 psf; or ___ psf>>**.
   a. Maximum allowable rate of water penetration in 15-minute test is **<< 0.5 ounce>>** that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.
4. Field test for air leakage in accordance with **<<ASTM E783>>** with uniform static air pressure difference of **<< 1.57 psf; 2.86 psf; 4.50 psf; 6.20 psf; or ___ psi>>**.
   a. Maximum allowable rate of air leakage is **<< 0.09 cfm/sq ft>>**.

D. Repair or replace curtain wall components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 ADJUSTING

A. Adjust operating components and hardware for smooth operation. Coordinate with Division 8 Door Hardware for hardware adjustments.

3.06 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, take care to remove dirt from corners, and wipe surfaces clean.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 084413

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SECTION 085113
ALUMINUM WINDOWS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AAMA 502 - Voluntary Specification for Field Testing of Newly Installed Fenestration Products.

B. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.

C. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).

D. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site.

A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for Windows, Doors, and Skylights.

B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

G. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

H. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

I. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors.

J. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.

K. ASTM F2090 - Standard Specification for Window Fall Prevention Devices with Emergency Escape (Egress) Release Mechanisms.

L. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a minimum of two weeks before starting work of this section.

1.03 SUBMITTALS

A. Product Data: Include **<< component dimensions; information on glass and glazing; internal drainage details; descriptions of hardware and accessories; and _____>>**.

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B. Shop Drawings: Indicate opening dimensions**<< , elevations of different types; , _____; or None - N/A>>**, framed opening tolerances, anchorage locations**<< , _____; or None - N/A>>**, and installation requirements.

C. Sustainable Design Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

D. Grade Substantiation: Prior to submitting shop drawings or starting fabrication, submit one of the following showing compliance with specified grade:

1. Evidence of AAMA Certification.
2. Evidence of WDMA Certification.
3. Evidence of CSA Certification.
4. Test report(s) by independent testing agency itemizing compliance**<< and acceptable to authorities having jurisdiction; _____; or None - N/A>>**.

E. Test Reports: Prior to submitting shop drawings or starting fabrication, submit test report(s) by independent testing agency showing compliance with performance requirements in excess of those prescribed by specified grade.

F. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of **<<AAMA CW-10>>**.

B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

1.05 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F.

B. Maintain this minimum temperature during and 24 hours after installation of sealants.

1.06 WARRANTY

A. Manufacturer Warranty: Provide 5-year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units. Complete forms in **<<Owner>>**'s name and register with manufacturer.

B. Manufacturer Warranty: Provide 20-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in **<<Owner>>**'s name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Aluminum Window Manufacturers:

1. Arcadia, Inc.
2. Boyd Aluminum.
3. EFCO.
4. Quaker Window Products Company.
5. TRACO/Kawneer North America.
6. Wausau Window and Wall Systems.
7. Winco Window Company, Inc.

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2.02 ALUMINUM WINDOWS

A. Aluminum Windows: Extruded aluminum frame and sash, factory fabricated, factory finished, with operating hardware, related flashings, and anchorage and attachment devices.

1. Window Types: Provide **<< fixed, non-operable type; outswinging awning type; and double-hung type>>**, as indicated on Drawings. ******Verify types needed on case-by-case basis******
2. Operable Units: Double weatherstripped.
3. Thermally Broken: All framing units shall be thermally broken.
4. Glazing: Provide factory-glazed units; double glazed IGUs with clear Low-E coating on #2 surface.
5. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for operating hardware and imposed loads.
6. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
7. Movement: Accommodate movement between window and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
8. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
9. Thermal Movement: Design to accommodate thermal movement caused by 180 **<< 180 degrees F>>** surface temperature without buckling stress on glass, joint seal failure, damaging loads on structural elements, damaging loads on fasteners, reduction in performance or other detrimental effects.

2.03 PERFORMANCE REQUIREMENTS

A. Grade: **<<AAMA/WDMA/CSA 101/I.S.2/A440>>** requirements for specific window type:

1. Performance Class and Grade (PC/PG): AW-50. ******Verify with components and claddings design pressures indicated on Structural Drawings******
2. Design pressure shall be calculated based on **<<ASCE 7>>** and requirements on Structural Drawings.

B. Member Deflection: Limit member deflection to **<< flexure limit of glass; 1/175; or _____>>** in any direction, with full recovery of glazing materials.

C. Water Leakage: No uncontrolled leakage on interior face when tested in accordance with **<<ASTM E331>>** at differential pressure of **<< 12.11 psf; 9.19 psf; or _____ psf>>**.

D. Air Leakage: **<< 0.1 cfm/sq ft; 0.3 cfm/sq ft; or ___ cfm/sq ft>>** maximum leakage per unit area of outside window frame dimension when tested in accordance with **<<ASTM E283/E283M>>**.

E. Thermal Performance Requirements:

1. Condensation Resistance Factor of Frame: 56, minimum, measured in accordance with **<<AAMA 1503>>**.
2. Overall U-Factor Including Glazing (Fixed Fenestration): 0.36 Btu/(hr sq ft deg F), maximum.
3. Overall U-value Including Glazing (Operable Fenestration): 0.45 Btu/(hr sq ft deg F), maximum.
4. Solar Heat Gain Coefficient (SHGC) Including Glazing: 0.36, maximum, measured in accordance with **<<NFRC 200>>**.

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2.04 COMPONENTS

A. Frames: **<< _____>>** inch wide by **<< _____>>** inch deep profile, of **<< _____>>** inch thick section; thermally broken with interior portion of frame insulated from exterior portion; flush glass stops of screw-fastened type. ******Verify sizes with basis-of-design product. Sizes may vary by type (fixed vs operable). Confirm with manufacturer******

B. Glazing: Refer to and coordinate with Division 8 Section "Glazing."

C. Reinforced Mullion: Provide extruded aluminum mullion with integral reinforcement of shaped steel structural section where required by manufacturer due to window configuration or size.

D. Sills: Extruded aluminum; sloped for positive wash; fit under sash leg to 1/2 inch beyond wall face; one piece full width of opening.

E. Insect Screens: Extruded aluminum frame with mitered and reinforced corners; screen mesh taut and secure to frame; secured to window with adjustable hardware allowing screen removal without use of tools. ******Only for windows at kitchen, confirm with design layout******

1. Provide insect screens only at operable aluminum windows located in kitchen.
2. Hardware: Spring loaded steel pins; four per screen unit.
3. Screen Mesh: Vinyl-coated fiberglass, window manufacturer's standard mesh.
4. Frame Finish: Same as frame and sash.

F. Operable Sash Weatherstripping: Permanently resilient and replaceable, profiled to achieve effective weather seal.

1. For sliding/hung windows, provide fin pile weatherstripping with synthetic brush on each side of a central plastic fin.
2. For awning/casement windows, provide continous compression seal using bulb weatherstripping fabricated of EPDM, silicone, or thermoplastic.

G. Fasteners: Stainless steel; of type recommended by manufacturer for indicated substrates.

H. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

2.05 MATERIALS

A. Extruded Aluminum: **<<ASTM B221>>** (**<<ASTM B221M>>**)**<< , 6063 alloy, T6 temper; , ____ alloy, __ temper; , _____; or None - N/A>>**.

B. Sheet Aluminum: **<<ASTM B209/B209M>><< , 5005 alloy, H12 or H14 temper; , ____ alloy, ___ temper; , _____; or None - N/A>>**.

C. Concealed Steel Items: Profiled to suit mullion sections; **<< galvanized in accordance with ASTM A123/A123M; primed with zinc oxide paint; or _____>>**.

2.06 HARDWARE

A. Sash Lock (Sliding Windows): Lever handle with cam lock.

B. Operator (Casement/Awning Windows): Lever action handle **<< Lever action handle; Geared rotary handle; or _____>>** fitted to projecting sash arms with limit stops.

C. Projecting Sash Arms: Cadmium plated steel, friction pivot joints with nylon bearings, removable pivot clips for cleaning.

D. Window Opening Control Devices (WOCD): Provide operable window sash hardware that limits window opening to prevent passage of 4-inch diameter rigid sphere and is easily releasable to allow full window opening without use of keys, tools, or special knowledge. Comply with **<<ASTM F2090>>**.

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2.07 FINISHES

A. Metal surfaces shall be prepared, pre-treated, and coated in accordance with coating and resin manufacturer's instructions.

B. Superior Performing Organic Coatings System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with **<<AAMA 2605>>**, including at least 70 percent PVDF resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of **<< 1.2 mils, 0.0012 inch>>**.

C. Finish Color: To be selected by Owner and Architect from manufacturer's full range.

D. Operator and Exposed Hardware: Enameled to color as selected from manufacturer's standard line.

E. Apply one coat of bituminous coating to concealed aluminum surfaces in contact with dissimilar materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall openings and adjoining air/weather barrier materials are ready to receive aluminum windows.

3.02 WINDOW INSTALLATION

A. Install windows in accordance with manufacturer's instructions.

B. Install window assembly in accordance with **<<AAMA/WDMA/CSA 101/I.S.2/A440>>**.

C. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.

D. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.

E. Install sill and sill end angles/end dams. Set sill members and sill flashing in continuous bead of sealant.

F. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

G. Install operating hardware where not pre-installed by manufacturer.

3.03 TOLERANCES

A. Maximum Variation from Level or Plumb: 1/16-inch every 3 ft non-cumulative or 1/8-inch per 10 ft, whichever is less.

3.04 FIELD QUALITY CONTROL

A. Coordinate with Division 1 Section "Quality Requirements" for independent field testing and inspection requirements, and requirements for monitoring quality of specified product installations.

B. Provide field testing of installed aluminum windows by**<< AAMA accredited; _____; or None - N/A>>** independent laboratory in accordance with **<<AAMA 502>>** and **<<AAMA/WDMA/CSA 101/I.S.2/A440>>** during construction process and before installation of interior finishes.

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1. Perform tests **<< on three individual windows; on one individual window of each type; or _____>>** in designated locations **<< as indicated on drawings; as directed by Architect; or _____>>**.
2. Conduct tests on individual windows prior to **<< 5 percent; 35 percent; 50 percent; 90 percent; and ___ percent>>** completion of this work.
3. Field test for water penetration in accordance with **<<ASTM E1105>>** using **<< Procedure B - cyclic; or Procedure A - uniform for AW windows>>** static air pressure difference; test pressure shall not be less than **<< 1.9 psf; or ___ psf>>**.
4. Field test for air leakage in accordance with **<<ASTM E783>>** with uniform static air pressure difference of **<< 1.57 psf; 6.27 psf; or ___ psi>>**.
   a. Maximum allowable rate of air leakage is **<< 0.10 cfm/sq ft; 0.30 cfm/sq ft; or ___ cfm/sq ft>>**.

C. Repair or replace fenestration components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 ADJUSTING

A. Adjust hardware for smooth operation and secure weathertight closure.

3.06 CLEANING

A. Remove protective material from factory finished aluminum surfaces.

B. Wash surfaces by method recommended and acceptable to window manufacturer; rinse and wipe surfaces clean.

C. Remove excess glazing sealant by moderate use of mineral spirits or other solvent acceptable to sealant and window manufacturer.

END OF SECTION 085113

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SECTION 085619
PASS WINDOWS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AAMA 611 - Specification for Anodized Architectural Aluminum.

B. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Furnish anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, to be embedded into concrete or masonry, with setting diagrams and installation, to applicable installer in time for installation.

B. Preinstallation Meeting: Prior to start of installation arrange a meeting on site to familiarize installer and installers of related work with requirements relating to this work.

1.03 SUBMITTALS

A. Product Data: Manufacturer's published data showing materials, construction details, dimensions of components, and finishes.

B. Shop Drawings: Drawings prepared specifically for this project, showing plans, elevations, sections, details of construction, anchorage to other work, hardware, and glazing.

1. For existing and in-place openings show verified field dimensions.
2. Show required opening dimensions and allowance for field deviation.

C. Selection Samples: Color charts for factory finishes.

D. Sustainable Design Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

1.04 QUALITY ASSURANCE

A. Source Limitations: Provide each type of ticket or pass window from a single manufacturer; furnished through a single supplier.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver pre-fabricated items to project site in manufacturer's standard secure packaging. Transport and store on site in a manner that prevents exposure to the elements.

1.06 FIELD CONDITIONS

A. Existing Conditions: Verify rough opening sizes for pass windows by field measurements prior to fabrication; indicate field dimensions on shop drawings.

1.07 WARRANTY

A. Manufacturer Warranty: Provide manufacturer warranty for 3 years from Date of Substantial Completion. Complete forms in Owner's name and register with manufacturer. Warranty shall cover failures in material or workmanship due to, but not limited to, the following:

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1. Structural failures or deterioration of metals and finishes beyond expected use and normal weathering.
2. Failure of glazing due to excessive deflection, warping, or bowing of supporting members.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Interior Pass/Cashier Windows:
   1. C.R. Laurence Co., Inc.
   2. Creative Industries, Inc.
   3. Frameless Hardware Company (FHC).
   4. Quikserv Corporation.

B. Exterior Ticket Windows:
   1. Armortex.
   2. C.R. Laurence Co., Inc.
   3. Quikserv Corporation.
   4. Ready Access, Inc.
   5. Total Security Solutions.

2.02 ASSEMBLIES

A. General Requirements:
   1. Design to fit openings indicated on drawings; design to accommodate deviation of actual construction from dimensions indicated on drawings.
   2. Fabricate frames and sash with corners mitered or coped full depth with concealed welded joints.
   3. Separate dissimilar metals to prevent corrosion by galvanic action by painting contact surfaces with primer or with sealant or tape recommended by manufacturer for the purpose.

2.03 INTERIOR PASS WINDOW ASSEMBLIES

A. Sliding Pass Window (Interior): Field fabricated unit consisting of fixed channel header and jambs, integral countertop, and two framed sliding windows; each window shall be independently operable.
   1. Basis-of-Design: C.R. Laurence; "Daisy" model.
   2. Configuration and Size: As indicated on Drawings.
   3. Framing: Manufacturer's standard, extruded aluminum; satin anodized finish. Provide double channel overhead track header to allow each sliding window leaf to move independently.
   4. Countertop: Provide integral countertop; fabricated of stainless steel sheet; 18 inches deep by 2 inches thick.
   5. Hardware: Provide manufacturer's standard top-hung ball bearing rollers. Provide unit with keyed lock.
   6. Provide spring loaded guide pin at countertop for each operable window panel.
   7. Provide with 1/4-inch tempered glazing.

B. Ticket Window (Interior): Prefabricated unit consisting of fixed channel header and jambs, integral countertop, and fixed glazing.

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1. Basis-of-Design: C.R. Laurence; "Ticket Window" model SCW102C.
2. Configuration and Size: As indicated on Drawings.
3. Framing: Manufacturer's standard, extruded aluminum channels nominal 1-3/8 inch deep by 5/8 inch high; satin anodized finish.
4. Countertop: Provide integral countertop; fabricated of stainless steel sheet; 18 inches deep by 2 inches thick; full width of window.
    a. Accessibility Compliance: On the public side, countertop shall protrude less than 4 inches out from wall.
5. Transaction Opening: Provide glazing cut-out with either a half-round aluminum trim and cover plate with spring-loaded snap lock and retaining pin (10-1/2 clear opening width at counter), or with rectangular vertical lift window that is spring-loaded to close automatically (8-1/4 inch clear opening width at counter); satin anodized aluminum finish.
6. Communication Device: Manufacturer's standard 5-inch diameter stainless steel talk-thru.
7. Provide with 1/4-inch tempered glazing.

C. Cashier Window (Interior): Prefabricated unit consisting of fixed channel header and jambs, integral countertop, and fixed glazing.
    1. Basis-of-Design: C.R. Laurence; "Cashier Window" SCW103C.
    2. Configuration and Size: As indicated on Drawings.
    3. Framing: Manufacturer's standard, extruded aluminum channels nominal 1-3/8 inch deep by 5/8 inch high; satin anodized finish.
    4. Countertop: Provide integral countertop; fabricated of stainless steel sheet; 18 inches deep by 2 inches thick; full width of window.
        a. Accessibility Compliance: On the public side, countertop shall protrude less than 4 inches out from wall.
    5. Deal Tray: Recessed, integrally formed with countertop; stainless steel; approximately 12 inches wide by 9 inches deep.
    6. Communication Device: Manufacturer's standard 5-inch diameter stainless steel talk-thru.
    7. Provide with 1/4-inch tempered glazing.

2.04 EXTERIOR TICKET WINDOWS

A. Ticket Window (Exterior): Prefabricated unit consisting of fixed aluminum framed header and jambs, integral countertop and channel sill.
    1. Framing: Manufacturer's standard, extruded aluminum channels nominal 4-1/2 inches deep by 2 inches high; satin anodized finish.
    2. Countertop: Provide integral countertop; fabricated of stainless steel sheet; 12 inches deep by 2 inches thick; full width of window.
        a. Accessibility Compliance: On the public side, countertop shall protrude less than 4 inches out from wall.
    3. Deal Tray: Recessed, integrally formed with countertop; stainless steel; approximately 11-1/2 inches wide by 8 inches deep.
    4. Communication Device: Manufacturer's standard 5-inch diameter stainless steel talk-thru.
    5. Glazing: Provide with 1-inch insulated glazing unit with clear low-e coating on #2 surface.

2.05 ACCESSORIES

A. Communication Devices: Coordinate glazing cut out requirements with glazing fabricator.

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1. Speaking Aperture Frame: Plastic snap-together ring with aluminum finish color; 5 inch outside diameter for use with a 4 inch glazing cut out. Conceals glazing edges and leaves an open talk-thru aperture. Basis-of-Design: C.R. Laurence Item #543.
2. Standard Talk-Thru: Stainless steel, round, allowing passage of speech at normal volume without distortion.

B. Fasteners: Provide stainless steel concealed fasteners of type recommended by manufacturer for substrates indicated.

2.06 MATERIALS

A. Aluminum Components: **<<ASTM B221>>** (**<<ASTM B221M>>**) extrusions of alloy and temper selected by manufacturer for strength, corrosion resistance, and finish required; not less that **<< 1/8 inch>>** thick at any location of frame and sash members.

B. Stainless Steel Sheet: **<<ASTM A666/A666M>>**, Type 304.

2.07 FINISHES

A. Class I Natural Anodized Finish: **<<AAMA 611>><< AA-M12C22A41; or None - N/A>>** Clear anodic coating not less than **<< 0.7 mils>>** thick.

B.

C. Stainless Steel: **<< No. 4; or ____>>** brushed/satin finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify rough window opening dimensions prior to fabrication; indicate field dimensions on shop drawings.

B. Verify that window openings are ready for installation of windows.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings.

B. Install windows in correct orientation (inside/outside or secure/non-secure).

C. Separate dissimilar metals, and metal members in contact with concrete and masonry, using bituminous paint.

3.03 ADJUSTING

A. Adjust operating components for smooth operation while also providing tight fit at contact points and a secure enclosure; lubricate operating hardware.

3.04 CLEANING AND REPAIR

A. Clean exposed surfaces promptly after installation without damaging finishes.

B. Remove and replace defective work.

END OF SECTION 085619

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SECTION 088000
GLAZING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.

C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.

E. ASTM C1036 - Standard Specification for Flat Glass.

F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.

G. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass.

H. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass.

I. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings.

J. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation.

K. ASTM F3561 - Standard Test Method for Forced-Entry-Resistance of Fenestration Systems After Simulated Active Shooter Attack.

L. GANA (GM) - GANA Glazing Manual.

M. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use.

N. NFRC 100 - Procedure for Determining Fenestration Product U-factors.

O. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.

P. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems.

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1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting at least two weeks before starting work of this section; require attendance by each of the affected installers.

1.03 SUBMITTALS

A. Product Data on Glazing Types: Provide structural, physical and environmental characteristics for each glazing type indicated. Include size limitations, special handling, and installation requirements.

B. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

C. Selection Samples: For each product requiring color selection, provide manufacturer's color charts.

D. Verification Samples: For each type of glazing other than standard interior and exterior glazings (glazing types 1 and 2), provide a 12 x 12 sample for review.

E. Certificate: Certify that **<< products of this section; or _____>>** meet or exceed **<< specified requirements; or _____>>**.

F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with **<< GANA (GM); GANA (SM); GANA (LGRM); IGMA TM-3000; and _____>>** for **<< glazing installation methods; or _____>>**. **<< Maintain one copy on site.; Maintain ____ copies on site.; or None - N/A>>**

1.05 MOCK-UPS

A. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

B. Integrated Exterior Mockups: Provide glazing to match glazing systems required for Project, including glazing installation methods, for incorporation into integrated exterior mockup as indicated on Drawings and as specified in Division 01 "Quality Requirements."

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's instructions. Deliver and store in a manner to prevent exposure to weather/moisture, direct sun/UV, and temperature changes.

1.07 FIELD CONDITIONS

A. Ambient Conditions: Do not install glazing, gasketing, or liquid sealants under adverse weather conditions, or when temperatures are above or below manufacturer's recommended limitations for sealant installation.

1. Do not install glazing when ambient temperature is less than **<< 40 degrees F; or ____ degrees F>>**.
2. Maintain minimum ambient temperature before, during and **<< 24; or ____>>** hours after installation of glazing compounds.

1.08 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Insulating Glass Units: Provide a **<< five (5); ten (10); or ____>>** year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

C. Laminated Glass: Provide a **<< five (5); ten (10); or ____>>** year manufacturer warranty to include coverage for delamination, including providing products to replace failed units.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Float Glass Manufacturers:

1. Cardinal Glass Industries.
2. Guardian Glass, LLC.
3. Viracon.
4. Vitro Architectural Glass (formerly PPG Glass).

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2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Design Pressure: Calculated in accordance with **<< applicable codes; ASCE 7; or _____>>** and values indicated on Structural Drawings.
   2. Comply with **<<ASTM E1300>>** for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
   4. Glass thicknesses listed are minimum.

B. Weather-Resistive Barrier Seals: Provide complete assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and air barrier.

C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
   1. Center of Glass U-Value: Comply with **<<NFRC 100>>** using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with **<<NFRC 200>>** using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   3. Solar Optical Properties: Comply with **<<NFRC 300>>** test method.

2.03 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Kind HS - Heat-Strengthened Type: Complies with **<<ASTM C1048>>**.
   2. Kind FT - Fully Tempered Type: Complies with **<<ASTM C1048>>**.
   3. Provide Type I, Quality-Q3, Class 1 (clear) glazing unless otherwise indicated.
      a. Tinted Glazing: Where tinted glazing is indicated, provide Class 2 (tinted).
   4. Fully Tempered Safety Glass: Complies with **<<ANSI Z97.1>>** or **<<16 CFR 1201>>** criteria for safety glazing used in hazardous locations.
   5. Tinted Type: **<<ASTM C1036>>**, Class 2 - Tinted**<< , Quality - Q3; , Quality - Q4; , _____; or None - N/A>>**, with color and performance characteristics as indicated.
   6. Spandrel Glass Type: ASTM C1048, Type I, Condition - B, Quality - Q3, glass coated with opacifying coating indicated; with performance characteristics matching those of adjacent non-spandrel units. Coating shall be water-based silicone; ceramic frit is not acceptable.
   7. Patterned Glass Type: ASTM C1048, Type II - Patterned Flat Glass**<< , Quality - Q5; , Quality - Q6; , _____; or None - N/A>>**, Form 3 - Patterned glass, with color and performance characteristics as indicated.
      a. "Frosted" Appearance: Provide non-directional acid-etch or simulated acid-etch "frosted"/translucent finish on one or both faces of glass lite.
   8. Bird-Friendly Glazing: Provide acid-etch pattern to provide full-surface bird protection.
      a. Pattern shall be applied to the #1 surface of IGU.
      b. Pattern shall have a threat factor of 25 or less in accordance with American Bird Conservancy tunnel test.
      c. Basis-of-Design Patterns:
         1) Non-directional 5 mm dots spaced 2 inches by 2 inches (Guardian Etch DX22). Threat Factor: 15.

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2) Directional 6 mm dots spaced 2 inches by 4 inches (Guardian Etch DV24). Threat Factor: 25.
3) Non-directional 6 mm dots randomly spaced no more than 2 inches by 2 inches (Guardian Etch SqX22). Threat Factor: 20.
4) Non-directional 6 mm squares randomly spaced no more than 2 inches by 4 inches (Guardian Etch SqX24). Threat Factor: 25.

9. Low-Iron (Ultraclear) Glass: ASTM C1048, Type I, Class I, Quality - Q3.
   a. Products:
      1) Cardinal; Purevision.
      2) Guardian; UltraClear.
      3) Pilkington; Optiwhite.
      4) Vitro; Starphire.
10. Decorative Glass (Backpainted): ASTM C1048, Type I, Quality - Q3; with baked-on decorative coating. Manufacturer shall provide for custom backpaint colors matched to Pantone colors or Division 9 painting manufacturer. Paint shall be UV-stable for use in exterior IGUs. Where backpainted glass is indicated, provide coating applied to low-iron glass.
    a. Manufacturers:
       1) Bendheim; Back-Painted Glass.
       2) GGI - General Glass International; Alice Back-Painted.
       3) Goldray Industries, Inc; Backpainted Glass.
       4) M3 Glass Technologies; Colorbak Back Painted Glass.
       5) McGrory Glass; Back Painted Glass.
       6) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
11. Decorative Glass (Gradient): ASTM C1048
    a. Manufacturers:
       1) Bendheim.
       2) GGI - General Glass International.
       3) Goldray Industries, Inc.
       4) M3 Glass Technologies.
       5) McGrory Glass.
       6) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
12. Decorative Glass (Interlayer): ASTM C1172, laminated glass with decorative interlayer.
    a. Manufacturers:
       1) Bendheim.
       2) GGI - General Glass International.
       3) Goldray Industries, Inc.
       4) M3 Glass Technologies.
       5) McGrory Glass.
       6) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
13. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

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B. Laminated Glass: Float glass laminated in accordance with **<<ASTM C1172>>**. Laminated glass shall be free of foreign substances and air or glass pockets.
   1. Laminated Safety Glass: Complies with **<<ANSI Z97.1>>** - **<< Class B; or Class A>>** or **<<16 CFR 1201>>** - **<< Category I; or Category II>>** impact test requirements.
   2. Ionoplast Interlayer: **<< 0.035 inch; 0.060 inch; 0.090 inch; 0.100 inch; or ___ inch>>** thick, minimum.
      a. Provide Kuraray "SentryGlas" or comparable ionoplast interlayer submitted as a properly formatted substitution request.
      b. Color: Clear.
      c. Interlayer Physical Properties:
         1) Young's Modulus:43 kpsi, when tested in accordance with ASTM D5026.
         2) Tensile Strength: 5.0 kpsi, when tested in accordance with ASTM D638.
         3) Elongation: 400%, when tested in accordance with ASTM D638.
         4) Flex Modulus: 50 kpsi, when tested in accordance with ASTM D790.
         5) Heat Deflection Temperature at 0.46 MPa: 110 degrees F, when tested in accordance with ASTM D648.

C. Active Shooter Tested Laminated Glass: Float glass laminated in accordance with **<<ASTM C1172>>**; free of foreign substances and air or glass pockets. Where indicated in exterior windows, provide laminated lite as the interior lite of insulated glazing unit.
   1. Laminated Safety Glass: Complies with **<<ANSI Z97.1>>** - **<< Class B; or Class A>>** or **<<16 CFR 1201>>** - **<< Category I; or Category II>>** impact test requirements.
   2. Active Shooter/Forced Entry Testing: Laminated glass assembly shall be tested in accordance with one of the following:
      a. **<<ASTM F3561>>**: Minimum Level 3.
      b. H.P. White 5aa-1: Minimum 6 minutes to failure after ballistic and forced entry attack.
   3. Laminated Lite Thickness: Nominal 7/16-inch (range between 3/8- and 1/2-inch).
   4. Products:
      a. School Guard Glass; SG4.
      b. McGrory Glass; DefendED.
      c. Kuraray; SentryGlas 0.090-inch SGP interlayer between two 3/16-inch heat-strengthened lites.
      d. Eastman-Saflex; Saflex Clear 0.090 PVB interlayer between two 3/16-inch heat-strengthened lites.
      e. Substitutions: **<< See Section 016000 - Product Requirements; Not permitted; or _____>>**.

2.04 INSULATING GLASS UNITS

A. Fabricator: Certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.

B. Insulating Glass Units: Types as indicated. IGU's shall be pre-assembled in factory of multiple lites, with dehydrated interspace.
   1. Durability: Certified by an independent testing agency to comply with **<<ASTM E2190>>**.
   2. Coated Glass: Comply with requirements of **<<ASTM C1376>>** for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
   3. Warm-Edge Spacers: Manufacturer's warm-edge technology design.

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a. Spacer Width: **<< 1/2 inch; ___ inch; As required for specified insulating glass unit; As selected from manufacturer's standard sizes; or _____>>**.

b. Spacer Height: **<< Manufacturer's standard; 0.27 inch; or ___ inch>>**.

c. Products:

1) H.B. Fuller Construction Products Inc**<< ; Kodispace 4SG; ; ____; or None - N/A>>**.

2) Quanex IG Systems, Inc**<< ; Super Spacer TriSeal; ; ____; or None - N/A>>**.

3) Technoform Glass Insulation**<< ; TGI-Spacer; ; ____; or None - N/A>>**.

4) Substitutions: **<< See Section 016000 - Product Requirements; Not permitted; or _____>>**.

4. Spacer Color: **<< Black; White; Gray; Dark gray; Light Gray; Champagne; Bronze; Aluminum; or _____>>**.

5. Edge Seal:

a. Dual-Sealed System: Provide **<< polyisobutylene; or _____>>** sealant as primary seal applied between spacer and glass panes, and **<< silicone; polysulfide; polyurethane; or _____>>** sealant as secondary seal applied around perimeter.

b. Color: **<< Black; Gray; or _____>>**.

6. Purge interpane space with dry air, hermetically sealed.

2.05 ACCESSORIES

A. Setting Blocks: **<< EPDM; Silicone; Neoprene; Thermoplastic; or _____>>**, with **<< 80 to 90; or ____ to ____>>** Shore A durometer hardness**<< ; ASTM C864 Option I; ; ASTM C864 Option II; ; _____; or None - N/A>>**. Length of **<< 0.1 inch for each square foot>>** of glazing or minimum **<< 4 inch>>** by width of glazing rabbet space minus **<< 1/16 inch>>** by height to suit glazing method and pane weight and area.

B. Spacer Shims: **<< EPDM; Silicone; Neoprene; or _____>>**, **<< 50 to 60; or ____ to ____>>** Shore A durometer hardness**<< ; ASTM C864 Option I; ; ASTM C864 Option II; ; _____; or None - N/A>>**. Continuous by one half the height of the glazing stop by thickness to suit application**<< , self adhesive on one face; , _____; or None - N/A>>**.

C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound**<< with integral resilient spacer rod applicable to application indicated; _____; or None - N/A>>**; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.

D. Glazing Splines and Gaskets: Resilient **<< polyvinyl chloride; silicone; or _____>>** extruded shape to suit glazing channel retaining slot**<< ; ASTM C864 Option I; ; ASTM C864 Option II; ; _____; or None - N/A>>**; color **<< black; as selected; or _____>>**.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

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3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry **<< immediately before glazing; within maximum of 24 hours before glazing; or _____>>**. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

C. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

D. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

E. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.

B. Place setting blocks at **<< 1/4; 1/3; or _____>>** points with edge block no more than **<< 6 inch; or ____ inch>>** from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.05 FIELD QUALITY CONTROL

A. **<< Glass; Glazing; and _____>>** product manufacturers to provide field surveillance of the installation of their products.

B. Monitor and report installation procedures and unacceptable conditions.

3.06 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove nonpermanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces **<< not more than 4 days; not more than ___ days; or _____>>** prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

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3.07 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste**<< ; do not mark heat absorbing or reflective glass units; , _____; or None - N/A>>**.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

3.08 GLAZING SCHEDULE

A. **<< Type _____>>** - Monolithic Interior Vision Glazing:

1. Applications: Interior glazing unless otherwise indicated.
2. Glass Type: **<< Annealed; Heat-strengthened; Fully tempered; Laminated; or Heat-strengthened / fully-tempered>>** float glass. Provide with safety glazing labeling.
3. Tint: Clear.
4. Thickness: **<< 1/4 inch; or ____ inch>>**, nominal.
5. Glazing Method: **<< Dry glazing method, gasket glazing; Dry glazing method, tape and gasket spline; Wet glazing method, sealant and sealant; Wet/dry glazing method, preformed tape and sealant; Butt joint glazing method, sealant only; or ____>>**.

B. **<< Type _____>>** - Insulating Glass Units: Vision glass, double glazed.

1. Applications: Exterior glazing except where otherwise indicated.
2. Space between lites filled with **<< air; argon; krypton; or _____>>**.
3. Outboard Lite: **<< Annealed float glass; Heat-strengthened float glass; Fully tempered float glass; Laminated; Anti-reflective glass; or Heat-strengthened / fully-tempered float glass>>**, **<< 1/4 inch; or ____ inch>>** thick**<< , minimum; None - N/A; or , _____>>**.
   a. Tint: **<< Clear; Green; Blue; Gray; Bronze; or _____>>**.
   b. Coating: **<< Low-E (passive type); Low-E (solar control type); Highly reflective; or _____>>**, on #2 surface.
   c. Coating Products (Low-E; Clear):
      1) Cardinal; ES 28 #2.
      2) Guardian; SNX 62/27.
      3) Viracon; VNE 1-63.
      4) Vitro; Solarban 70.
4. Warm-edge spacer.
5. Inboard Lite: **<< Annealed; Heat-strengthened; Fully tempered; Laminated; Anti-reflective glass; or Heat-strengthened / fully-tempered>>** float glass, **<< 1/4 inch; or ____ inch>>** thick**<< , minimum; None - N/A; or , _____>>**.
   a. Tint: **<< Clear; Green; Blue; Gray; Bronze; or _____>>**.
6. Total Thickness: **<< 1 inch; or ____ inch>>**.
7. Thermal Transmittance (U-Value)**<< , Summer - Center of Glass; , Winter - Center of Glass; , _____; or None - N/A>>**: **<< 0.30>><< , nominal; , minimum; , maximum; , exactly; or , _____>>**.
8. Solar Heat Gain Coefficient (SHGC): **<< 0.25>><< , nominal; , minimum; , maximum; , exactly; or , _____>>**.
9. Glazing Method: **<< Dry glazing method, gasket glazing; Dry glazing method, tape and gasket spline; Wet glazing method, sealant and sealant; Wet/dry glazing method, preformed tape and sealant; Butt joint glazing method, sealant only; or ____>>**.

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10. Provide with safety glazing labeling.

C. **<< Type _____>>** - Insulating Glass Units - Spandrel Glass.
   1. Applications: Exterior glazing where indicated..
   2. Space between lites filled with **<< air; argon; krypton; or _____>>**.
   3. Outboard Lite: **<< Annealed; Heat-strengthened; Fully tempered; Laminated; or _____>>** low-iron float glass, **<< 1/4 inch; or ____ inch>>** thick**<< , minimum; , _____; or None - N/A>>**.
      a. Tint: Clear.
      b. Coating: Low-E (passive type), on #2 surface.
      c. Coating Products (Clear; Low-E):
         1) AGC; Energy Select 28.
         2) Cardinal; ES 28 #2.
         3) Guardian; SNX 62/27.
         4) Viracon; #VNE 1-63.
         5) Vitro; Solarban 70.
   4. Warm-edge spacer.
   5. Inboard Lite: **<< Annealed; Heat-strengthened; Fully tempered; or _____>>** low-iron float glass, **<< 1/4 inch; or ____ inch>>** thick.
      a. Tint: **<< Clear; Green; Blue; Gray; Bronze; or _____>>**.
      b. Opacifier: Water-based silicone coating, on #4 surface. Ceramic frit is not acceptable.
      c. Opacifier Color: Selected by Architect from manufacturer's full range.
   6. Total Thickness: **<< 1 inch; or ____ inch>>**.
   7. Thermal (U-Value and SHGC): Match requirements of vision units.
   8. Glazing Method: **<< Dry glazing method, gasket glazing; Dry glazing method, tape and gasket spline; Wet glazing method, sealant and sealant; Wet/dry glazing method, preformed tape and sealant; Butt joint glazing method, sealant only; or ____>>**.
   9. Provide with safety glazing labeling.

D. **<< Type _____>>** - Insulating Metal Infill Panel - Refer to **<< 084313 - Aluminum-Framed Storefronts; 084413 - Glazed Aluminum Curtain Walls; and 085200 - Aluminum-Clad Wood Windows and Doors>>** for metal infill panels.

E. **<< Type _____>>** - Fire-Protection or Fire-Resistance Rated Glazing - Refer to **<< 088813 - Fire-Rated Glazing; or _____>>**.

F. **<< Type _____>>** - Bullet-Resistance-Rated Glazing - Refer to **<< 085653 - Security Windows>> << and 111950 Security Glass and Glazing.; or None - N/A>>**

G. **<< Type ____>>** - **<< Patterned; Obscure; Obscure - Patterned; or _____>>** ("Frosted") Interior Glazing:
   1. Applications: Interior glazing where indicated.
   2. Glass Type: **<< Fully tempered; Annealed; Laminated annealed; Insulating glass unit; or _____>>** float glass. Provide with safety glazing labeling.
   3. Thickness: 1/4 inch, nominal.
   4. Pattern: Non-directional "frosted" pattern applied by acid etch or simulated acid etch to one or both glass surfaces.

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5. Glazing Method: **<< Dry glazing method, gasket glazing; Dry glazing method, tape and tape; Wet glazing method, compound and compound; Wet/dry glazing method, tape and sealant; or _____>>**.

H. **<< Type ____>> - << Patterned; Obscure; Obscure - Patterned; or _____>>** ("Frosted") Exterior Glazing:

I. **<< Type ____>>** - Back-Painted Interior Glazing: Back-painted on surface that will be concealed in the final work, highly opaque**<< , with low volatile organic compounds (VOC); , _____; or None - N/A>>**.

J. **<< Type ____>>** - Back-Painted Exterior Glazing: Back-painted on #3 surface and highly opaque; with low volatile organic compounds (VOC).

K. **<< Type ____>>** - Decorative Glazing with Gradient Pattern:

L. **<< Type ____>>** - Decorative Glazing with Decorative Interlayer:

M. **<< Type ___>>** - Insulating Glass Units With Light-Diffusing Translucent Core: Factory-assembled units consisting of sealed lites of glass with manufacturer's proprietary diffusing core material.

1. Products: Provide Okalux+ by OKALUX North America, Solera S R5+Aerogel by Advanced Glazings Ltd, or a comparable product submitted via properly formatted substitution request.
2. Applications: Exterior glazing where indicated.
3. Outboard Lite: **<< Annealed float glass; Heat-strengthened float glass; Fully tempered float glass; Laminated; Anti-reflective glass; or Heat-strengthened / fully-tempered float glass>>**, clear; **<< 1/4 inch; or ____ inch>>** thick**<< , minimum; None - N/A; or , _____>>**.
   a. Coating: **<< Low-E (passive type); Low-E (solar control type); Highly reflective; or _____>>**, on #2 surface.
4. Translucent Core: 1/2-inch thick; material as standard with manufacturer: either diffusing cloth layers with capillary slab material, and with air space filled with argon gas, or a honeycomb capillary insulation filled with manufacturer's proprietary aerogel.
5. Inboard Lite: **<< Annealed; Heat-strengthened; Fully tempered; Laminated; Anti-reflective glass; or Heat-strengthened / fully-tempered>>** float glass, clear; **<< 1/4 inch; or ____ inch>>** thick**<< , minimum; None - N/A; or , _____>>**.
6. Total Thickness: **<< 1 inch; or ____ inch>>**.
7. Thermal Transmittance (U-Value)**<< , Summer - Center of Glass; , Winter - Center of Glass; , _____; or None - N/A>>**: **<< 0.24>><< , nominal; , minimum; , maximum; , exactly; or , _____>>**.
8. Visible Light Transmittance (VLT): **<< 31>>** percent**<< , nominal; , minimum; , maximum; , exactly; or , _____>>**.
9. Solar Heat Gain Coefficient (SHGC): **<< 0.29>><< , nominal; , minimum; , maximum; , exactly; or , _____>>**.
10. Glazing Method: **<< Dry glazing method, gasket glazing; Dry glazing method, tape and gasket spline; Wet glazing method, sealant and sealant; Wet/dry glazing method, preformed tape and sealant; Butt joint glazing method, sealant only; or ____>>**.
11. Provide with safety glazing labeling.

N. **<< Type ____>>** - Transparent One-Way Mirror: Mirror quality float glass with pyrolytic (hard coat) type coating located on high light level surface of glass; **<<ASTM C1376>>**.

1. Applications: Locations as indicated on drawings.

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2. Thickness: **<< 1/4 inch; or ____ inch>>**.
3. Glass Tint: **<< Grey; or _____>>**.
4. Glass Type: **<< Annealed; Fully tempered; Laminated annealed; Insulating glass unit; or _____>>**.
5. Lighting Ratio: Maintain at least 8:1 lighting level ratio between coated side (bright-observed side) and uncoated side (dim-observer side).
6. Glazing Method: **<< Gasket glazing; Interior dry method, tape and tape; Interior wet/dry method, tape and sealant; Interior wet method, glazing compound; or _____>>**.

O. **<< Type _____>>** - Active Shooter/Forced Entry Laminated Interior Glazing:
1. Applications: Interior glazing where indicated.
2. Glass Type: Nominal 7/16-inch nominal active shooter tested laminated assembly. Provide with safety glazing labeling.
3. Glazing Method: **<< Dry glazing method, gasket glazing; Dry glazing method, tape and gasket spline; Wet glazing method, sealant and sealant; Wet/dry glazing method, preformed tape and sealant; Butt joint glazing method, sealant only; or ____>>**.

P. **<< Type _____>>** - Active Shooter/Forced Entry Insulating Glass Units: Active shooter/forced entry tested; vision glass, double glazed.
1. Applications: Exterior glazing where indicated.
2. Space between lites filled with **<< air; argon; krypton; or _____>>**.
3. Outboard Lite: **<< Annealed float glass; Heat-strengthened float glass; Fully tempered float glass; Laminated; Anti-reflective glass; or Heat-strengthened / fully-tempered float glass>>**, **<< 1/4 inch; or ____ inch>>** thick**<< , minimum; None - N/A; or , _____>>**.
   a. Tint: **<< Clear; Green; Blue; Gray; Bronze; or _____>>**.
   b. Coating: **<< Low-E (passive type); Low-E (solar control type); Highly reflective; or _____>>**, on #2 surface.
   c. Coating Products (Low-E; Clear):
      1) Cardinal; ES 28 #2.
      2) Guardian; SNX 62/27.
      3) Viracon; VNE 1-63.
      4) Vitro; Solarban 70.
4. Warm-edge spacer.
5. Inboard Lite: Nominal 7/16-inch active shooter tested laminated assembly.
6. Total Thickness: As required by manufacturer to acieve thermal properties indicated. Do not exceed 1-1/8 inch.
7. Thermal Transmittance (U-Value)**<< , Summer - Center of Glass; , Winter - Center of Glass; , _____; or None - N/A>>**: **<< 0.30>><< , nominal; , minimum; , maximum; , exactly; or , _____>>**.
8. Solar Heat Gain Coefficient (SHGC): **<< 0.25>><< , nominal; , minimum; , maximum; , exactly; or , _____>>**.
9. Glazing Method: **<< Dry glazing method, gasket glazing; Dry glazing method, tape and gasket spline; Wet glazing method, sealant and sealant; Wet/dry glazing method, preformed tape and sealant; Butt joint glazing method, sealant only; or ____>>**.

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10. Provide with safety glazing labeling.

END OF SECTION 088000

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SECTION 088300
MIRRORS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.

C. ASTM C1036 - Standard Specification for Flat Glass.

D. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror.

E. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

F. GANA (GM) - GANA Glazing Manual.

G. GANA (SM) - GANA Sealant Manual.

H. SCAQMD 1168 - Adhesive and Sealant Applications.

1.02 SUBMITTALS

A. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, and special handling and installation requirements.

B. Safety Mirror Certificate: Provide certification that mirrors with film backing used for this project are tested to and pass the requirements of safety glazing per **<<ANSI Z97.1>>** and CPSC **<<16 CFR 1201>>**, Category II.

C. Executed warranty.

1.03 DELIVERY, STORAGE, AND HANDLING

A. See Section **<< 017419 - Construction Waste Management and Disposal>>** for packaging waste requirements.

B. Transport, receive, and store mirrors in accordance with manufacturer's recommendations.

C. Perform Work in accordance with **<<GANA (GM)>>** for glazing installation methods, including GANA's "Glazing Manual" and "Mirrors: Handle with Extreme Care."

1.04 FIELD CONDITIONS

A. Do not install mirrors when ambient temperature is less than 50 degrees F.

B. Maintain minimum ambient temperature before, during, and 24 hours after installation of glazing compounds.

1.05 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Provide **<< five; or ____>>** year manufacturer warranty for deterioration of reflective coating on mirrors and replacement of same.

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PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Mirrors:
   1. Arch Aluminum and Glass Co., Inc.
   2. Binswanger Mirror/ACI Distribution.
   3. Gardner Glass Products.
   4. Gilded Mirrors, Inc.
   5. Guardian Industries Corp.
   6. Independent Mirror Industries, Inc.
   7. Lenoir Mirror Co.
   8. Messer Industries, Inc.
   9. Stroupe Mirror Co., Inc.
   10. Sunshine Mirror.
   11. Trulite Glass and Aluminum Solutions.
   12. Virginia Mirror Company, Inc.
   13. Walker Glass Company Ltd.

2.02 MIRROR MATERIALS

A. Mirror Design Criteria: Select materials and provide supports as required to limit mirror material deflection to **<< 1/200; or _____>>**, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.

B. Mirror Glass: **<<ASTM C1036>>**, Type 1 - Transparent Flat, Class 1 - Clear, Quality - Q1 (high-quality mirrors); silvering, protective coating, and quality requirements in compliance with **<<ASTM C1503>>**.
   1. Thickness: 1/4-inch nominal.
   2. Sizes: As indicated on drawings.
   3. Safety Glazing: Mirror glass shall be certified as safety glazing per ANSI Z97.1 and CPSC 16 CFR 1201, Category II.

2.03 ACCESSORIES

A. Setting Blocks: Manufacturer's recommended neoprene or silicone, nominal Shore A durometer hardness of 80 +/- 5.

B. Glazing Tape: Preformed polyethylene or acrylic foam tape; on release paper.

C. Glazing Clips: Manufacturer's standard type.

D. Fasteners/Anchors: Provide manufacturer's recommended fasteners and anchors for indicated substrates.
   1. Where metal or wood stud substrate is indicated, coordinate with Division 6 section Rough Carpentry and Division 9 section Cold-Formed Steel Framing - Non-Structural (CFSF-NS) to provide concealed blocking or reinforcing along full length of J-channel mounting locations to provide a solid substrate for fastening.

E. Mirror Adhesive/Mastic: Silicone pre-polymer based, chemically compatible with mirror coating and wall substrate.
   1. Low-Emitting Material: Provide mastic that is tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND that meets the chemical content requirements of **<<SCAQMD 1168>>**.

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F. Aluminum Channel Frame: Provide J-channel framing, fabricated from minimum 0.045-inch clear anodized aluminum extrusions. Size all channel framing for 1/4 inch nominal mirror thickness, in lengths sized to cover edges of each mirror section with one continuous piece.
   1. Bottom Trim: J-channel with 3/8-inch exposure front leg, 3/4- or 7/8-inch rear leg. Available Products:
      a. Brunner Enterprises, Inc.; Mirror Lower "J" Channel.
      b. C.R. Laurence Co., Inc.; CRL Standard "J" Channel.
      c. Eagle Mouldings, Inc; Aluminum J-Cap - 3/8" Face for 1/4" Material.
   2. Top Trim: J-channel with 5/8-inch exposure front leg, 1- or 1-1/8-inch rear leg. Available Products:
      a. Brunner Enterprises, Inc.; Mirror Upper "J" Channel.
      b. C.R. Laurence Co., Inc.; CRL Deep "J" Channel.
      c. Eagle Mouldings, Inc; Aluminum J-Cap - 5/8" Face for 1/4" Material.
   3. Side Trim: H-shape division bar with 1/2-inch face, and approximately 1-1/4 inch rear leg. Available Products: ******Verify if side trim is necessary - if doing full length in fitness/weight room the mirrors may terminate at cornres******
      a. Brunner Enterprises, Inc.; Division Bar.
      b. C.R. Laurence Co., Inc.; CRL Aluminum Divider Bar.
      c. Eagle Mouldings, Inc; Aluminum Divider - 1/2" Face for 1/4" Material.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings for mirrored glazing are sized within tolerance of manufacturer's instructions.

B. Verify surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

C. Notify **<<Architect>>** in writing of conditions detrimental to completion of work. Do not proceed with installation until detrimental conditions are corrected.

3.02 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Seal porous mirror frames or recesses with substrate-compatible primer or sealer. Prime surfaces scheduled to receive sealant.

3.03 INSTALLATION

A. Install mirrors in accordance with manufacturer's recommendations and with **<<GANA (GM)>>**.

B. Install J-channel frame sections to the wall with mechanical fasteners. Install fasteners in a manner so that they do not cause point loads to impact the rear of mirror panels.

C. Install mirrors with mirror mastic; provide mastic in coverage amount recommended by manufacturer, and in coverage pattern allowing for air circulation behind mirrors.

D. Set mirrors plumb and level and free of optical distortion.

E. Set mirrors with edge clearance free of surrounding construction, including countertops or backsplashes.

F. Glazing Tape Installation in Frames:
   1. Cut glazing tape to length and set against permanent stops, projecting 1/16-inch above sight line.

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2. Place setting blocks at one-quarter points with edge block no more than 6 inches from corners.
3. Rest mirrors on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
4. Place glazing tape on free perimeter of mirrors in same manner described above.
5. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
6. Trim protruding tape edge.

3.04 CLEANING

A. See Section **<< 017000 - Execution and Closeout Requirements>>** for additional requirements.

B. Remove wet glazing materials from finished surfaces.

C. Remove nonpermanent labels after work is complete.

D. Clean mirrors and adjacent surfaces immediately prior to Substantial Completion in accordance with manufacturer's recommendations.

3.05 PROTECTION

A. Protect installed mirrors from subsequent construction operations.

B. Remove and replace mirrors damaged during construction period prior to Substantial Completion.

END OF SECTION 088300

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SECTION 088723
SAFETY AND SECURITY FILMS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

C. ASTM F1642/F1642M - Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loadings.

1.02 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Record of product certification for safety requirements.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements and recommendations.
   4. Installation methods.

B. Shop Drawings: Detailing installation of film, anchoring accessories, and sealant.

C. Samples: For each film product to be used, minimum size 8 inches by 12 inches, representing actual product, color, and patterns.

D. Test Reports: Detailed reports of full-scale chamber tests to specified criteria, using assemblies identical to those required for this project.

E. Specimen Warranty.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Certified by glazing film manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of authorities having jurisdiction.

1.05 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.06 WARRANTY

A. Provide 10 year manufacturer's replacement warranty to cover film against peeling, cracking, discoloration, and deterioration.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. 3M Window Film.

B. Avery Dennison.

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C. Flexvue Films.

D. Llumar.

E. Madico, Inc.

2.02 MATERIALS ******NOTE: THIS IS A MINIMAL SECURITY FILM FOR IMPACT RESISTANCE AND DELAYING FORCED ENTRY. SHOULD NOT BE USED FOR ACTIVE SHOOTER/BALLISTIC RESISTANCE. IF USED ON NEW EXTERIOR INSULATED GLAZING, IT MAY VOID THE GLAZING MANUFACTURER'S WARRANTY******

A. Security Glazing Film: Transparent polyester film for permanent bonding to glass.
   1. Basis-of-Design Product: 3M Scotchshield Ultra S800.
   2. Thickness: 0.008 inch, minimum (8 mil).
   3. Color: Clear.
   4. Construction: Multi-ply laminate.
   5. Adhesive Type: Pressure sensitive acrylic.
   6. Tensile Strength: 25,000 psi minimum when tested in accordance with **<<ASTM D882>>**.
   7. Breaking Strength: 150 psi minimum when tested in accordance with **<<ASTM D882>>**.
   8. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with **<<ASTM E84>>** (Class A).

B. Accessory Materials: As recommended or required by film manufacturer.

C. Supplementary Anchorage System: As required by performance criteria and acceptable to Architect. Basis-of-Design is 3M Impact Protection Adhesive attachment system.

D. Glass Cleaner: As recommended by glazing film manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Field-Applied Film: Verify that existing conditions are adequate for proper application and performance of film.

B. Examine glass and frames. Verify that existing conditions are adequate for proper application and performance of film.

C. Verify glass is not cracked, chipped, broken, or damaged.

D. Verify that frames are securely anchored and free of defects.

E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean glass of dust, dirt, paint, oil, grease, mildew, mold, and other contaminants that would inhibit adhesion.

B. Immediately prior to applying film, thoroughly wash glass with neutral cleaning solution.

C. Protect adjacent surfaces.

D. Do not begin installation until substrates have been properly prepared.

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3.03 INSTALLATION

A. Do not apply glazing film when surface temperature is less that 40 degrees F or if precipitation is imminent.

B. Install in accordance with manufacturer's instructions, without air bubbles, wrinkles, streaks, bands, thin spots, pinholes, or gaps, as required to achieve specified performance.

C. Accurately cut film with straight edges to required sizes allowing 1/16-inch to 1/8-inch gap at perimeter of glazed panel unless otherwise required by anchorage method.

D. Seams: Seam film only as required to accommodate material sizes; form seams vertically without overlaps and gaps; do not install with horizontal seams.

E. Supplemental Adhesive Anchorage: Install in accordance with manufacturer's instructions and shop drawings.

F. Clean glass and anchoring accessories following installation. Remove excess sealants and other glazing materials from adjacent finished surfaces.

G. Remove labels and protective covers.

3.04 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 088723

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SECTION 088733
DECORATIVE FILMS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.02 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Record of product certification for safety requirements.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements and recommendations.
   4. Installation methods.

B. Shop Drawings: Detailing installation of film, anchoring accessories, and sealant.

C. Samples: For each film product to be used, minimum size 8 inches by 12 inches, representing actual product, color, and patterns.

D. Specimen Warranty.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Certified by glazing film manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of authorities having jurisdiction.

1.05 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.06 WARRANTY

A. Provide 10 year manufacturer's replacement warranty to cover film against peeling, cracking, discoloration, and deterioration.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. 3M Window Film.

B. Avery Dennison.

C. Flexvue Films.

D. Llumar.

E. Madico, Inc.

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2.02 MATERIALS

A. Glazing Film: Translucent polyester film for permanent bonding to glass. ******This is set up for a frosted film. Customize this paragraph with a specific basis-of-design and pattern/color as needed******
   1. Basis-of-Design Product: 3M Crystal Glass 7725SE-324.
   2. Thickness: 4.7 mils, minimum.
   3. Color: Frosted White.
   4. Construction: Multi-ply laminate.
   5. Adhesive Type: Pressure sensitive acrylic.
   6. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with **<<ASTM E84>>** (Class A).

B. Accessory Materials: As recommended or required by film manufacturer.

C. Glass Cleaner: As recommended by glazing film manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Field -Applied Film: Verify that existing conditions are adequate for proper application and performance of film.

B. Examine glass and frames. Verify that existing conditions are adequate for proper application and performance of film.

C. Verify glass is not cracked, chipped, broken, or damaged.

D. Verify that frames are securely anchored and free of defects.

E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean glass of dust, dirt, paint, oil, grease, mildew, mold, and other contaminants that would inhibit adhesion.

B. Immediately prior to applying film, thoroughly wash glass with neutral cleaning solution.

C. Protect adjacent surfaces.

D. Do not begin installation until substrates have been properly prepared.

3.03 INSTALLATION

A. Do not apply glazing film when surface temperature is less than 40 degrees F or if precipitation is imminent.

B. Install in accordance with manufacturer's instructions, without air bubbles, wrinkles, streaks, bands, thin spots, pinholes, or gaps, as required to achieve specified performance.

C. Accurately cut film with straight edges to required sizes allowing 1/16-inch to 1/8-inch gap at perimeter of glazed panel unless otherwise required by anchorage method.

D. Seams: Seam film only as required to accommodate material sizes; form seams vertically without overlaps and gaps; do not install with horizontal seams.

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E. Clean glass and anchoring accessories following installation. Remove excess sealants and other glazing materials from adjacent finished surfaces.

F. Remove labels and protective covers.

3.04 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 088733

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SECTION 088813
FIRE-RATED GLAZING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.

C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.

D. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.

E. ASTM C1193 - Standard Guide for Use of Joint Sealants.

F. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

G. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings.

H. GANA (GM) - GANA Glazing Manual.

I. GANA (SM) - GANA Sealant Manual.

J. ICC (IBC) - International Building Code.

K. ITS (DIR) - Directory of Listed Products.

L. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.

M. NFPA 257 - Standard on Fire Test for Window and Glass Block Assemblies.

N. UL (DIR) - Online Certifications Directory.

O. UL 9 - Standard for Fire Tests of Window Assemblies.

P. UL 10B - Standard for Fire Tests of Door Assemblies.

Q. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

R. UL 263 - Standard for Fire Tests of Building Construction and Materials.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene preinstallation meeting two weeks minimum before starting work of this section; require attendance by each of affected installers. Preinstallation meeting for this section may be included as part of Division 8 "Glazing" preinstallation meeting.

1.03 SUBMITTALS

A. Product Data on Glazing Types: Provide structural, physical, and environmental characteristics, size limitations, special handling and installation requirements.

B. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

C. Certificate: Certify that **<< products of this section; or _____>>** meet or exceed **<< specified requirements; or _____>>**.

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1.04 QUALITY ASSURANCE

A. Perform work in accordance with **<< GANA (GM); GANA (SM); GANA (LGRM); IGMA TM-3000; and _____>>** for **<< glazing installation methods; or _____>>**.

B. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.

1.05 FIELD CONDITIONS

A. Ambient Conditions: Do not install glazing when ambient temperature is less than 40 degrees F.

B. Maintain minimum ambient temperature before, during, and 24 hours after installation of glazing compounds.

1.06 WARRANTY

A. Manufacturer Warranty for Coated or Laminated Fire Glass: Provide 5-year manufacturer warranty coverage for coating deterioration or delamination, including providing products to replace failed units, and commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 GLASS MATERIALS AND PERFORMANCE REQUIREMENTS, GENERAL

A. Coordinate with Division 8 Section "Glazing" for general glass material characteristics including float glass, heat-strengthening and tempering, laminated glass, and performance requirements including thermal and safety requirements.

2.02 GLAZING UNITS

A. Glazing Type **<< _____>>** - Fire-Resistance-Rated Glazing: Type, thickness, and configuration of glazing that contains flames, smoke, and blocks radiant heat, as required to achieve indicated fire rating period exceeding 45 minutes.

1. Applications: Provide in the following applications where glass sizes exceed that allowable for fire-protection-rated glazing:
   a. Glazing in fire-rated door assemblies.
   b. Glazing in fire-rated window/storefront/curtainwall assemblies.
   c. Glazing in sidelites, borrowed lites, and other glazed openings in fire-rated wall assemblies.
   d. Other locations as indicated on drawings.
2. Glass Type: Laminated annealed glass with intumescent fire retardant interlayer(s).
3. Provide products listed by **<< ITS (DIR); UL (DIR); or _____>>** and approved by authorities having jurisdiction.
4. Safety Glazing Certification: **<<16 CFR 1201>>** Category II.
5. Glazing Method: As required for fire rating.
6. Fire Rating Period: As indicated on Drawings.
7. Markings for Fire-Resistance-Rated Glazing Assemblies: Provide permanent markings on fire-resistance-rated glazing in compliance with **<< ICC (IBC); local building code; authorities having jurisdiction; and _____>>**.
   a. "W" - meets wall assembly criteria of **<<ASTM E119>>** or **<<UL 263>>** fire test standards.

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b. "D" - meets fire door assembly criteria of **<<NFPA 252>>**, **<<UL 10B>>**, or **<<UL 10C>>** fire test standards.
c. "H" - meets fire door assembly hose stream test of **<<NFPA 252>>**, **<<UL 10B>>**, or **<<UL 10C>>** fire test standards.
d. 'T' - meets temperature rise of not more than **<< 450 degrees F>>** above ambient at end of 30 minutes fire exposure in accordance with **<<NFPA 252>>**, **<<UL 10B>>**, or **<<UL 10C>>** fire test standards.
e. "XXX" - placeholder that represents fire rating period, in minutes.

8. Products:
a. McGrory Glass, Inc; AGC Pyrobel Series.
b. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite II-XL.
c. Technical Glass Products; Pilkington Pyrostop.

B. Glazing Type **<< _____>>** - Fire-Protection-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and does not block radiant heat, as required to achieve indicated fire rating period(s) as indicated on Drawings.
1. Applications:
a. Vision lites in fire-rated door assemblies where glazing area does not exceed allowable.
b. Other locations as indicated on drawings.
2. Glass Type: Safety ceramic glass.
3. Provide products listed by **<< ITS (DIR); UL (DIR); or _____>>** and approved by authorities having jurisdiction.
4. Safety Glazing Certification: **<<16 CFR 1201>>** Category II.
5. Glazing Method: As required for fire rating.
6. Fire-Rating Period: As indicated on Drawings.
7. Markings for Fire-Protection-Rated Glazing Assemblies: Provide permanent markings on fire-protection-rated glazing in compliance with **<< ICC (IBC); local building code; authorities having jurisdiction; and _____>>**
a. "D" - meets fire door assembly criteria of **<<NFPA 252>>**, **<<UL 10B>>**, or **<<UL 10C>>** fire test standards.
b. "OH" - meets fire window assembly criteria, including hose stream test of **<<NFPA 257>>** or **<<UL 9>>** fire test standards.
c. "H" - meets fire door assembly hose stream test of **<<NFPA 252>>**, **<<UL 10B>>**, or **<<UL 10C>>** fire tests standards.
d. "XXX" - placeholder that represents fire-rating period, in minutes.
8. Products:
a. McGrory Glass, Inc; SCHOTT PYRAN Platinum Series.
b. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite X-45/60/90 (SuperClear 45-HS is acceptable for 45 minute glazing).
c. Technical Glass Products; Firelite NT.

2.03 ACCESSORIES

A. Setting Blocks: **<< Calcium silicate; Aluminum silicate; or _____>>**, with **<< 80 to 90; or ____ to ____>>** Shore A durometer hardness**<< ; ASTM C864 Option I; ; ASTM C864 Option II; ; _____; or None - N/A>>**. Length of **<< 0.1 inch for each square foot>>** of glazing or minimum **<< 4 inch>>** by width of glazing rabbet space minus **<< 1/16 inch>>** by height to suit glazing method and pane weight and area.

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B. Spacer Shims: **<< EPDM; Silicone; Neoprene; or _____>>**, **<< 50 to 60; or ____ to ____>>** Shore A durometer hardness**<< ; ASTM C864 Option I; ; ASTM C864 Option II; ; _____; or None - N/A>>**. Continuous by one half the height of glazing stop by thickness to suit application**<< , self adhesive on one face; , _____; or None - N/A>>**.

C. Glazing Tape: Flexible tape made from spun calcium-magnesium-silica fibers in binder; designed to remain stable at temperatures up to **<< 2,012 degrees F; or ___ degrees F >>**.

1. Thickness: **<< As recommended by framing manufacturer for glazing application; or _____>>**.

D. Glazing Gaskets: Flexible intumescent seals.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that minimum required face and edge clearances are provided.

C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

D. Verify that sealing between joints of glass framing members has been completed effectively.

E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry **<< immediately before glazing; within maximum of 24 hours before glazing; or _____>>**. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION - GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers unless more stringent requirements are indicated, including those in referenced glazing standards.

B. Install glazing sealants in accordance with **<<ASTM C1193>>**, **<<GANA (SM)>>**, and manufacturer's instructions.

C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

F. Prevent glass from contact with contaminating substances that may result from construction operations including, but not limited to weld spatter, fire-safing, plastering, mortar droppings, etc.

3.04 INSTALLATION - DRY GLAZING METHOD (TAPE AND TAPE)

A. Application - Interior Glazed: Set glazing infills from interior of building.

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B. Cut glazing tape to length and set against permanent stops, projecting **<< 1/16 inch>>** above sightline.

C. Place setting blocks at **<< 1/4; 1/3; or _____>>** points with edge block no more than **<< 6 inches; or ____ inches>>** from corners.

D. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.

E. Place glazing tape on free perimeter of glazing in same manner described above.

F. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.

G. Carefully trim protruding tape with knife.

3.05 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove nonpermanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces **<< not more than four days; not more than ___ days; or _____>>** prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.06 PROTECTION

A. After installation, mark pane with 'X' by using removable plastic tape or paste**<< ; do not mark heat-absorbing or reflective glass units; ; _____; or None - N/A>>**.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION 088813

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SECTION 089100
LOUVERS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).

B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating.

C. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices.

1.02 SUBMITTALS

A. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.

B. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, and tolerances; head, jamb and sill details; blade configuration, screens, blank-off areas required, and frames.

C. Sustainability Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

D. Samples: Manufacturer's color charts indicating full range of available colors.

E. Test Reports: Independent agency reports showing compliance with specified performance criteria.

F. Manufacturer's Certificate: Certify that products meet or exceed specified performance requirements.

1.03 WARRANTY

A. Provide five year manufacturer's warranty against distortion, metal degradation, and connection failures of louver components.
   1. Finish: Include twenty year coverage against degradation of exterior finish.

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PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Louvers:
   1. Airline Louvers.
   2. Airolite Company, LLC.
   3. American Warming and Ventilating.
   4. Construction Specialties, Inc.
   5. Greenheck Fan Corporation.
   6. Industrial Louvers, Inc.
   7. NCA, a brand of Metal Industries Inc.
   8. Pottorff.
   9. Reliable Products, Inc.
   10. Ruskin.
   11. United Enertech.

2.02 LOUVERS

A. Louvers, General: All louvers shall be factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified in accordance with **<<AMCA 511>>**; provide AMCA Certified seal/marking on all louvers.

B. Drainable-Blade Louvers: Horizontal blade, extruded aluminum construction. ******Standard drainable blade louver can be used at non-critical locations. Provide storm resistant louver below for high wind areas and intake louvers.******

1. Locations: Provide at all louvers**<< except where storm resistant louvers are indicated>>**.
2. Basis-of-Design Product: Construction Specialties; B-5157.
3. Free Area: 50 percent, minimum.
4. Free Area Velocity at Point of Beginning Water Penetration (0.01 oz. / ft^2): Minimum 1000 fpm.
5. Intake Pressure Drop at 0.01 oz/ft^2 free area velocity: 0.45 in. H_2O, maximum.
6. Blades: Drainable-blade.
7. Frame: 5 inches deep, channel profile; corner joints mitered and welded.
8. Aluminum Thickness: Frame 12 gauge, 0.080-inch minimum; blades 12 gauge, 0.080-inch minimum.

C. Storm-Resistance/Wind-Driven Rain Resistant Louvers: Horizontal blade, extruded aluminum construction. Provide at all intake louvers. ******Provide at all intake louvers, or just default to use at all louvers******

1. Locations: **<< Provide at all louvers; or Provide at all air intake louvers>>**.
2. Basis-of-Design Product: Construction Specialties; RS-7315.
3. Free Area: 50 percent, minimum.
4. Pressure Drop: 0.40 inches of water gauge maximum, per square foot of free area at velocity of 1,000 fpm, when tested in accordance with **<<AMCA 500-L>>**, test unit size 48 inch by 48 inch.
5. Wind-Driven Rain Performance: To maintain AMCA certified Class A rating: minimum 99 percent effectiveness when tested at a rainfall rate of 3.0 inches per hour, wind speed of 29 mph, and nominal core ventilation rate of 283 ft/min (1.5 m/s).
6. High-Velocity Wind Load Resistance: Design to comply with applicable requirements of **<<ICC 500>>** and **<<FEMA P-361>>**, including resistance to horizontal debris impact.
7. Blades: Inverted V-shaped, drainable. Provide with integral gutters to direct water to the exterior.
8. Frame: 7 inches deep, channel profile; corner joints mitered and welded.
9. Aluminum Thickness: Frame 0.068 inch minimum; blades 0.068 inch minimum.

2.03 MATERIALS

A. Extruded Aluminum: **<<ASTM B221>>** (**<<ASTM B221M>>**)**<< , ____ alloy, ____ temper; or None - N/A>>**.

2.04 FINISHES

A. Metal surfaces shall be prepared, pre-treated, and coated in accordance with coating and resin manufacturer's instructions.

B. Superior Performing Organic Coatings System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with **<<AAMA 2605>>**, including at

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least 70 percent PVDF resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of **<< 1.2 mils, 0.0012 inch>>**.

C. Color: To be selected by Architect from manufacturer's full range.

2.05 ACCESSORIES

A. Blank-Off Panels: Aluminum face and back sheets, polyisocyanurate foam core, 1-1/2-inch thick, painted black on exterior side; provide where duct connected to louver is smaller than louver frame, sealing off louver area outside duct.
   1. Uninsulated aluminum sheet may be provided at uninsulated spaces; provide minimum 0.050-inch thick aluminum with black exterior face.

B. Screens: Frame of same material as louver, with reinforced corners; removable, screw attached; installed on inside face of louver frame. Provide insect screens at intake louvers and at non-ducted louvers, and provide bird screens at exhaust louvers
   1. Bird Screen: Interwoven wire mesh of steel, 14 gauge, 0.0641-inch diameter wire, 1/2 inch open weave.
   2. Insect Screen: 18 x 16 size aluminum mesh.

C. Fasteners: Concealed type; stainless steel. If exposed fasteners are unavoidable, provide color-matched heads to match framing color.

D. Flashings: Of same material as louver frame, formed to required shape, single length in one piece per location.

E. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared openings and flashings are ready to receive this work and opening dimensions are as indicated on shop drawings.

3.02 INSTALLATION

A. Install louver assembly in accordance with manufacturer's instructions.

B. Install louvers level and plumb.

C. Set sill members and sill flashing in continuous bead of sealant.

D. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.

E. Secure louver frames in openings with concealed fasteners.

F. Coordinate with installation of mechanical ductwork.

3.03 CLEANING

A. Strip protective finish coverings.

B. Clean surfaces and components.

END OF SECTION 089100

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SECTION 092216
COLD FORMED STEEL FRAMING - NON-STRUCTURAL (CFSF-NS)

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Refer to Section **<< 054000 - Cold-Formed Steel Framing - Structural (CFSF-S)>>**: Requirements for **<< structural, load-bearing, metal stud framing; exterior wall stud framing; and overhead/suspended/bulkhead framing>>**.

1.02 REFERENCE STANDARDS

A. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

D. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.

E. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members.

F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

G. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.

H. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.

1.03 SUBMITTALS

A. Product Data: Provide data describing **<< framing member materials and finish; product criteria; load charts; limitations; and _____>>**.

B. Product Data: Provide manufacturer's data on project-specific partition head to structure connectors, showing compliance with requirements.

C. Sustainability Submittals: Refer to Division 01, "Sustainable Design Requirements."

PART 2 PRODUCTS

2.01 FRAMING MATERIALS

A. Non-Loadbearing Framing System Components: **<<AISI S220>>**; sheet steel, of size and properties necessary for the spacing indicated, with maximum deflection of wall framing of **<< L/120 at 5 psf; L/120 at 7.5 psf; L/120 at 10 psf; L/240 at 5 psf; L/240 at 7.5 psf; L/240 at 10 psf; L/360 at 5 psf; L/360 at 7.5 psf; L/360 at 10 psf; or _____>>**.

1. Steel Thickness (Studs and Runners): Minimum 0.0179-inch (18 mil / 25 gauge) unless otherwise required to comply with **<<ASTM C754>>** for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf, and as indicated below:
    a. Provide minimum 0.0329-inch thickness (33 mil / 20 gauge) for all partitions using 3-5/8-inch-deep studs where stud partition height is greater than 12 feet above floor level.

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b. Provide minimum 0.0329-inch (33 mil / 20 gauge - Structural) for high-density board applications, such as ASTM C1178 tile backing panels and ASTM C1629 abuse- or impact-resistant gypsum board, and at door frames.

c. Provide minimum 0.0329-inch (33 mil / 20 gauge - Structural) for walls receiving heavy wall-hung items or loads, including but not limited to wall cabinets, wall-hung countertops, TV brackets, liquid tanks, folding and fixed seats, grab bars, handrails, exercise equipment, and shelving greater than 9 inches deep and over 3 feet in length.

2. Studs: C-shaped**<< with flat faces; with knurled or embossed faces; with ribbed webs and flanges with rolled-edge stiffeners; with _____; or None - N/A>>**.

3. Runners: U-shaped, sized to match studs.

4. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.

a. Minimum Steel Thickness: Provide minimum 0.0329-inch (33 mil / 20 gauge - Structural) for all shaft wall stud applications.

b. Studs: C-T shaped shaft wall stud profile.

c. Runners and Jamb Struts: J-shaped with tabs, sized to match studs.

5. Furring: Hat-shaped sections, minimum depth of **<< 7/8 inch>>**.

6. Resilient Furring Channels: **<< Single leg; Double leg; Single or double leg; or _____>>** configuration; 1/2 inch channel depth.

B. Deflection and Firestop Track: Slotted; intumescent strip **<< factory-applied; field-applied; or _____>>** to track flanges expands when exposed to heat or flames to provide a perimeter joint seal. ******MCPS prefers slotted deflection and firestop track only.******

C. Non-Loadbearing Framing Accessories:

1. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.

a. Materials: **<<ASTM A36/A36M>>** formed sheet steel support member with factory-welded **<<ASTM A1003/A1003M>>** steel plate base.

2. Bracing and Bridging: **<<ASTM A653/A653M>>** G90 galvanized steel; cold-rolled channel / hat-section profile; for lateral bracing of wall studs with slots for engaging on-module studs.

3. Framing Connectors: **<<ASTM A653/A653M>>** steel clips; secures cold rolled channel to wall studs for lateral bracing.

4. Sheet Metal Backing: 0.036 inch thick flat strap/plate.

5. Fasteners: Self-tapping screws designed for attachment of metal framing and recommended by manufacturer.

6. Anchorage Devices: Powder actuated or screw anchors with sleeves, recommended by manufacturer for anchorage to indicated substrates.

7. Acoustic Insulation: **<<ASTM C665>>**; preformed mineral-fiber, friction fit type, unfaced. Thickness as indicated, or sized to fit stud depth indicated.

8. Acoustic Sealant: Refer to Division 07, "Joint Sealants."

D. Isolation Strips: Provide either closed-cell foam tape with rubberized adhesive membrane or asphalt-saturated organic felt (ASTM D226, Type I, No. 15).

2.02 GYPSUM BOARD SUSPENSION SYSTEM

A. For interior overhead gypsum board, in lieu of separate stick built fixed-framing bulkheads and soffits fabricated of Structural Cold-Formed Steel Framing (CFSF-S), Contractor may provide a

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direct hung suspension system, per **<<ASTM C645>>**, composed of pre-fabricated beams and cross-furring members, specifically designed for use with gypsum board.

B. Products:
   1. Armstrong; Quikstix Drywall Grid System.
   2. Certainteed; 1-1/2" Drywall Suspension System.
   3. Rockfon; Chicago Metallic Drywall Grid System.
   4. USG; Drywall Suspension System.

2.03 FABRICATION

A. Fabricate assemblies of framed sections to sizes and profiles required.

B. Fit, reinforce, and brace framing members to suit design requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that rough-in utilities are in proper location.

3.02 INSTALLATION OF STUD FRAMING

A. Install in accordance with **<<ASTM C754>>**. Provide framing, including bracing, bridging, and anchorage accessories, to meet L/240 deflection limit at a lateral pressure of 5 psf unless indicated otherwise.
   1. Gypsum Board: At gypsum board partitions and assemblies, comply with applicable requirements of **<<ASTM C840>>** for framing installation.
   2. Install a continuous isolation strip where studs or stud-framed partitions directly abut dissimilar metals or exterior masonry wall.

B. Extend partition framing **<< to structure where indicated and to ceiling in other locations; to structure in all locations; to ceiling in all locations; or to deck at locations indicated, and to a height 4 inches above ceiling level at all other locations, unless otherwise indicated>>**.

C. Partitions Terminating to Deck: Secure partitions to building structure in accordance with Structural Drawings. Do not fasten runner directly to floor/roof deck; provide clearance for firestopping. Coordinate with Section **<< 078400 - Firestopping; or _____>>** for head-of-wall joint firestopping assemblies and firestopping around structural elements as required.

D. Partitions Terminating Above Ceiling: Attach studs to runner using specified mechanical devices in accordance with manufacturer's instructions. Brace runners to structural elements in accordance with Structural Drawings.

E. Align and secure top and bottom runners at maximum 24 inches on center.

F. At partitions indicated with an acoustic rating:
   1. Provide components and install as required to produce STC ratings as indicated, based on published tests by manufacturer conducted in accordance with **<<ASTM E90>>** with STC rating calculated in accordance with **<<ASTM E413>>**.
   2. Place acoustic sealant between runners and substrate, studs and adjacent construction.
   3. Place acoustic sealant between studs and adjacent vertical surfaces.
   4. Place acoustic sealant at top and bottom of partition

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G. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.

H. Install studs vertically at 16 inches on center, unless otherwise indicated.

I. Align stud web openings horizontally.

J. Secure both sides of studs to tracks using method. Do not weld.

K. Stud splicing is not permissible.

L. Fabricate corners using a minimum of three studs.

M. Install double studs at wall openings, door and window jambs, not more than **<< 2 inches>>** from each side of openings.

N. Install bracing, bridging, and anchorage to brace stud framing system rigid.

O. Coordinate erection of studs with requirements of **<< door frames; window frames; and _____>>**; install supports and attachments.

P. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.

Q. Blocking: Use FRT wood blocking secured to studs. Provide blocking for support of **<< plumbing fixtures; toilet partitions; wall cabinets; toilet accessories; hardware; opening frames; and other built-in-place wall mounted items and equipment>>**.

R. Furring: **<< Install at spacing and locations shown on drawings; Coordinate with sound isolation clip spacing and locations; or _____>>**. Lap splices a minimum of **<< 6 inches>>**.

3.03 GYPSUM BOARD SUSPENSION SYSTEM

A. Install suspension system in accordance with manufacturer's instructions. Do not attach overhead suspension hangers to or suspend from steel floor or roof deck; fasten to primary structural beams/joists or provide intermediate slotted track as supplemental structure between primary structural elements.

3.04 TOLERANCES

A. Maximum Variation From True Position: 1/8 inch in 10 feet.

B. Maximum Variation From Plumb: 1/8 inch in 10 feet.

END OF SECTION 092216

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SECTION 092900
GYPSUM BOARD

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units.

B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units.

C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

D. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

E. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

G. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.

H. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

I. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.

J. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

K. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel.

L. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing.

M. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units.

N. ASTM C1396/C1396M - Standard Specification for Gypsum Board.

O. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels.

P. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels.

Q. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.

R. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

S. ASTM E413 - Classification for Rating Sound Insulation.

T. ASTM E1414/E1414M - Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.

U. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

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V. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

W. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.

X. GA-216 - Application and Finishing of Gypsum Panel Products.

Y. GA-226 - Application of Gypsum Board to Form Curved Surfaces.

Z. GA-600 - Fire Resistance and Sound Control Design Manual.

AA. SCAQMD 1113 - Architectural Coatings.

BB. SCAQMD 1168 - Adhesive and Sealant Applications.

CC. UL (FRD) - Fire Resistance Directory.

1.02 SUBMITTALS

A. Product Data: Provide data on each type of product specified, including gypsum board, accessories, and joint finishing components.

B. Sustainable Design Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

C. Samples: Provide two samples in manufacturer's standard length of each type of decorative trim indicated. ******Only needed for more decorative items, customize as needed. Not needed for standard gypsum products******

D. Evaluation Service Reports: Show compliance of grid suspension systems with specified requirements.

1.03 DELIVERY, STORAGE, HANDLING, AND FIELD CONDITIONS

A. Do not deliver or install until building is weather-tight and conditioned.

B. Store materials in dry and clean location until needed for installation. During installation, handle in a manner that will prevent damage and to prevent marring and soiling of finished surfaces.

C. Do not install gypsum products that have gotten wet or moldy, or show signs of past moisture damage.

D. Maintain uniform temperature and humidity at occupancy conditions during and after installation. Allow products to acclimatize prior to installation.

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PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES, GENERAL

A. Provide completed assemblies complying with **<<ASTM C840>>** and **<<GA-216>>**.

B. Fire-Resistance-Rated Assemblies: Provide with requirements of **<<GA-600>>**, and provide complete assemblies that are equivalent to a listed test assembly in **<<UL (FRD)>>**.

1. Coordinate with the work of other sections, including but not limited to cold-formed steel framing, joint sealants, and firestopping to ensure complete assembly is equivalent to tested listing. Coordinate with accessory products including joint treatments and fasteners to ensure they are compliant with tested listing.

C. Acoustic Rated Partitions: Provide complete assemblies with STC ratings indicated on Drawings, as calculated in accordance with **<<ASTM E413>>** and based on tests conducted in accordance with **<<ASTM E90>>**.

D. Shaft Walls: Provide complete assemblies with the following characteristics:

1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

E. Sustainability Requirements:
1. Paints and Coatings: Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet applicable VOC limits of **<<CARB (SCM)>>** or **<<SCAQMD 1113>>**.
2. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet the chemical content requirements of **<<SCAQMD 1168>>**.

2.02 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
1. American Gypsum Company.
2. CertainTeed Corporation.
3. Georgia-Pacific Gypsum.
4. National Gypsum Company.
5. PABCO Gypsum.
6. USG Corporation.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in **<<ASTM C1396/C1396M>>**; sizes to minimize joints in place; with tapered edges.
1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
2. Mold Resistance: Score of 10, when tested in accordance with **<<ASTM D3273>>**.
a. Mold-resistant board is required whenever gypsum board is indicated in rooms subject to steam or water, including mechanical rooms, toilet rooms, custodial rooms, and kitchens.
3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
4. Thickness:
a. Vertical Surfaces: 5/8-inch.
b. Ceilings: 5/8-inch Type X, or manufacturer's 1/2-inch ceiling board with documented sag resistance equivalent to 5/8-inch Type X board.
c. Curved Surfaces: Provide flexible 1/4 inch thickness gypsum board, installed in two layers.

C. Abuse Resistant Wallboard: ******Abuse-resistant protects against scuffs and scratches, but not direct impacts. Recommended to use only within reach (to 8 ft height) then switch to regular gypsum above******
1. Application: High-traffic areas indicated.
2. Surface Abrasion: Level 2, minimum, when tested in accordance with **<<ASTM C1629/C1629M>>**.
3. Indentation: Level 1, minimum, when tested in accordance with **<<ASTM C1629/C1629M>>**.
4. Soft Body Impact: Level 2, minimum, when tested in accordance with **<<ASTM C1629/C1629M>>**.
5. Mold Resistance: Score of 10, when tested in accordance with **<<ASTM D3273>>**.

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6. Paper-Faced Type: Gypsum wallboard, as defined in **<<ASTM C1396/C1396M>>**.
7. Glass Mat-Faced Type: Gypsum wallboard, as defined in **<<ASTM C1658/C1658M>>**.
8. Type: Fire-resistance-rated Type X, UL or WH listed.
9. Thickness: 5/8 inch.
10. Edges: Tapered.
11. Paper-Faced Products:
    a. American Gypsum Company; M-Bloc AR Type X.
    b. CertainTeed Corporation; Extreme Abuse Resistant Drywall with M2Tech.
    c. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold-Guard Abuse-Resistant.
    d. National Gypsum Company; Gold Bond Hi-Abuse XP Gypsum Board.
    e. USG Corporation; USG Sheetrock Brand Mold Tough AR Firecode X Panels.
12. Glass Mat Faced Products:
    a. Georgia-Pacific Gypsum; DensArmor Plus Abuse-Resistant.
    b. National Gypsum Company; Gold Bond eXP Interior Extreme AR Gypsum Panel.
    c. USG Corporation; USG Sheetrock Brand Glass-Mat Panels Mold Tough AR Firecode X.

D. Impact Resistant Wallboard: ******Impact-resistant gypsum protects against scuffs and scratches but also direct impact. Recommended to use only within reach (to 8 ft height) then switch to regular gypsum above.******
1. Application: High-traffic areas indicated.
2. Surface Abrasion: Level 3, minimum, when tested in accordance with **<<ASTM C1629/C1629M>>**.
3. Indentation: Level 1, minimum, when tested in accordance with **<<ASTM C1629/C1629M>>**.
4. Soft Body Impact: Level 3, minimum, when tested in accordance with **<<ASTM C1629/C1629M>>**.
5. Hard Body Impact: Level 2, minimum, when tested in accordance with **<<ASTM C1629/C1629M>>**.
6. Mold Resistance: Score of 10, when tested in accordance with **<<ASTM D3273>>**.
7. Paper-Faced Type: Gypsum wallboard, as defined in **<<ASTM C1396/C1396M>>**.
8. Glass Mat-Faced Type: Gypsum wallboard, as defined in **<<ASTM C1658/C1658M>>**.
9. Type: Fire-resistance-rated Type X, UL or WH listed.
10. Thickness: 5/8-inch.
11. Edges: Tapered.
12. Paper-Faced Products:
    a. American Gypsum Company; M-Bloc IR Type X.
    b. CertainTeed Corporation; Extreme Impact Resistant Drywall with M2Tech.
    c. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold-Guard MAX-Impact.
    d. National Gypsum Company; Gold Bond Hi-Impact XP Gypsum Board.
    e. USG Corporation; USG Sheetrock Brand Mold Tough VHI Firecode X Panels.
13. Glass Mat Faced Products:
    a. Georgia-Pacific Gypsum; DensArmor Plus Impact-Resistant.
    b. National Gypsum Company; Gold Bond eXP Interior Extreme IR Gypsum Panel.
    c. USG Corporation; USG Sheetrock Brand Glass-Mat Panels Mold Tough VHI.

E. Tile Backing Board:

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1. Application: Surfaces behind tile in wet areas including **<< tub and shower surrounds; shower ceilings; and _____>>**.
2. Mold Resistance: Score of 10, when tested in accordance with **<<ASTM D3273>>**.
3. ANSI Cement-Based Board: Non-gypsum-based; cementitious panels with glass fiber mesh embedded in front and back surfaces complying with **<<ANSI A118.9>>** and ASTM C 1288 or **<<ASTM C1325>>**.
   a. Thickness: 5/8-inch.
   b. Available Products:
      1) USG Corporation; Durock Cement Board. ******MCPS preferred product.******
      2) FinPan, Inc.; Util-A-Crete Backer Board.
      3) National Gypsum Company; PermaBase Cement Board.
      4) USG Corporation; Durock Cement Board. ******MCPS preferred product.******
4. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in **<<ASTM C1178/C1178M>>**.
   a. Fire-Resistance-Rated Type: Type X core, thickness 5/8-inch.
   b. Mold Resistance: Score of 10, when tested in accordance with **<<ASTM D3273>>**.
   c. Available Products:
      1) USG Corporation; Durock Glass-Mat Tile Backerboard. ******MCPS preferred product.******
      2) CertainTeed Corporation; 5/8" GlasRoc Tile Backer Type X.
      3) Georgia-Pacific Gypsum; DensShield Tile Backer.
      4) National Gypsum Company; Gold Bond eXP Tile Backer.

F. Acoustical Sound Dampening Wall and Ceiling Board: Two layers of heavy paper-faced, high-density gypsum board separated by a viscoelastic polymer layer and capable of achieving STC rating of**<< 50; or ___ >>** or more in typical stud wall assemblies as calculated in accordance with **<<ASTM E413>>** and when tested in accordance with **<<ASTM E90>>**. ******Verify assembly STC rating required******
   1. Thickness: 5/8-inch.
   2. Long Edges: Tapered.
   3. Mold Resistance: Score of 10, when tested in accordance with **<<ASTM D3273>>**.
   4. Products:
      a. CertainTeed Corporation; SilentFX Quick Cut Gypsum Board.
      b. National Gypsum Company; Gold Bond SoundBreak XP Gypsum Board.
      c. PABCO Gypsum; Quiet Rock.

G. Exterior Sheathing Board for Ceilings and Soffits: Sizes to minimize joints in place; ends square cut.
   1. Mold Resistance: Score of 10, when tested in accordance with **<<ASTM D3273>>**.
   2. Fungal Resistance: No fungal growth when tested in accordance with **<<ASTM G21>>**.
   3. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in **<<ASTM C1177/C1177M>>**.
   4. Board Type: Regular; 5/8-inch thick.
   5. Edges: Square**<< Square; or _____>>**.
   6. Available Glass Mat Faced Products:
      a. American Gypsum Company; M-Glass Exterior Sheathing.
      b. CertainTeed Corporation; GlasRoc Exterior Sheathing.

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c. Georgia-Pacific Gypsum; DensGlass Sheathing.
d. National Gypsum Company; Gold Bond eXP Sheathing.
e. USG Corporation; USG Securock Brand Ultralight Glass-Mat Sheathing.

H. Shaftwall Liner Panels: Type X; 1 inch thick, square long edges, ends square cut.
1. Glass Mat Faced Type: Glass mat shaftliner gypsum panel or glass mat coreboard gypsum panel as defined in **<<ASTM C1658/C1658M>>**.
2. Mold Resistance: Score of 10, when tested in accordance with **<<ASTM D3273>>**.
3. Glass Mat Faced Products:
a. American Gypsum Company; M-Glass Shaft Liner.
b. CertainTeed Corporation; GlasRoc Shaftliner Type X.
c. Georgia-Pacific Gypsum; DensGlass Shaftliner (mold-resistant).
d. National Gypsum Company; Gold Bond eXP Shaftliner.
e. USG Corporation; Sheetrock Brand Glass-Mat Liner Panels Mold Tough 1 in.

2.03 SEAMLESS SOUND-ABSORBING GYPSUM BOARD CEILING SYSTEM

A. Sound-Absorbing Gypsum Board Ceiling System: Perforated seamless mineral fiber panels or perforated gypsum board with acoustic backer panels; with acoustically transparent spray-applied finish.
1. Thickness, Perforated Gypsum Board: 5/8-inch.
2. Thickness, Backer Panels: 1 inch.
3. Spray-Applied Finish: Acoustically transparent, acrylic-based finish coating.
a. Finish Color: Manufacturer's standard, flat white.
4. Noise Reduction Coefficient (NRC): Not less than 0.80 when measured and calculated in accordance with **<<ASTM C423>>**.
5. Ceiling Attenuation Class (CAC): Not less than 44 when tested in accordance with **<<ASTM E1414/E1414M>>** and classified in accordance with **<<ASTM E413>>**.
6. Suspension System: Refer to Division 09 Section "Cold-Formed Steel Framing - Non-Structural (CFSF-NS)" for drywall suspension system.
7. Products:
a. Armstrong Ceilings; Acoustibuilt Seamless Acoustical Ceiling Sytem.
b. Rockfon; Mono Acoustic.
c. USG Corporation; Ensemble Acoustical Drywall Ceiling System.

2.04 GYPSUM BOARD ACCESSORIES

A. Acoustic Accessories:
1. Sound Attenuation Batts: **<<ASTM C665>>**; preformed glass fiber, friction fit type, unfaced. Thickness sized to fit metal stud cavity.
2. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant. **<< Refer to sealant AS-1 in Division 07 Section "Joint Sealants."; or None - N/A>>**
3. Putty Pads: Non-hardening endothermic material, in pad form, faced on both sides with poly liner, designed to seal around penetrations and wiring devices, enhancing acoustic performance.
a. Nominal Size: 7-1/4 x 7-1/4 x 3/16 inches.
b. Available Products:
1) 3M; Fire Barrier Moldable Putty Pads MPP+.

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2) Hilti; Firestop Putty Pad, CFS-P PA.
3) Specified Technologies, Inc.; SpecSeal Putty Pad.

B. Beads, Joint Accessories, and Other Trim: **<<ASTM C1047>>**, galvanized steel, rolled zinc, or PET/PVC, unless noted otherwise.
1. Corner Beads: Bullnosed, with minimum 7/8-inch flanges each side. Provide at outside corners of vertical partitions in public-facing spaces. Do not provide at bulkheads, windows, and back of house areas.
a. Bullnose Radius: 3/4-inch.
b. Products:
1) Basis-of-Design: CertainTeed Corporation; AquaBead Bullnose Corner Reinforcement. ******MCPS preferred product******
2) ClarkDietrich; PRO-Bull 3/4" Corner Bead.
3) Flannery, Inc; Expanded Flange Bullnose Corner.
4) Phillips Manufacturing Co; gripSTIK 3/4" Bullnose Corner Bead.
5) Trim-Tex, Inc; 3/4-inch Large Bullnose.
2. L-Bead, LC-Bead, and U-Bead: Sized to fit gypsum wallboard size(s) indicated.
a. Provide LC-bead at exposed panel edges and U-bead at concealed panel edges, unless otherwise indicated. Provide L-bead at locations indicated.

C. Decorative Metal Trim:
1. Material: Extruded aluminum alloy 6063-T5 temper.
2. Finish: **<< Anodized, clear; Anodized, _____ color; Factory primed for field painting; or _____>>**.
3. Reveal Trim: Provide 1/2-inch wide by either 1/2-inch or 5/8-inch deep, as standard with manufacturer.
a. Products:
1) Fry Reglet; Model DRM-625-50.
2) Flannery, Inc; Model DWR 625-50.
3) Gordon, Inc; Part # 512-5/8.
4) Pittcon Industries; Model SWR-050-063.
5) Tamlyn; Model RV5-12.
4. "F" Reveal Molding: 1/2-inch wide by 5/8-inch deep with 7/8-inch flange on one side only for reveals where drywall terminates against jamb, ceiling, or other finish material.
a. Products:
1) Fry Reglet; Model DRMF-625-50.
2) Flannery, Inc; Model DWRF 625-50.
3) Gordon, Inc; Part # 412-5/8.
4) Pittcon Industries; Model SWR-050U-063.
5) Tamlyn; Model MCR5-12.
5. L-Trim Molding: "L" angle molding where drywall raised panel terminates at other substrates.
a. Products:
1) Fry Reglet: Model DRML-625.
2) Flannery, Inc; Model DWL 625.
3) Gordon, Inc; Part # 258.
4) Pittcon Industries; Model ST-063.

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5) Tamlyn; Model MLR-58.

6. Stepped Outside Corner: Exposed metal reveal profile for 90 degree outside corners.
   a. Products:
      1) Fry Reglet: Model DRMW 625-625.
      2) Flannery, Inc; Model DWRW 625-625.
      3) Gordon, Inc; Part # 945-2X-58.
      4) Pittcon Industries; Model SCS-2X 063-063.
      5) Tamlyn; (no product - provide custom to match profiles above).

D. Metal Edge Trim for "Cloud" Suspended Ceilings: Steel or extruded aluminum; provide attachment clips, splice plates, and preformed corner pieces for a complete trim system.
   1. Trim Height: **<< 4 inches; 6 inches; 8 inches; or _____>>**.
   2. Finish: Baked enamel; **<< color as selected by Architect from manufacturer's full range; white; or _____>>**.
   3. Available Products:
      a. Armstrong World Industries, Inc.; Axiom Classic.
      b. Certainteed; Terminus Perimeter Trim.
      c. Chicago Metallic Corp.; Infinity System.
      d. USG Corporation; Compasso Suspension Trim.

E. Acoustic Partition Closure at Storefront or Curtain Wall: Multi-piece rectangular-section assembly of nested U-shape aluminum extrusions for finished closure between aluminum storefront or curtainwall system vertical mullion (and glass where indicated), and partition assembly. Closure shall allow for movements of framing and glass it attaches to, and shall not allow direct metal to glass contact. Fill cavity of partition closure with acoustic batt insulation.
   1. Thickness: Aluminum closure plates not less than 0.125-inch thick.
   2. Acoustic Rating: Provide product with a minimum tested STC rating of 55.
      a. Acoustic Material: Fungi- and microbe-resistant foam, Class A rated when tester per ASTM E 84.
   3. Acoustical Sealant: Seal both ends of partition closure with acoustical sealant.
   4. Finish: **<< Match adjacent storefront/curtain wall; or Powder coat; color selected by Architect from manufacturer's full range>>**.
   5. Available Products:
      a. Gordon, Inc; Mullion Mate.
      b. Mull-It-Over Products; Mull-It-Over.

F. Moisture Guard Trim: **<<ASTM C1047>>**, rigid plastic, **<< 48 inch>>** length, applied to bottom edge of gypsum board.
   1. Height: 1-3/4 inch.
   2. Depth: Match gypsum board thickness.
   3. In lieu of moisture guard trim; Contractor may at its option install gypsum board with a maximum 5/8-inch gap at base of wall.

G. Joint Materials: **<<ASTM C475/C475M>>**, and as recommended by gypsum board manufacturer for project conditions.
   1. Joint Tape: 2-inch wide; provide creased paper tape for paper-faced board products, and provide 10-by-10 coated glass fiber tape for glass-fiber-faced board products and for exterior locations.
   2. Joint Compound: Drying type, vinyl-based, ready-mixed.

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H. High Build Drywall Surfacer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.

I. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs and Wood Members: **<<ASTM C1002>>**, self-piercing tapping screws, corrosion-resistant.

J. Adhesives: Manufacturer's recommended type; provide adhesive only where required by approved tested fire- or acoustic-rated assembly, unless otherwise indicated.

K. Exterior Soffit Vents: One piece, perforated, **<< ASTM A653/A653M galvanized steel with G90 coating; ASTM B221 6063 T5 alloy aluminum; solid vinyl; or _____>>**, with edge suitable for direct application to gypsum board and manufactured especially for soffit application. Provide continuous vent unless otherwise indicated.

1. Available Manufacturers:
   a. Fry Reglet.
   b. Gordon, Inc.
   c. Pittcon Industries.
   d. Stockton Products.
2. Flat, horizontal-to-horizontal application: **<< 3/4-inch wide with one row of vent slots for a minimum of 1 square inch of opening per linear foot; 2-inch wide with three rows of vent slots for a minimum of 3 square inches of opening per linear foot; or 3-inch wide with five rows of vent slots for a minimum of 5 square inches of opening per linear foot.>>**.
3. Finish: High performance organic coating; color selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION

A. Shaft Wall Framing: Prior to beginning installation of shaft wall liner panels, verify that framing is properly installed at spacing required to meet performance requirements.

B. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special friction studs.

3.03 ACOUSTIC ACCESSORIES INSTALLATION

A. Sound Attenuation Batts: At all walls/partitions where sound attenuation batts are indicated, place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install at all STC-rated walls/partitions, and at all walls indicated ot receive sound attenuation batts. Install in accordance with manufacturer's instructions.

C. Putty Pads: Install at all STC-rated walls/partitions, and at all walls indicated ot receive sound attenuation batts. Install putty pads on the backside of items penetrating gypsum board. Items include, but are not limited to, wiring devices, cable, conduit, and pipe. Completely cover and seal around each penetration.

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3.04 BOARD INSTALLATION

A. Comply with **<<ASTM C840>>**, **<<GA-216>>**, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
   1. Do not overdrive screws. Install snug with head of screw slightly below face of gypsum board, without tearing or ripping of facer.

B. Single-Layer Nonrated: Install gypsum board in most econominal direction, with ends and edges occurring over firm bearing.

C. Double-Layer, Nonrated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.

D. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

E. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.

F. At base of gypsum board wall/partitions, install gypsum board with moisture-guard trim or with an open horizontal joint (gap) not to exceed 5/8-inch above finished floor slab, and tape and finish vertical joints to bottom edge of board to afford a smooth substrate for applied wall base.

G. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.
   1. Seal joints, cut edges, and holes with water-resistant sealant.

H. Cementitious Backing Board: Install over steel framing members where indicated, in accordance with **<<ANSI A108.11>>** and manufacturer's instructions.

I. Installation on Metal Framing: Use screws for attachment of gypsum board**<< except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination; _____; or None - N/A>>**.

J. Curved Surfaces: Apply gypsum board to curved substrates **<< in accordance with GA-226; or _____>>**.

3.05 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints at locations indicated on Drawings; where not indicated provide in compliance with ASTM C840, consistent with lines of building spaces, and as follows:
   1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
   2. At exterior soffits, not more than 30 feet apart in both directions.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Decorative Trim: Install at locations shown on drawings and in accordance with manufacturer's instructions.

D. Exterior Soffit Vents: Install according to manufacturer's written instructions and in locations indicated on drawings. Provide vents at locations indicated on Drawings.

E. Putty Pads: Install putty pads on the backside of items penetrating gypsum board on STC-rated walls/partitions. Items include, but are not limited to, wiring devices, cable, conduit, and pipe. Completely cover and seal around each penetration.

3.06 JOINT TREATMENT

A. Finish gypsum board in accordance with levels defined in **<<ASTM C840>>**, as follows:

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1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
3. Level 3: Walls to receive textured wall finish.
4. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
5. Level 1: Wall areas above finished ceilings, whether or not accessible in the completed construction.
6. Level 0: Temporary partitions.
7. Level 0: Surfaces indicated to be finished in later stage of project.

B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.

C. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

D. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.07 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8-inch in 10 feet in any direction.

3.08 PROTECTION

A. Protect installed gypsum board assemblies from subsequent construction operations.

END OF SECTION 092900

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SECTION 093000
TILING

PART 1 GENERAL

1.01 DEFINITIONS

A. General: Refer to definitions in the **<<ANSI A108/A118/A136>>** series of tile installation standards and in ANSI A137.1 for the Work of this Section unless indicated otherwise.

B. Module Size: Actual tile size plus indicated joint width.

C. Face Size: Actual tile size, not including spacer lugs.

1.02 REFERENCE STANDARDS

A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar.

B. ANSI A108.1b - Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar.

C. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar.

D. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship.

E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive.

F. ANSI A108.5 - Setting of Ceramic Tile with Dry-Set Cement Mortar, Modified Dry-Set Cement Mortar, EGP (Exterior Glue Plywood) Modified Dry-Set Cement Mortar, or Improved Modified Dry-Set Cement Mortar.

G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy.

H. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout.

I. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework.

J. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone.

K. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar.

L. ANSI A108.20 - American National Standard Specifications for Exterior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs.

A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium).

B. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive.

C. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar.

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D. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation.

E. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation.

F. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation.

G. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar.

H. ANSI A137.1 - American National Standard Specifications for Ceramic Tile.

I. ANSI A137.3 - American National Standard Specification for Gauged Porcelain Tile and Gauged Porcelain Tile Panels/Slabs.

J. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

K. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.

L. SCAQMD 1113 - Architectural Coatings.

M. SCAQMD 1168 - Adhesive and Sealant Applications.

N. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting at the Project Site one week before starting work of this section; require attendance by affected installers.

1. Review substrate preparation requirements.
2. Review each type of tile, mortar, grout, and TCNA installation methods.
3. Review requirements for waterproofing and/or crack isolation membrane(s).
4. Review existing conditions, and specialty bedding and grout materials recommended by manufacturer's technical representative for tile applications over existing conditions.

1.04 SUBMITTALS

A. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

B. Sustainability Submittals: Refer to Division 01, "Sustainable Design Requirements."

C. Shop Drawings: Indicate **<< tile layout; patterns; color arrangement; perimeter conditions; junctions with dissimilar materials; control and expansion joints; thresholds; ceramic accessories; setting details; and _____>>**.

1. Include waterproofing details at floor drains, shower pans, cove base, and thresholds.

D. Selection Samples: Manufacturer's standard size for each tile, trim piece, and grout. Include samples of accessories requiring color selection.

E. Waterproof Membrane Flood Test Reports.

F. Installer's Qualification Statement.

G. Material Test Reports: Indicating that mortars, grouts, and special purpose tiles meet specified requirements.

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1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

B. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.

1. Extra Tile and Trim Units: 1 extra box for every 50 boxes installed of each type, size, color, pattern, and surface finish combination.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Installer shall have documented experience of work similar in scope, materials, and design to that indicated for this Project, with a record of successful in-service performance, with references upon request.

1. Installer Certification: Installer's employees have one of the following:

a. Ceramic Tile Education Foundation (CTEF): Certified Tile Installer (CTI).

b. Apprenticeship Program: Installer has achieved Journeyworker status through an apprenticeship from the International Union of Bricklayers and Allied Craftworkers (IUBAC) or a U.S. Department of Labor (DOL)-recognized program.

1.07 MOCK-UPS

A. See Section **<< 014000 - Quality Requirements>>** for general requirements for mock-up.

B. Construct tile mock-ups, incorporating all components specified for the location.

1. Provide mock-up of minimum 5 square feet for each type of floor tile, unless otherwise indicated.

2. Provide mock-up of minimum 5 square feet for each type of wall tile, unless otherwise indicated.

3. Approved mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Store tile, grout, and mortar off the ground, protected from weather and water infiltration.

B. Store products in unopened containers or packages until ready for use.

C. Protect materials from freezing or overheating in accordance with manufacturer's instructions.

1.09 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

B. Maintain ambient and substrate temperature and humidity at levels required by referenced ANSI and TCNA tile standards, and per manufacturer's instructions.

PART 2 PRODUCTS

2.01 TILE

A. Source Limitations:

1. Tile: Provide tile of each type, color, and finish by the same manufacturer from the same production run. Quality of appearance and physical properties shall be consistent for continguous areas.

2. Mortar and Grout: Provide mortar, grout, adhesive, and aggregate of uniform quality by the same manufacturer or producer.

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a. Provide mortar, grout, and crack isolation and waterproofing membranes from a single manufacturer. Portland cement, aggregate, and sheet membrane products are excepted.

3. Other Items: Provide each of the following from a single manufacturer:
   a. Stone thresholds.
   b. Crack isolation and waterproofing wamembrane.
   c. Metal edge strips.

B. General:
1. Provide tiles with types and compositions that comply with **<<ANSI A137.1>>**, standard grade.
2. Refer to SETTING MATERIALS and GROUTS articles in this section for specific ANSI standards.
3. Tiles with Color Variation: Provide factory blended units that show the same range of variation between packages and matching approved samples.
4. Factory Mounted Tile: Provide manufacturer's standard back or edge mounted tiles.
   a. Do not provide back or edge mounted tile for shower installation unless approved by tile manufacturer for this type of installation.

C. Ceramic Mosaic Tile: ***MCPS prefers wall tile or FRP at janitor sinks. Extend 24 to 30 inches above sink top.***
1. Certified by the Porcelain Tile Certification Agency. ******Indicate this only if using a porcelain based tile product.******
2. Size: **<< 1 by 1 inch; 1 by 2 inch; 2 by 2 inch; or ____by____ inch>>**, nominal.
3. Shape: **<< Square; Hexagon; Round; Rectangle; Multiple size rectangles; or _____>>**.
4. Edges: **<< Square; Cushioned; or _____>>**.
5. Surface Finish: **<< Unglazed; Matte glazed; Mottle glazed; Slip resistant; or _____>>**.
6. Color(s): To be selected by **<<Architect>>** from manufacturer's **<< standard; full; custom; or _____>>** range.
7. Trim Units: Matching **<< bead; cove; surface bullnose; and _____>>** shapes in **<< sizes indicated; sizes coordinated with field tile; or _____>>**.
8. Products:
   a. American Olean; a division of Dal-Tile Corporation.
   b. Dal-Tile Corporation.
   c. Deutsche Steinzeug America, Inc.
   d. Emser Tile.
   e. Porcelanite-Lamosa.
   f. Interceramic, USA.
   g. Lone Star Ceramics.
   h. Portobello America, Inc.
   i. Seneca Tiles, Inc.
   j. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

D. Glazed Wall Tile: ******MCPS prefers wall tile or FRP at janitor sinks. Extend 24 to 30 inches above sink top.******

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1. Size: **<< 4-1/4 by 4-1/4 inch; 3 by 6 inch; 6 by 6 inch; or ____by____ inch>>**, nominal; 5/16-inch thick.
2. Edges: **<< Square; Cushioned; or _____>>**.
3. Surface Finish: **<< Matte glaze; Mottle glaze; High gloss; or _____>>**.
4. Color(s): To be selected by **<<Architect>>** from manufacturer's **<< standard; full; custom; or _____>>** range.
5. Trim Units: Matching **<< bead; bullnose; surface bullnose; cove; base; curb; counter trim; and _____>>** shapes in **<< sizes indicated; sizes coordinated with field tile; or _____>>**.
6. Products:
   a. American Olean; a division of Dal-Tile Corporation.
   b. Dal-Tile Corporation.
   c. Emser Tile.
   d. Interceramic, USA.
   e. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

E. Quarry Tile:
1. Size: **<< 4 by 8 inch; 6 by 6 inch; 8 by 8 inch; or ____by_____ inch>>**, nominal.
2. Thickness: **<< 1/2 inch; 3/4 inch; or ____ inch>>**, nominal.
3. Edges: **<< Cushioned; Square; or _____>>**.
4. Surface Finish: **<< Unglazed; Matte glazed; Non-slip; or _____>>**.
5. Color(s): To be selected by **<<Architect>>** from manufacturer's **<< standard; full; custom; or _____>>** range.
6. Trim Units: Matching **<< bullnose; double bullnose; cove; cove base; window sill or step nosing; and _____>>** shapes in **<< sizes indicated; sizes coordinated with field tile; or _____>>**.
7. Products:
   a. American Olean; a division of Dal-Tile Corporation.
   b. Dal-Tile Corporation.
   c. Metropolitan Ceramics.
   d. Summitville Tiles, Inc.
   e. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

F. Porcelain Tile:
1. Certified by the Porcelain Tile Certification Agency.
2. Size: **<< 6 by 6 inch; 8 by 8 inch; 12 by 12 inch; 18 by 18 inch; or ____by____ inch>>**, nominal.
3. Thickness: **<< 5/16 inch; 3/8 inch; 1/2 inch; or _____ inch>>**.
4. Edges: **<< Square; Cushioned; Interlocking shape; or _____>>**.
5. Surface Finish: **<< Unglazed; Matte glazed; Non-slip; or _____>>**.
6. Color(s): To be selected by **<<Architect>>** from manufacturer's **<< standard; full; custom; or _____>>** range.
7. Trim Units: Matching **<< bullnose; surface bullnose; double bullnose; cove base; cove; window sill or step nosing; and _____>>** shapes in **<< sizes indicated; sizes coordinated with field tile; or _____>>**.
8. Products:

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a. American Marazzi Tile, Inc.
b. American Olean; a division of Dal-Tile Corporation.
c. Crossville, Inc.
d. Dal-Tile Corporation.
e. Florim USA.
f. GranitiFiandre; c/o Trans Ceramica, Ltd.
g. Interceramic.
h. Iris US.
i. Laufen.
j. Lone Star Ceramics Company.
k. Porcelanite-Lamosa.
l. Portobello America, Inc.
m. Seneca Tiles, Inc.
n. United States Ceramic Tile Company.
o. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

G. Gauged Porcelain Tiles and Panels/Slabs:
1. Certified by the Porcelain Tile Certification Agency. ******Indicate this only if using a porcelain based tile product.******
2. Size: Manufacturer's standard slab size.
3. Thickness: **<< 1/8 inch; 1/4 inch; or _____ inch>>**.
4. Edges: **<< Square; Cushioned; or _____>>**.
5. Surface Finish: **<< Glossy; Matte; or _____>>**.
6. Color(s): To be selected by **<<Architect>>** from manufacturer's **<< full; standard; or custom>>** range.
7. Products:
a. Atlas Concorde; Atlas Plan.
b. Cosentino; Dekton.
c. Crossville Studios; Laminam.
d. Dal-Tile Corporation; Panoramic Porcelain Surfaces.
e. Florim USA; Porcelain Slabs.
f. Porcelanosa Grupo; XLight.
g. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.02 TRIM AND ACCESSORIES

A. Ceramic Trim: Matching **<< bullnose; surface bullnose; double bullnose; cove base; cove; window sill or step nosing; and _____>>** ceramic shapes in **<< sizes indicated; sizes coordinated with field tile; or _____>>**.
1. Applications:
a. Open Edges: Bullnose.
b. Inside Corners: **<< Jointed; Coved; or _____>>**.
c. Floor to Wall Joints: **<< Cove; Straight; or _____>>** base.
2. Manufacturers: Same as for tile.

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B. Non-Ceramic Trim: **<< Satin brass anodized extruded aluminum; Satin natural anodized extruded aluminum; Solid brass; Brushed stainless steel; Integrally colored extruded PVC; or _____>>**, style and dimensions to suit application, for setting using tile mortar or adhesive. ******Beveled metal transitions can be used at group restroom thresholds with no doors to common hallways.******
   1. Applications:
      a. Open edges of wall tile.
      b. Open edges of floor tile.
      c. Wall corners, outside and inside.
      d. Transition between floor finishes of different heights.
      e. Thresholds at door openings.
      f. Expansion and control joints, floor and wall.
      g. Floor to wall joints.
      h. Borders and other trim as indicated on drawings.
   2. Manufacturers:
      a. Blanke Corporation.
      b. Ceramic Tool Company.
      c. Genesis APS International.
      d. LATICRETE International.
      e. Schluter-Systems.
      f. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

C. Thresholds: **<< 2 inches; 4 inches; or ___ inches>>** wide by full width of wall or frame opening; **<< beveled; or rounded>>** edge on **<< both long edges; one long edge; or _____>>**; without holes, cracks, or open seams. ******MCPS standards: indicate 4 inches wide with beveled edge for marble thresholds at doors; indicate 2 inches wide with rounded edge for marble thresholds at showers.******
   1. Thickness: **<< 1/2 inch; 5/8 inch; 3/4 inch; 1 inch; ____ inch; thickness to fit application; or _____>>**.
   2. Material: Marble, **<< honed; polished; or _____>>** finish.
   3. Material: Solid surface acrylic resin, mineral filler, and pigments; non-porous, color and pattern consistent throughout thickness.
   4. Material: Artificial stone tile; 93 percent quartz aggregate, resin, color pigments.
   5. Color and Pattern: As selected by Architect from manufacturer's full range.
   6. Applications:
      a. At doorways where tile terminates.

2.03 SETTING MATERIALS

A. Provide setting and grout materials from same manufacturer.

B. Modified Dry-Set Mortar (Thinset): ANSI A118.4. ******For tiles with both sides smaller than 15 inches.******
   1. Applications: Use this type at all locations where thinset mortar is indicated, unless otherwise indicated.
   2. Products:
      a. Custom Building Products; VersaBond Professional Thin-Set Mortar.
      b. H.B. Fuller Construction Products, Inc.; TEC Full Flex TA 390/391.

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c. LATICRETE International, Inc.; 252 Silver.
d. MAPEI Corporation; Ultraflex 2.
e. Summitville Tiles, Inc.; S-1000 MP Thin-Set Latex Mortar.
f. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

C. Latex-Portland Cement LHT Mortar (Medium-Bed): **<<ANSI A118.4>>**. ******For tiles with at least one side larger than 15 inches.******
1. Applications: Use this type of bond coat where Large and Heavy Tile (LHT) mortar is indicated, in a 1/4- to 3/8-inch thick medium-bed application.
2. Products:
a. ARDEX Engineered Cements; ARDEX X5.
b. Custom Building Products; ProLite Premium Rapid Setting Large Format Tile Mortar, with Multi-Surface Bonding Primer.
c. H.B. Fuller Construction Products, Inc; TEC Ultimate Large Tile Mortar.
d. LATICRETE International, Inc; 257 TITANIUM.
e. MAPEI Corporation; Ultraflex LFT.
f. Merkrete, by Parex USA, Inc; Merkrete 735 Premium Flex.
g. Summitville Tiles, Inc.; S-1200 MP Premium Medium Bed Mortar.
h. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

D. Improved Latex-Portland Cement Dry-Set Mortar (Thinset): **<<ANSI A118.15>>** and ISO 13007 "C2" classification. ******For exterior spaces exposed to freeze/thaw cycles and submerged/water immersion applications.******
1. Applications: Use this type of mortar where indicated.
2. Products:
a. ARDEX Engineered Cements; ARDEX S 28.
b. Custom Building Products; MegaFlex Crack Prevention Mortar.
c. H.B. Fuller Construction Products, Inc; TEC 3N1 Performance Mortar.
d. LATICRETE International, Inc; LATICRETE 254 Platinum.
e. MAPEI Corporation; Ultraflex 3.
f. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

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2.04 GROUTS

A. Provide setting and grout materials from same manufacturer.

B. High Performance Polymer Modified Grout: **<<ANSI A118.7>>** polymer modified cement grout.
1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
2. Use sanded grout for joints **<< 1/8 inch>>** wide and larger; use unsanded grout for joints less than **<< 1/8 inch>>** wide.
3. Color(s): To be selected by **<<Architect>>** from manufacturer's full range.
4. Products:
a. ARDEX Engineered Cements; ARDEX FL.
b. Custom Building Products; Prism Color Consistent Grout.
c. H.B. Fuller Construction Products, Inc; TEC AccuColor Plus Grout.

d. LATICRETE International, Inc; LATICRETE PERMACOLOR Grout.
e. MAPEI Corporation; Ultracolor Plus.
f. Merkrete, by Parex USA, Inc; Merkrete Pro Grout.
g. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

C. Water-Cleanable Epoxy Grout: **<<ANSI A118.3>>** stain-resistant epoxy grout. ******For spaces that require increased stain resistance. Use in kitchens.******
1. Applications: Where indicated.
2. Heat Resistance: Tested by manufacturer for continuous exposure up to 140 deg F, and intermittent exposure up to 212 deg F.
3. Color(s): To be selected by **<<Architect>>** from manufacturer's full range.
4. Products:
a. ARDEX Engineered Cements; ARDEX WA.
b. Custom Building Products; CEG-Lite 100% Solids Commercial Epoxy Grout.
c. H.B. Fuller Construction Products, Inc; TEC AccuColor EFX Epoxy Special Effects Grout.
d. LATICRETE International, Inc; LATICRETE SPECTRALOCK PRO Premium Grout.
e. MAPEI Corporation; Kerapoxy CQ.
f. Merkrete, by Parex USA, Inc; Merkrete Pro Epoxy.
g. Sika Corp; SikaTile 825 Epoxy.
h. Summitville Tiles, Inc; S-500 Ultra Max.
i. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.05 MORTAR AND GROUT MIXING

A. Comply with referenced ANSI standards.
B. Comply with manufacturer's instructions.
C. Measure accurate proportions when adding materials, water, and additives.
D. Use equipment, speeds, containers, times, and procedures necessary to produce mortars and grouts suitable for best performance in indicated installations.

2.06 MAINTENANCE MATERIALS

A. Tile Sealants: Moisture- and mildew-resistant type sealants; one-part silicone for wall applications and multi-part urethane for floor applications. Sealants and accessories shall comply with requirements below and with requirements of Division 7 Section "Joint Sealants."
1. Color(s): As selected by **<<Architect>>** from manufacturer's full line. Sealant colors shall match grout colors in adjacent joints unless otherwise indicated.
2. Low-Emitting Materials:
a. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet the chemical content requirements of **<<SCAQMD 1168>>**.
3. Silicone Sealant (Walls): ASTM C 920, Type S, Grade NS, Class 25; Uses NT (non-traffic), G (glass), A (aluminum), O (other substrates indicated).
a. Products:
1) GE Silicones, a division of GE Specialty Materials; SCS1700 Sanitary.

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2) Pecora Corporation; Pecora 898 NST.
3) Tremco Inc.; Tremsil 200.
4) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

4. Urethane Sealant (Floors): ASTM C 920, Type M, Grade P, Class 25; Uses T (traffic), M (mortar), A (aluminum), O (other substrates indicated).
   a. Products:
      1) Master Builders Solutions; MasterSeal SL 2.
      2) Pecora Corporation; NR-200 Urexpan.
      3) Sika Corporation; Sikaflex-2c SL.
      4) Tremco Inc.; THC-901.
      5) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
5. Chemical-Resistant Sealant: For chemical-resistant floors, provide non-staining chemical-resistant elastomeric sealant, of type recommended by chemical-resistant grout manufacturer, compatible with tile and setting materials for applications indicated. ******Use for kitchens.******
   a. Manufacturers:
      1) Atlas Minerals & Chemicals, Inc.
      2) Master Builders Solutions.
      3) Sauereisen.
6. Sealant Accessories: Provide backer rod, primer, and other sealant accessories as recommended by sealant manufacturer for applications required.

B. Grout Sealer: Liquid-applied, penetrating, moisture and stain protection for existing or new Portland cement grout.
   1. Composition: Water-based colorless silicone.
   2. Products:
      a. Custom Building Products; Aqua Mix Sealer's Choice Go**<< ; Aqua Mix Sealer's Choice Gold; ; Aqua Mix Enrich 'N' Seal; ; Aqua Mix Penetrating Sealer; ; _____; or None - N/A>>**.
      b. Merkrete, by Parex USA, Inc; M**<< ; Merkrete Revive; ; Merkrete Grout Sealer; ; _____; or None - N/A>>**.
      c. SGM, Inc.; Grout Sealer.
      d. Summitville Tiles, Inc.; SL-99 Summitseal II.
      e. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

C. Tile Sealer: Stain protection for exposed surfaces of unglazed ceramic tile, other porous tile, and grout. Provide penetrating sealer with no sheen, preserving natural tile appearance.
   1. Products:
      a. Custom Building Products; Aqua Mix Sealer's Choice Gold.
      b. Rust-Oleum Corporation; Miracle Sealants 511 Impregnator Natural Looking Penetrating Sealer**<< ; Miracle Sealants 511 Impregnator Natural Looking Penetrating Sealer; ; Miracle Sealants 511 Porous Plus Penetrating Sealer; ; Miracle Sealants 511 Seal & Impregnating Color Enhancer; ; _____; or None - N/A>>**.
      c. STONETECH, a division of LATICRETE international, Inc; STONETECH Heavy Duty Sealer.

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d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

D. Grout Release: Temporary, water-soluble pre-grout coating.

1. Products:
   a. Custom Building Products; Aqua Mix Grout Release.
   b. MAPEI Corporation; UltraCare Grout Release.
   c. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.07 ACCESSORY MATERIALS

A. Low-Emitting Materials:

1. Paints and Coatings: Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet applicable VOC limits of **<<CARB (SCM)>>** or **<<SCAQMD 1113>>**.
2. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet the chemical content requirements of **<<SCAQMD 1168>>**.

B. Concrete Floor Slab Crack Isolation Membrane: Material complying with **<<ANSI A118.12>>**; not intended as waterproofing.

1. Crack Resistance: No failure at 1/8 inch**<< 1/16 inch; 1/8 inch; 3/8 inch; or _____ inch>>** gap, minimum.
2. Peel-and-Stick Sheet Type: ******Choose peel and stick type or bonded sheet membrane type.******
   a. Material: Rubberized membrane laminated to reinforcing fabric.
   b. Thickness: 40 mils, nominal.
   c. Products:
      1) Boiardi Products Corp.; a QEP company; Elastiment 340 Sound Control Sheet Membrane Waterproofing and Anti-Fracture/Crack-Suppression System.
      2) Custom Building Products; Crack Buster Pro-Crack Prevention Mat Underlayment.
      3) MAPEI Corporation; Mapeguard 2.
      4) National Applied Construction Products, Inc.; ECB Anti-Fracture Membrane.
      5) Sika Corp; SikaTile 225 PNS.
      6) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
3. Bonded Sheet Membrane Type: ******Choose peel and stick type or bonded sheet membrane type.******
   a. Material: Polyethylene sheet membrane with polyester fleece laminated to underside, 1/8 inch thick.
   b. Products:
      1) Blanke Corporation; Blanke SecuMat.
      2) LATICRETE International, Inc; LATICRETE STRATAMAT Sheet Membrane.
      3) Mapei Corporation; Mapeguard UM 35 Membrane.
      4) Noble Company; Noble
      5) Schluter-Systems; DITRA.

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6) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

C. Waterproofing Membrane: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with **<<ANSI A118.10>>**.

1. Crack Resistance: No failure at 1/8 inch gap, minimum; comply with **<<ANSI A118.12>> << ; comply with ANSI A118.12; ; _____; or None - N/A>>**.
2. Fluid or Trowel Applied Type with embedded Reinforcing Fabric: ******Choose fluid/trowel applied type or bonded sheet membrane type.******
   a. Material: Synthetic rubber or Acrylic.
   b. Thickness: 30 mils, minimum, dry film thickness.
   c. Products:
      1) Custom Building Products; 9240 Waterproofing and Anit-Fracture Membrane.
      2) H.B. Fuller Construction Products, Inc; TEC HydraFlex Waterproofing Crack Isolation Membrane.
      3) LATICRETE International, Inc; 9235 Waterproofing Membrane.
      4) MAPEI Corporation; Mapelastic AquaDefense.
      5) Merkrete, by Parex USA, Inc; Merkrete Hydro Guard 2000.
      6) Sika Corp; Sika Tile 100 Moisture Guard.
      7) Summitville Tiles, Inc.; S-9000.
      8) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
3. Bonded Sheet Membrane Type: ******Choose fluid/trowel applied type or bonded sheet membrane type.******
   a. Material: Polyethylene sheet membrane with non-woven fabric laminated to both sides, 20 to 30 mils thick, nominal.
   b. Products:
      1) Blanke Corporation; Blanke Aqua-Shield.
      2) LATICRETE International, Inc; LATICRETE HYDRO BAN Sheet Membrane.
      3) Mapei Corporation; Mapeguard WP 200 Membrane.
      4) Noble Company; Noble TS.
      5) Schluter-Systems; KERDI.
      6) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify with installer present that surfaces are smooth and flat within the tolerances specified for that type of work, per ANSI A108.01, and are ready to receive tile.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.

C. Verify that subfloor surfaces are dust free and free of substances or coatings that could impair bonding of setting materials to subfloor surfaces, including but not limited to soap, wax, oil, or silicone.

D. Verify that concrete surfaces receiving bonded or thin-set mortar applications comply with the requirements of ANSI A108.01.

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1. Mechanically scarify steel trowel finished surfaces.
2. Remove protrustions, bumps, and ridges by sanding or grinding.

E. Verify that required floor-mounted utilities, grounds, anchors, and recessed frames are in correct location and completed prior to tile installation.

F. Coordinate joints and cracks in substrates with tile joints with Architect if not coordinated prior to installation.

G. Commence with installation after noncompliant conditions are corrected.

3.02 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks, holes, and depressions with manufacturer's standard trowelable leveling and patching compound. Level existing substrate surfaces to acceptable flatness tolerances.

D. For waterproofing installations with a reinforced mortar bed, comply with ANSI A108.1A and slope substrate 1/4 inch per foor (1:50) toward drains.

E. For tiles with color variations, confirm packaged tile is factory blended such that tiles from taken from package contain the same variation in color as tiles taken from another. Blend tiles at project site or return to manufacturer if packages are not factory blended.

F. For ease of cleaning and to prevent staining, precoat tile with temporary grout release without covering unexposed surfaces. For unglazed ceramic and other porous tile types, provide either combination tile sealer/grout release, or a temporary grout release with final tile sealer applied after tile installation.

3.03 INSTALLATION - GENERAL

A. Comply with requirements of TCNA (HB) installation methods indicated in this section and referenced **<<ANSI A108/A118/A136>>** Series or that apply to the setting and grout materials indicated.

1. Provide 95 percent mortar coverage for the following in compliance with procedures in **<<ANSI A108/A118/A136>>**Series:
   a. Exterior tile floors.
   b. Tile floors in wet areas.
   c. Tile floors with 8 by 8 inches tiles or larger.
   d. Tile floors with rib-backed tiles.

B. Mortar Types: Provide modified dry-set mortar in a standard thin-set bed except as indicated:

1. Provide LHT mortar in a 1/4- to 3/8-inch medium bed at all large format tile (tile 12 inches or greater in any dimension).

C. Grout Types: Grout all tile joints unless otherwise indicated. Provide high-performance polymer-modified grout except as indicated:

1. Provide epoxy grout in toilet, shower, and locker rooms, custodial/janitorial rooms, and other spaces subject to water.
2. Provide chemical- and heat-resistant epoxy grout in commercial kitchens.

D. Install **<< tile; thresholds; and _____>>** and grout in accordance with applicable requirements of **<<ANSI A108.1a>>** through **<<ANSI A108.20>>**, manufacturer's instructions, and **<<TCNA (HB)>>** recommendations.

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E. Lay tile to pattern indicated. Do not interrupt tile pattern through openings or transition to adjacent floor material in centerline of openings under doorleafs. Cut or extend tiles to suit transitions where they occur. Lay tile to form complete covering extending into recesses and under or behind equipment and fixtures. At obstructions, edges, and corners, terminate tile without disprupting patterns or joint alignments.

F. Cut tile without marring visible surfaces and fit closely to penetrations through tile including but not limited to, electrical outlets, piping, and fixtures, leaving sealant joint space. Plates, collars, or covers shall overlap tile. Form corners and bases neatly. Form intersectiosn and returns accurately. **<< Align floor joints.; Align floor and base joints.; Align floor, base, and wall joints.; Align floor and wall joints.; Align base joints.; Align base and wall joints.; Align wall joints.; _____ .; or None - N/A>>** Grind tile edges adjacent to trim, finish, or built-in items to form straight and aligned joints.

G. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout. Center tile against each wall and lay out in a grid pattern unless indicated otherwise. Minimize pieces measuring less than half a tile.

1. Sheet Mounted Tile: Joints between tile sheets shall match joints within tile sheets so there is no variation in finished installation.
2. Adjoining Units: Align joints between floor wall, base, and trim units if their sizes match.
3. Whole Integer Units: Align joints where whole integer values of floor, base, wall, and trim units are indicated.

H. Install tile in accordance with manufacturer's standard recommendation maintaining module size. If manufacturer has no recommendation, provide the following:

1. Ceramic Mosaic Tile: 1/16 inch
2. Quarry Tile: 1/4 inch.
3. Porcelain Tile: 1/4 inch.
4. Glazed Wall Tile: 1/16 inch.
5. Thin

I. Lay out wainscots to heights indicated or next full tile beyond.

J. Form internal angles **<< square; coved; or _____>>** and external angles **<< bullnosed; square; or _____>>**.

K. Install non-ceramic trim where tile abuts adjacent materials in accordance with manufacturer's instructions. Use trim appropriate for application where adjacent finish is flush with top of tile and where adjacent finish is lower than top of tile.

L. Install thresholds where indicated.

M. Install sealants in accordance with Division 07, "Joint Sealants."

N. Sound tile after setting. Replace hollow sounding units.

O. Keep control and expansion joints free of mortar, grout, and adhesive.

P. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

Q. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.04 INSTALLATION - COMBINATION WATERPROOFING AND CRACK ISOLATION MEMBRANE

A. Install combination waterproofing and crack isolation membrane in accordance with **<<ANSI A118.10>>** for waterproofing, **<<ANSI A118.12>>** for crack isolation, and manufacturer's requirements.

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B. Install fluid-applied combination waterproofing and crack isolation membrane to achieve manufacturer's recommended uniform thickness and bond securely with substrate.

C. Turn membrane up the wall a minimum of 3 inches above the floor.
   1. Terminate edges of sheet membrane using manufacturer's standard termination strip. Seal edges to maintain waterproofing continuity.

D. Cure and test combination waterproofing and crack isolation membrane prior to installing tile and setting materials.

3.05 INSTALLATION - FLOORS - THIN-SET METHODS

A. Install crack isolation membranes in accordance with **<<ANSI A118.12>>** and manufacturer's requirements.

B. Over exterior concrete substrates, install in accordance with **<<TCNA (HB)>>** Method F102.

C. Crack Isolation Membrane:
   1. Full Application: Over new interior concrete substrates, install in accordance with TCNA (HB) Method F122/F122A, over combination waterproofing/crack-isolation membrane.
      a. Provide expansion joints, control joints, isolation joints where indicated during installation, setting, and grouting of tile. Do not saw-cut joints after tile installation is complete.
   2. Partial Application: Over existing interior concrete substrates on grade, install in accordance with TCNA (HB) Method F125-Full, over full coverage crack-isolation membrane.
      a. Install crack isolation membrane centered over subfloor control joints and existing cracks and measuring a minimum of two tiles wide. Terminate sheet crack isolation membranes with manufacturer's standard edge termination detail.
   3. Cure crack isolation membrane prior to installing tile and setting materials.

D. Install tile-to-tile floor movement joints in accordance with **<<TCNA (HB)>>** Method EJ171F.
   1. Lay cove metal strip at toe of tile base. Do not set toe of coved tile base on top of floor tile.

3.06 INSTALLATION METHODS - WALL TILE

A. Over cementitious backer units on studs, install in accordance with **<<TCNA (HB)>>** Method W244**<< , using membrane at toilet rooms; , using membrane at toilet rooms and kitchens; , using membrane at toilet rooms, kitchens, and locker rooms; , using membrane at toilet rooms and locker rooms; , using membrane at kitchens; , using membrane at kitchens and locker rooms; , using membrane at locker rooms; _____; or None - N/A>>**.

B. Over interior concrete / masonry install in accordance with **<<TCNA (HB)>>** Method W202.

3.07 INSTALLATION METHODS - SHOWER RECEPTOR WALLS AND DRAINS

A. At tiled shower receptors install in accordance with **<<TCNA (HB)>>** Method **<< B414, mortar bed floor, and W201, mortar bed over concrete or masonry walls; B415, mortar bed floor, and W244, thin-set over cementitious backer unit walls; B420, mortar bed floor, and W245, thin-set over coated glass mat backer board walls; or _____>>**.
******Indicate B414/W201 if floor and wall have mortar bed. Indicate B415/W244 floor has mortar bed and wall has cementitious backers. Indicate B420/W245 if floor has mortar bed and wall has glass mat backers.******

B. At tiled shower receptors in renovations install in accordance with TCNA (HB) Method **<< TR418, mortar bed floor, and W201, mortar bed over concrete or masonry walls; TR420, mortar bed floor, and W244, thin-set over cementitious backer unit walls; TR420, mortar**

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bed floor, and W245, thin-set over coated glass mat backer board walls; or _____>> . ******Indicate TR418/W201 if floor and wall have mortar bed. Indicate TR420/W244 floor has mortar bed and wall has cementitious backers. Indicate TR420/W245 if floor has mortar bed and wall has glass mat backers.******

C. At integrated bonding flange drains install in accordance with TCNA (HB) Method B422. ******Use this for integral flange drains, similar to the integral Schluter type drain. Otherwise indicate Paragraphs A or B for standard drain details.******

D. Grout with latex-Portland cement.

3.08 FIELD QUALITY CONTROL

A. Perform a flood test of the waterproofing assembly a minimum of 24 hours after installation and prior to tile instllation.
   1. Plug drains or waste line. Dam periemter of waterproofing.
   2. Fill with water high enough to cover membrane connection at drain and floor to wall transition.
   3. Inspect waterproofing for leaks.
   4. Repair leaks and re-test until watertight.

B. Prepare test and inspection reports. Indicate corrective measures taken.

3.09 CLEANING

A. Clean tile and grout surfaces immediately after placement.

B. Remove epoxy and latex-portalnd cement ground residue as quickly as it becomes feasible.

C. Remove grout smears and haze in accordance with manufacturer's instructions a minimum of 10 days after installation. Use manufacturer's standard or recommended cleaners. Test the cleaner on a small area of the installation prior to full cleaning. Protect non-tile materials, plumbing fixtures, and metal surfaces during cleaning. Flush with water prior to and after cleaning.

3.10 PROTECTION

A. Do not permit foot or wheeled traffic over finished floor surface for minimum 7 days after installation.

B. Cover installed tile with kraft paper or durable flooring protection board during construction to prevent staining, damage, and wear. Apply manufacturer's recommended neutral protective tile cleaner.

C. Remove floor coverings and rinse neutral protective cleaner prior to final inspection.

END OF SECTION 093000

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SECTION 095100
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 DEFINITIONS

A. AC: Articulation Class.

B. CAC: Ceiling Attenuation Class.

C. LRC: Light Reflectance Coefficient.

D. NRC: Noise Reduction Coefficient.

1.02 REFERENCE STANDARDS

A. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

D. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.

E. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.

F. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

H. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

I. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements.

J. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.

K. ASTM E795 - Standard Practices for Mounting Test Specimens during Sound Absorption Tests.

L. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.

M. NAAMM AMP 500-06 - Metal Finishes Manual.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene at the Project site on one week before starting work of this section.

1. Review preparation and installation procedures and coordinating and scheduling required with related work.

2. Coordinate layout and installation of acoustical ceilings with work in Divisions 21, 22, 23, and 26.

1.04 SUBMITTALS

A. Shop Drawings: Indicate **<< grid layout and related dimensioning; junctions with other ceiling finishes; mechanical and electrical items installed in the ceiling; and _____>>**.

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B. Product Data: Provide data on **<< suspension system components; acoustical units; and specialty ceiling products as indicated>>**.

C. Manufacturer's Installation Instructions: Indicate **<< special procedures; perimeter conditions requiring special attention; and _____>>**.

D. Sustainablilty Submittals: Refer to Division 01, "Sustainable Design Requirements."

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.
   1. Extra Acoustical Panels: 3 boxes, of each type.
   2. Extra Suspension System Components: 3 boxes, of each type.

B. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Source Limitations: Provide each acoustical ceiling assembly (ceiling panel and suspension system) from a single manufacturer to obtain manufacturer's system warranty.

B. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum **<< three; or _____>>** years**<< documented; or None - N/A>>** experience.

C. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum **<< three; or _____>>** years**<< documented; or None - N/A>>** experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver until building is weather-tight and conditioned.

B. Deliver ceiling panels, suspension system parts, and accessories to site in manufacturer's unopened packaging.

C. Store materials in dry and clean location and protect from moisture, humidity, freeze/thaw cycles, direct sunlight, and surface contamination until needed for installation. During installation, handle in a manner that will prevent damage and to prevent marring and soiling of finished surfaces.

1.08 FIELD CONDITIONS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Install products after work of other trades including painting and work above ceiling is complete. Do not install acoustical units until after interior wet work is dry.

C. Maintain uniform temperature and humidity at occupancy conditions during and after acoustical unit installation. Allow products to acclimatize prior to installation.

D. Operate ventilation systems in pressurized plenums a minimum of 48 hours prior to installing acoustical ceilings.

1.09 WARRANTY

A. System Warranty: Provide a single source system warranty covering both acoustical ceiling panels and suspension system.

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1. Warranty shall cover material failures including sag, warping, shrinkage, or delamination, biologic growth including mold or mildew, and rusting of suspension system.
2. Warranty Period: Minimum 15 years, from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Each acoustical ceiling shall be Class A rated, with flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with **<<ASTM E84>>**.

B. Fire-Resistance Rating: Determined in accordance with test procedures in **<<ASTM E119>>** by UL or other qualified testing agency.

2.02 ACOUSTICAL PANELS

A. Acoustical Panels - General: **<<ASTM E1264>>**, Class A.
1. Mountin Method: E-400; in accordance with **<<ASTM E795>>** for measuring NRC with face of tested product is 15-3/4 inches away from the test surface.
2. VOC Content: Third-party tested and certified, according to California Department of Public Health (CDPH) Standard Method (CA Section 01350).
3. Antibacterial/Antimicrobial Treatment: Provide acoustical panels that have been factory-treated by manufacturer for resistance to bacteria, mold, mildew, and fungus in accordance with **<<ASTM D3273>>**.
4. Humidity/Sag Treatment: Provide acoustical panels that have been factory-treated by manufacturer for humidity and sag-resistance **<<ASTM D3273>>**.
5. Formaldehyde-Free: Provide acoustical panels with formaldhyde-free compositon.

******Mineral fiber core ceiling panels with holes. Use in classrooms, music rooms, language labs, and media centers.******

B. ******These are square edge products.****** Acoustical Panels: Painted mineral fiber, with the following characteristics:
1. Classification: **<<ASTM E1264>>**, Type A - Mineral Base.
   a. Form: A1.2 - with painted finish, wet formed.
   b. Pattern: "D" - fissured.
2. Size: **<< 24 by 24 inches; 24 by 48 inch; or ___ by ___ inches>>**.
3. Thickness: 7/8 inch.
4. Light Reflectance: Not less than 0.83, determined in accordance with **<<ASTM E1264>>**.
5. NRC Range: Not less than 0.75, determined in accordance with **<<ASTM E1264>>**.
6. Ceiling Attenuation Class (CAC): Not less than 35, determined in accordance with **<<ASTM E1264>>**.
7. Panel Edge: Square.
8. Color: White.
9. Suspension System: Exposed grid.
10. Products: ******The first choice option is the 24x24 product. The second choice option is the 24x48 product.******
    a. Armstrong World Industries, Inc; Fine Fissured High NRC**<< - Item #1754; or - Item #1755>>**.

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b. CertainTeed; Fine Fissured High NRC**<< - Item #HHF-457 HNRCX; or - Item #HHF-497 HNRCX>>**.

c. USG Corporation; Radar Open Plan Acoustical Panels**<< - Item #22320; or - Item #22325>>**.

d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

C. ******These are beveled edge products.****** Acoustical Panels: Painted mineral fiber, with the following characteristics:

1. Classification: **<<ASTM E1264>>**, Type A - Mineral Base.
   a. Form: A1.2 - with painted finish, wet formed.
   b. Pattern: "D" - fissured.
2. Size: **<< 24 by 24 inches; or 24 by 48 inch>>**.
3. Thickness: 7/8 inch.
4. Light Reflectance: Not less than 0.83, determined in accordance with **<<ASTM E1264>>**.
5. NRC Range: Not less than 0.75, determined in accordance with **<<ASTM E1264>>**.
6. Ceiling Attenuation Class (CAC): Not less than 35, determined in accordance with **<<ASTM E1264>>**.
7. Panel Edge: Beveled.
8. Color: White.
9. Suspension System: Exposed grid.
10. Products: ******The first choice option is the 24x24 product. The second choice option is the 24x48 product.******
    a. Armstrong World Industries, Inc; Fine Fissured High NRC**<< - Item #1756; or - Item #1757>>**.
    b. CertainTeed Ceilings, Inc; Fine Fissured High NRC**<< - Item #HHF-454 HNRCX; or - Item #HHF-494 HNRCX>>**.
    c. USG Corporation; Radar Open Plan Acoustical Panels**<< - Item #22340; or - Item #22345>>**.
    d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

******Heavily textured mineral fiber core ceiling panels. Use in classrooms, music rooms, language labs, and media centers.******

D. ******These are square edge products.****** Acoustical Panels: Painted mineral fiber, with the following characteristics:

1. Classification: **<<ASTM E1264>>**, Type A - Mineral Base.
   a. Form: A1.2 - with painted finish, wet formed.
   b. Pattern: "F" - heavily textured.
2. Size: **<< 24 by 24 inches; or 24 by 48 inch>>**.
3. Thickness: 3/4 inch.
4. Light Reflectance: Not less than 0.82, determined in accordance with **<<ASTM E1264>>**.
5. NRC Range: Not less than 0.70, determined in accordance with **<<ASTM E1264>>**.
6. Ceiling Attenuation Class (CAC): Not less than 30, determined in accordance with **<<ASTM E1264>>**.
7. Panel Edge: Square.

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8. Color: White.
9. Suspension System: Exposed grid.
10. Products: ***The first choice option is the 24x24 product. The second choice option is the 24x48 product.***
    a. Armstrong World Industries, Inc; Cirrus**<< - Item #574; or - Item #533>>**.
    b. CertainTeed Ceilings, Inc; Cashmere High NRC**<< - Item #CM-457NRCP; or - Item #CM-497NRCP>>**.
    c. USG Corporation; Eclipse Acoustical Panels**<< - Item #76575; or - Item #78575>>**.
    d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

E. ******These are beveled edge products.****** Acoustical Panels: Painted mineral fiber, with the following characteristics:
1. Classification: **<<ASTM E1264>>**, Type A - Mineral Base.
    a. Form: A1.2 - with painted finish, wet formed.
    b. Pattern: "F" - heavily textured.
2. Size: **<< 24 by 24 inches; or 24 by 48 inch>>**.
3. Thickness: 3/4 inch.
4. Light Reflectance: Not less than 0.82, determined in accordance with **<<ASTM E1264>>**.
5. NRC Range: Not less than 0.70, determined in accordance with **<<ASTM E1264>>**.
6. Ceiling Attenuation Class (CAC): Not less than 30, determined in accordance with **<<ASTM E1264>>**.
7. Panel Edge: Beveled.
8. Color: White.
9. Suspension System: Exposed grid.
10. Products: ******The first choice option is the 24x24 product. The second choice option is the 24x48 product.******
    a. Armstrong World Industries, Inc; Cirrus**<< - Item #584; or - Item #535>>**.
    b. CertainTeed Ceilings, Inc; Cashmere High NRC**<< - Item #CM-454NRCP; or - Item #CM-494NRCP>>**.
    c. USG Corporation; Eclipse Acoustical Panels**<< - Item #76775; or - Item #78775>>**.
    d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

******Lightly textured mineral fiber core ceiling panels. Use in public facing spaces such as admin, school offices, mother's rooms, and teacher rooms.******

F. ******These are square edge products.****** Acoustical Panels: Mineral fiber with membrane-faced overlay, with the following characteristics:
1. Classification: **<<ASTM E1264>>**, Type A - Mineral Base.
    a. Form: A2.2 - With membrane-faced overlay, wet formed.
    b. Pattern: "E" - lightly textured.
2. Size: **<< 24 by 24 inches; 24 by 48 inch; or ___ by ___ inches>>**.
3. Thickness: 3/4 inch.
4. Light Reflectance: Not less than 0.88, determined in accordance with **<<ASTM E1264>>**.
5. NRC Range: Not less than 0.75, determined in accordance with **<<ASTM E1264>>**.

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6. Ceiling Attenuation Class (CAC): Not less than 35, determined in accordance with **<<ASTM E1264>>**.
7. Panel Edge: Square.
8. Color: White.
9. Suspension System: Exposed grid.
10. Products: ******The first choice option is the 24x24 product. The second choice option is the 24x48 product.******
    a. Armstrong World Industries, Inc; Ultima**<< - Item #1910; or - Item #1913>>**.
    b. CertainTeed Ceilings, Inc.; Symphony m**<< - Item #1222-75-1; or - Item #1220-75-1>>**.
    c. USG Corporation; Mars Acoustical Panels**<< - Item #86185; or - Item #88185>>**.
    d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

G. ******These are beveled edge products.****** Acoustical Panels: Mineral fiber with membrane-faced overlay, with the following characteristics:
1. Classification: **<<ASTM E1264>>**, Type A - Mineral Base.
    a. Form: A2.2 - With membrane-faced overlay, wet formed.
    b. Pattern: "E" - lightly textured.
2. Size: **<< 24 by 24 inches; 24 by 48 inch; or ___ by ___ inches>>**.
3. Thickness: 3/4 inch.
4. Light Reflectance: Not less than 0.88, determined in accordance with **<<ASTM E1264>>**.
5. NRC Range: Not less than 0.75, determined in accordance with **<<ASTM E1264>>**.
6. Ceiling Attenuation Class (CAC): Not less than 35, determined in accordance with **<<ASTM E1264>>**.
7. Panel Edge: Beveled.
8. Color: White.
9. Suspension System: Exposed grid.
10. Products: ******The first choice option is the 24x24 product. The second choice option is the 24x48 product.******
    a. Armstrong World Industries, Inc; Ultima**<< - Item #1911; or - Item #1914>>**.
    b. CertainTeed Ceilings, Inc.; Symphony m**<< - Item #1222BB-75-1; or - Item #1220BB-75-1>>**.
    c. USG Corporation; Mars Acoustical Panels**<< - Item #86785; or - Item #88785>>**.
    d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

H. ******These are square edge products.****** Acoustical Panels: Mineral fiber with membrane-faced overlay, with the following characteristics:
1. Classification: **<<ASTM E1264>>**, Type A - Mineral Base.
    a. Form: A2.2 - With membrane-faced overlay, wet formed.
    b. Pattern: "E" - lightly textured.
2. Size: **<< 24 by 24 inches; 24 by 48 inch; or ___ by ___ inches>>**.
3. Thickness: 1 inch.
4. Light Reflectance: Not less than 0.85, determined in accordance with **<<ASTM E1264>>**.
5. NRC Range: Not less than 0.85, determined in accordance with **<<ASTM E1264>>**.

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6. Ceiling Attenuation Class (CAC): Not less than 30, determined in accordance with **<<ASTM E1264>>**.
7. Panel Edge: Square.
8. Color: White.
9. Suspension System: Exposed grid.
10. Products: ******The first choice option is the 24x24 product. The second choice option is the 24x48 product.******
    a. Armstrong World Industries, Inc; Calla**<< - Item #2820; or - Item #2821>>**.
    b. CertainTeed Ceilings, Inc.; Symphony m High NRC**<< - Item #1222-85-1; or - Item #1220-85-1>>**.
    c. USG Corporation; Mars High-NRC Acoustical Panels**<< - Item #88134; or - Item #89134>>**.
    d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

I. ******These are beveled edge products.****** Acoustical Panels: Mineral fiber with membrane-faced overlay, with the following characteristics:
1. Classification: **<<ASTM E1264>>**, Type A - Mineral Base.
    a. Form: A2.2 - With membrane-faced overlay, wet formed.
    b. Pattern: "E" - lightly textured.
2. Size: **<< 24 by 24 inches; 24 by 48 inch; or ___ by ___ inches>>**.
3. Thickness: 1 inch.
4. Light Reflectance: Not less than 0.85, determined in accordance with **<<ASTM E1264>>**.
5. NRC Range: Not less than 0.85, determined in accordance with **<<ASTM E1264>>**.
6. Ceiling Attenuation Class (CAC): Not less than 30, determined in accordance with **<<ASTM E1264>>**.
7. Panel Edge: Beveled.
8. Color: White.
9. Suspension System: Exposed grid.
10. Products: ******The first choice option is the 24x24 product. The second choice option is the 24x48 product.******
    a. Armstrong World Industries, Inc; Calla**<< - Item #2822; or - Item #2823>>**.
    b. CertainTeed Ceilings, Inc.; Symphony m High NRC**<< - Item #1222B-85-1; or - Item #1220B-85-1>>**.
    c. USG Corporation; Mars High-NRC Acoustical Panels**<< - Item #88135; or - Item #89135>>**.
    d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

******Srubbable and water-resistant mineral fiber core ceiling panel. Use in medical areas, kitchens, locker rooms, or any spaces that may be exposed to moisture vapor.******

J. ******These are square edge products.****** Acoustical Panels: Mineral fiber with membrane-faced overlay, with the following characteristics:
1. Classification: **<<ASTM E1264>>**, Type A - Mineral Base.
    a. Form: A2.2 - with membrane-faced overlay, wet formed.
    b. Pattern: "E" - lightly textured.

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2. Size: **<< 24 by 24 inches; or 24 by 48 inch>>**.
3. Thickness: 3/4 inch.
4. Light Reflectance: Not less than 0.86, determined in accordance with **<<ASTM E1264>>**.
5. NRC Range: Not less than 0.70, determined in accordance with **<<ASTM E1264>>**.
6. Ceiling Attenuation Class (CAC): Not less than 35, determined in accordance with **<<ASTM E1264>>**.
7. Panel Edge: Square.
8. Color: White.
9. Suspension System: Exposed grid.
10. Products: ******The first choice option is the 24x24 product. The second choice option is the 24x48 product.******
    a. Armstrong World Industries, Inc; Ultima Health Zone**<< - Item #1935; or - Item #1938>>**.
    b. CertainTeed Ceilings, Inc.; Symphony m 70 Rx**<< - Item #1222-RSX-1; or - Item #1220-RSX-1>>**.
    c. USG Corporation; Mars Healthcare Acoustical Panels**<< - Item #86169; or - Item #88189>>**.
    d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

K. ******These are beveled edge products.****** Acoustical Panels: Mineral fiber with membrane-faced overlay, with the following characteristics:

1. Classification: **<<ASTM E1264>>**, Type A - Mineral Base.
    a. Form: A2.2 - with membrane-faced overlay, wet formed.
    b. Pattern: "E" - lightly textured.
2. Size: **<< 24 by 24 inches; or 24 by 48 inch>>**.
3. Thickness: 3/4 inch.
4. Light Reflectance: Not less than 0.86, determined in accordance with **<<ASTM E1264>>**.
5. NRC Range: Not less than 0.70, determined in accordance with **<<ASTM E1264>>**.
6. Ceiling Attenuation Class (CAC): Not less than 35, determined in accordance with **<<ASTM E1264>>**.
7. Panel Edge: Square.
8. Color: White.
9. Suspension System: Exposed grid.
10. Products: ******The first choice option is the 24x24 product. The second choice option is the 24x48 product.******
    a. Armstrong World Industries, Inc; Ultima Health Zone**<< - Item #1937; or - Made to Order>>**.
    b. CertainTeed Ceilings, Inc.; Symphony m 70 Rx**<< - Item #1222B-RSX-1; or - Item #1220B-RSX-1>>**.
    c. USG Corporation; Mars Healthcare Acoustical Panels**<< - Item #86684; or - Item #86683>>**.
    d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

******Lightly-textured fiberglass core ceiling panels. Use in spaces where it's important to prevent sound from traveling such as conference rooms, performing arts spaces, music rooms, and gyms.******

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L. ******These are square edge products.****** Acoustical Panels: Glass fiber with membrane-faced overlay, with the following characteristics:
   1. Classification: **<<ASTM E1264>>**, Type B - Glass fiber base with membrane overlay.
      a. Form: B2 - Cloth.
      b. Pattern: "E" - lightly textured.
   2. Size: **<< 24 by 24 inches; 24 by 48 inch; or ___ by ___ inches>>**.
   3. Thickness: 1 inch.
   4. Light Reflectance: Not less than 0.88, determined in accordance with **<<ASTM E1264>>**.
   5. NRC Range: Not less than 0.90, determined in accordance with **<<ASTM E1264>>**.
   6. Panel Edge: Square.
   7. Color: White.
   8. Suspension System: Exposed.
   9. Products: ***The first choice option is the 24x24 product. The second choice option is the 24x48 product.***
      a. Armstrong World Industries, Inc; Optima**<< - Item #3152; or - Item #3153>>**.
      b. CertainTeed Ceilings, Inc; Symphony f**<< - Item #1342-IOF-1; or - Item #1340-IOF-1>>**.
      c. USG Corporation; Halcyon Acoustical Panels**<< - Item #98221; or - Item #98241>>**.
      d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

M. ******These are beveled edge products.****** Acoustical Panels: Glass fiber with membrane-faced overlay, with the following characteristics:
   1. Classification: **<<ASTM E1264>>**, Type B - Glass fiber base with membrane overlay.
      a. Form: B2 - Cloth.
      b. Pattern: "E" - lightly textured.
   2. Size: **<< 24 by 24 inches; 24 by 48 inch; or ___ by ___ inches>>**.
   3. Thickness: 1 inch.
   4. Light Reflectance: Not less than 0.88, determined in accordance with **<<ASTM E1264>>**.
   5. NRC Range: Not less than 0.90, determined in accordance with **<<ASTM E1264>>**.
   6. Panel Edge: Beveled.
   7. Color: White.
   8. Suspension System: Exposed.
   9. Products: ******The first choice option is the 24x24 product. The second choice option is the 24x48 product.******
      a. Armstrong World Industries, Inc; Optima**<< - Item #3250; or - Item #3252>>**.
      b. CertainTeed Ceilings, Inc; Symphony f**<< - Item #1342B-IOF-1; or - Item #1340B-IOF-1>>**.
      c. USG Corporation; Halcyon Acoustical Panels**<< - Item #98223; or - Item #98243>>**.
      d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

N. ******These are square edge products.****** Acoustical Panels: Glass fiber with membrane-faced overlay, with the following characteristics:
   1. Classification: **<<ASTM E1264>>**, Type B - Glass fiber base with membrane overlay.
      a. Form: B2 - Cloth.

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1) Pattern: "G" - smo**<< "C" - perforated, small holes; "D" - fissured; "E" - lightly textured; "F" - heavily textured; "G" - smooth; or _____>>**.

b. Size: **<< 24 by 24 inches; 24 by 48 inch; or ___ by ___ inches>>**.

2. Thickness: 1 inch.
3. Light Reflectance: Not less than 0.88, determined in accordance with **<<ASTM E1264>>**.
4. NRC Range: Not less than 0.95, determined in accordance with **<<ASTM E1264>>**.
5. Panel Edge: Square.
6. Color: White.
7. Suspension System: Exposed.
8. Products: ******The first choice option is the 24x24 product. The second choice option is the 24x48 product.******

a. Armstrong World Industries, Inc; Lyra PB**<< - Item #8372PB; or - Item #8373PB>>**.

b. CertainTeed Ceilings, Inc; Symphony f**<< - Item #1342-IOF-1; or - Item #1340-IOF-1>>**.

c. USG Corporation; Halcyon ECO Acoustical Panels**<< - Item #97312; or - Item #97313>>**.

d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

O. ******These are beveled edge products.****** Acoustical Panels: Glass fiber with membrane-faced overlay, with the following characteristics:

1. Classification: **<<ASTM E1264>>**, Type B - Glass fiber base with membrane overlay.

a. Form: B2 - Cloth.

1) Pattern: "G" - smooth.

b. Size: **<< 24 by 24 inches; 24 by 48 inch; or ___ by ___ inches>>**.

2. Thickness: 1 inch.
3. Light Reflectance: Not less than 0.88, determined in accordance with **<<ASTM E1264>>**.
4. NRC Range: Not less than 0.95, determined in accordance with **<<ASTM E1264>>**.
5. Panel Edge: Beveled.
6. Color: White.
7. Suspension System: Exposed.
8. Products: ******The first choice option is the 24x24 product. The second choice option is the 24x48 product.******

a. Armstrong World Industries, Inc; Lyra PB**<< - Item #8360PB; or - Item #8352PB>>**.

b. CertainTeed Ceilings, Inc; Symphony f**<< - Item #1342B-IOF-1; or - Item #1340B-IOF-1>>**.

c. USG Corporation; Halcyon ECO Acoustical Panels**<< - Item #97315; or - Item #97316>>**.

d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

******Srubbable and water-resistant fiberglass core ceiling panels. Use in spaces where it's important to prevent sound from traveling that are prone to moisture vapor such as gyms and locker rooms.******

P. ******These are square edge products.****** Acoustical Panels: With the following characteristics:

1. Classification: **<<ASTM E1264>>**, Type B - Glass fiber with membrane overlay.

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a. Form: B2 - Cloth.
1) Pattern: "E" - lightly textured.
b. Size: **<< 24 by 24 inches; or 24 by 48 inch>>**.
2. Thickness: 1 inch.
3. Light Reflectance: Not less than 0.86, determined in accordance with **<<ASTM E1264>>**.
4. NRC Range: Not less than 0.95, determined in accordance with **<<ASTM E1264>>**.
5. Panel Edge: Square.
6. Color: .
7. Suspension System: Exposed.
8. Products: ******The first choice option is the 24x24 product. The second choice option is the 24x48 product.******
a. Armstrong World Industries, Inc; Optima Healthzone PB**<< - Item #3114PB; or - Item #3115PB>>**.
b. CertainTeed Ceilings, Inc; Symphony f Rx**<< - Item #1342-RXS-1; or - Item #1340-RXS-1>>**.
c. USG Corporation; Halcyon ECO Acoustical Panels**<< - Item #97312; or - Item #97313>>**.
d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

Q. ******These are beveled edge products.****** Acoustical Panels: With the following characteristics:
1. Classification: **<<ASTM E1264>>**, Type B - Glass fiber with membrane overlay.
a. Form: B2 - Cloth.
1) Pattern: "E" - lightly textured.
b. Size: **<< 24 by 24 inches; or 24 by 48 inch>>**.
2. Thickness: 1 inch.
3. Light Reflectance: Not less than 0.86, determined in accordance with **<<ASTM E1264>>**.
4. NRC Range: Not less than 0.95, determined in accordance with **<<ASTM E1264>>**.
5. Panel Edge: Beveled.
6. Color: White.
7. Suspension System: Exposed.
8. Products: ******The first choice option is the 24x24 product. The second choice option is the 24x48 product.******
a. Armstrong World Industries, Inc; Optima Healthzone PB**<< - Item #3214PB; or - Item #3215PB>>**.
b. CertainTeed Ceilings, Inc; Symphony f Rx**<< - Item #1342B-RXS-1; or - Item #1340B-RXS-1>>**.
c. USG Corporation; Halcyon ECO Acoustical Panels**<< - Item #97315; or - Item #97316>>**.
d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.03 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with **<<ASTM C635/C635M>>**; die cut and interlocking components, with **<< perimeter moldings; stabilizer bars; clips; splices; and _____>>** as required.
1. Materials:

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a. Steel Grid: **<<ASTM A653/A653M>>**, **<< G30; G60; G90; or _____>>** coating, unless otherwise indicated.
b. Standard Finish: Comply with **<<NAAMM AMP 500-06>>** and manufacturer's standard factory-applied finish.
c. High Humidity Finish: Comply with **<<ASTM C635/C635M>>** for "Coating Classification for Severe Environment Performance."

2. Cross Tee/Main Runner Connection: Override (stepped).
3. Main Runner End Coupling: Bayonet ("stab") type; knuckle type is not acceptable.
4. Recycled Content: 25 percent of product, equal to postconsumer recycled content plus 1/2 preconsumer recycled content.

B. Exposed Suspension System: Hot-dipped galvanized steel grid and cap.
1. Fire-Rated Assemblies: Where fire-rated ceiling assemblies are indicated, provide manufacturer's products that are UL tested for fire-rated assemblies. ******Do not indicate this for non-fire-rated assemblies.******
2. Structural Classification: **<< Intermediate-duty; or Heavy-duty>>**, when tested in accordance with **<<ASTM C635/C635M>>**.
3. Profile: Tee; 15/16 inch face width. ******MCPS prefers 15/16 inch grid. MCPS does not want 9/16 inch grid.******
4. Finish: Baked enamel.
5. Products:
a. Armstrong World Industries, Inc; Prelude XL 15/16".
b. CertainTeed Ceilings, Inc; 15/16" EZ Stab Classic System.
c. USG Corporation; Donn Brand DX/DXL 15/16 inch Acoustical Suspension System.
d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.04 ACOUSTICAL CLOUDS/CANOPIES

A. Acoustical Clouds/Canopies: Prefabricated shapes with consistent size and finish.
1. Classification: **<<ASTM E1264>>** Type XII.
a. Form: 2 cloth.
b. Pattern: "E" - Lightly Textured; or "G" - Smooth.
2. Shape: **<< Square; Circular; Hexagon; Parallelogram; Triangle; Convex; Concave; and _____>>**.
3. Panel Thickness: 7/8-inch minimum.
4. Suspension: Provide manufacturer's standard individual mounting kit for each panel, consisting of aircraft cables, anchors at each end, and method for fine adjustment after installation. Provide minimum 4 anchors/cables per panel.
5. Color: **<< White; As selected from manufacturer's standard range; or _____>>**.
6. Products:
a. Basis-of-Design: Armstrong World Industries, Inc; SoundScapes Shapes.
b. Certainteed; Ecophon Solo Clouds. (1-1/2 inch thick)
c. USG Corporation; Halcyon Canopies. (1 inch thick)

2.05 ACCESSORIES

A. Attachment Devices: Sized to hold 5 times the design load in direct-hung applications in accordance with **<<ASTM C635/C635M>>**, Table 1.

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1. Concrete Anchors: Able to support weight 5 times the design load when tested in accordance with **<<ASTM E488/E488M>>** or ASTM E1512 by a qualified testing agency.
2. Type: Post-installed expansion anchors.
3. Corrosion Protection: Zinc plating on carbon-steel components in accordance with **<<ASTM B633>>**, Class Fe/Zn 5 (0.005 mm) for service condition Class 1.

B. Support Channels and Hangers: Galvanized steel **<<ASTM A641/A641M>>**, Class 1 zinc coating, soft temper; size and type to suit application and ceiling system flatness requirement specified.

C. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire, sized to provide a minimum of 0.0135 inch diameter wire when stress is 3 times the hanger design load in accordance with **<<ASTM C635/C635M>>**, Table 1 for direct hung applications.

D. Perimeter Moldings: Same metal and finish as grid.
1. Products:
   a. Armstrong World Industries, Inc; Axiom.
   b. CertainTeed; Infinity System.
   c. USG Corporation; Compasso.
2. Fascia: 4 inch wide clip-on system compatible with metal suspension system.
3. Finish: Match grid system finish.

E. Acoustical Sealant: Refer to Division 07, "Joint Sealants" for acoustical sealant for use in conjunction with suspended ceiling system.

F. Metal Edge Trim for "Cloud" Suspension Systems: Steel or extruded aluminum; provide attachment clips, splice plates, and preformed corner pieces for complete trim system. Manufacturer's standard fitting acoustical panel edges. Provide stepped edge molding matching depth and width of ceiling panels with reveal edges. Match diameter of circular penetrations to form tight fit.
1. Trim Height: **<< 2-1/4 inch; 4 inch; 6 inch; 8 inch; 10 inch; or _____ inch>>**.
2. Finish: Baked enamel.
3. Width: Match adjacent grid system width.
4. Color: Match adjacent grid system finish.
5. Products:
   a. Armstrong World Industries, Inc.; Axiom Classic.
   b. Certainteed; Terminus Perimeter Trim.
   c. USG Corporation; Compasso Suspension Trim.
   d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions of structural framing which acoustical ceilings anchor to with installer before starting work. Verify compliance with installation tolerances required by this section and others related to acoustical ceiling installation and anchoring.

B. Verify that layout of hangers will not interfere with other work.

C. Commence with installation after noncompliant conditions are corrected.

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3.02 PREPARATION

A. Install after major above-ceiling work is complete.

B. Coordinate the location of hangers with other work.

C. Measure ceiling area prior to laying out system to achieve required balances.

D. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

3.03 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with **<< ASTM C636/C636M; ASTM E580/E580M; and manufacturer's instructions>>** and as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of **<< 1:360; 1:240; or ____>>**.

C. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size. Install suspension runners squarely and securely.

D. Do not use and replace dented, bent, kinked, or damaged suspension members.

E. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.

1. Screw attach using longest practical lengths. Secure at a maximum of 16 inches on center and a minimum of 3 inches on center.
2. Do not use exposed fasteners such as pop rivets.
3. Miter corners and connect securely, avoiding sharp edges.
4. Apply acoustical sealant in a continuous bead at top edge of vertical legs of moldings after they are installed.

F. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

1. Splay hangers around obstructions. Balance and offset horizontal forces with bracing, countersplaying, or comparable effective methods.
2. Use a minimum of three tight turns to secure wire hangers.
3. Connect hangers to steel structures or secured concrete anchoring devices that will not deteriorate or fail due to age, corrosion, or high temperatures.
4. Do not hang suspension system directly from steel floor or roof deck. Connect hangers to cast-in-place hanger inserts, post-installed concrete anchors, or power-actuated anchors extending through forms in concrete.
5. Install carrying channels or other supports to attach hanger wires where steel framing does not allow for installation of hangers.
6. Hanger Spacing: Manufacturer's standard recommendation with a maximum span of 48 inches along each suspension member supported by hangers. Install hangers a maximum of 8 inches away from each end of suspension member.
7. Provide supplemental suspension members and hangers of size to hold designed ceiling loads in accordance with referenced standards.

G. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

H. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

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I. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

J. Do not eccentrically load system or induce rotation of runners.

K. Form expansion joints as detailed. Form to accommodate plus or minus 1 inch movement. Maintain visual closure.

3.04 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Lay directional patterned units **<< with pattern parallel to longest room axis; with pattern parallel to shortest room axis; in basket weave pattern; or _____>>**.

D. Hide edges of square-edged panels from view behind suspension grid members.

E. Install reveal-edged panels firmly and securely against top of suspension grid members.

F. Fit border trim neatly against abutting surfaces.

G. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

H. Cutting Acoustical Units:

1. Make field cut edges of same profile as factory edges.

I. Where **<< round obstructions; bullnose concrete block corners; and ____>>** occur, provide preformed closures to match perimeter molding.

J. Protect work and products from Division 21, 23, and 26 sections during acoustical panel installation.

K. Canopies: Install in accordance with manufacturer's instructions and requirements of authorities having jurisdiction.

3.05 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.06 CLEANING

A. Clean acoustical panels, suspension grids, and accessories in accordance with manufacturer's instructions.

B. Remove and replace components that are not successfully cleaned and repaired.

END OF SECTION 095100

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SECTION 095426
SUSPENDED WOOD CEILINGS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

B. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.

C. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.

D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.

E. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.

F. CISCA (WC) - Wood Ceilings Technical Guidelines.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure ceilings are not installed until building is enclosed, dust generating activities have terminated, and overhead work is completed.

1.03 SUBMITTALS

A. Shop Drawings: Indicate **<< grid layout and related dimensioning; attachment of wood ceiling components to grid; accessory attachments; junctions with other ceiling finishes; mechanical and electrical items installed in the ceiling; and _____>>**.

B. Product Data: Provide data on **<< wood ceiling components; suspension system components; and _____>>**.

C. Selection Samples: Submit manufacturer's color charts indicating full range of available finishes, for wood veneer species indicated.

D. Verification Samples: Submit two samples, manufacturer's standard size, illustrating material and finish of wood ceiling components.

E. Test Reports: Certified test data from an independent test agency verifying that panels meet specified requirements for **<< fire; acoustical; seismic; and _____>>** performance.

F. Installer's qualification statement.

G. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.

1. See Section **<< 016000 - Product Requirements>>** for additional provisions.
2. Wood Ceiling Components: Provide a quantity equal to 2 percent of total product installed.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified; certified or approved by manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver wood ceiling components to project site in original, unopened packages.

B. Store in fully enclosed space, flat, level and off the floor.

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1.06 FIELD CONDITIONS

A. Do not install suspended wood ceiling system until wet construction work is complete and permanent heat and air conditioning is installed and operating.

B. Maintain room temperature between 60 degrees F and 75 degrees F and relative humidity between 35 to 55 percent before, during, and after installation.

PART 2 PRODUCTS

2.01 SUSPENDED WOOD CEILING SYSTEM

A. Performance Requirements:
   1. Design for maximum deflection of 1/360 of span.
   2. Surface Burning Characteristics: Flame spread index of 25, smoke developed index of 450, when tested in accordance with **<<ASTM E84>>**.

B. Wood-Based Materials:
   1. Bio-Based Material: Provide sustainably harvested wood; include chain of custody certification. Lumber and wood products shall be certified by American Tree Farm System (ATFS), Forest Stewardship Council (FSC), or Sustainable Forestry Initiative (SFI).
   2. Composite Wood Panels: Containing no urea-formaldehyde resin binders.

C. Wood Veneer **<< Panels; or Planks>>**: Composite wood core with wood veneer finish.
   1. Panel Size: **<< 24 by 24 inch; 24 by 48 inches; or _____ by _____ inches>>**.
   2. Panel/Plank Thickness: 3/4 inch.
   3. Veneer Species: **<< Red oak; Maple; Cherry; Beech; Walnut; Bamboo, natural; Bamboo, carbonized; or _____>>**.
      a. Veneer Cut: **<< Plain sliced; Quarter cut; Rift cut; or _____>>**.
      b. Veneer Matching: **<< Random matched; Book matched; Slip matched; or _____>>**.
      c. End/Edge Matching: Manufacturer's recommended matching.
      d. Factory Finish: **<< Clear sealer; Wood stain as selected, clear sealer top coat; As scheduled; or _____>>**.
   4. Attachment to Suspension Grid: Either a double-shoulder slot cut into edge of panel (Armstrong "Vector" detail or similar), or a proprietary mounting system (9Wood "Lift & Shift" detail or similar). Attachment method shall allow for accessibility from below.
   5. Edge Profile: **<< Square; Reveal; or _____>>**.
   6. Suspension System: Type specified below.
   7. Products:
      a. 9Wood; 4300 Lift & Lock.
      b. Armstrong World Industries, Inc; Woodworks Vector.
      c. CertainTeed Ceilings, Inc; Lay-in Wood Ceiling Panels.
      d. Rulon International; Flat Veneer Panel.
      e. USG Corporation; True Wood Accessible Reveal Panels.
      f. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

D. Wood Veneer **<< Panels; or Planks>>**: Composite wood core with wood veneer finish.
   1. Classification: **<<ASTM E1264>>**, Class A, Type F, Form F1, perforated.

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a. Pattern: **<< A - perforated, regularly spaced large holes; B - perforated, randomly spaced large holes; C - perforated, small holes; G - smooth; or _____>>**.
b. Backing: Glass fiber acoustical backing**<< Glass fiber acoustical backing; Mineral fiber acoustical backing; or _____>>**.

2. Panel Size: **<< 24 by 24 inch; 24 by 48 inches; or _____ by _____ inches>>**.
3. Panel/Plank Thickness: 3/4 inch.
4. Veneer Species: **<< Red oak; Maple; Cherry; Beech; Walnut; Bamboo, natural; Bamboo, carbonized; or _____>>**.
   a. Veneer Cut: **<< Plain sliced; Quarter cut; Rift cut; or _____>>**.
   b. Veneer Matching: **<< Random matched; Book matched; Slip matched; or _____>>**.
   c. End/ Matching: Manufacturer's recommended matching.
   d. Factory Finish: **<< Clear sealer; Wood stain as selected, clear sealer top coat; As scheduled; or _____>>**.
5. NRC Range: 0.40 to 0.45, determined in accordance with **<<ASTM E1264>>**.
6. Perforations:
   a. Pattern: **<< Square / parallel; Diagonal / staggered; or _____>>**.
   b. Shape: **<< Circular; Square; Slotted; or _____>>**.
   c. Size: **<< 1/4 inch (6 mm)>><< diameter; square; or _____>>**, spaced 0.9 inch o.c.
   d. Open Area: 5 to 6 percent.
7. Acoustical Fabric: Manufacturer's standard non-woven fabric\ **<< Manufacturer's standard non-woven fabric; or _____>>**, black color.
8. Attachment to Suspension Grid: Either a double-shoulder slot cut into edge of panel (Armstrong "Vector" detail or similar), or a proprietary mounting system (9Wood "Lift & Shift" detail or similar). Attachment method shall allow for accessibility from below.
9. Edge Profile: **<< Square; Reveal; or _____>>**.
10. Suspension System: Type specified below.
11. Products:
    a. 9Wood; 5100 Parallel Perf.
    b. Armstrong World Industries, Inc; Woodworks Vector - W2 Perf Pattern.
    c. CertainTeed Corporation; Lay-in Wood Ceiling Panels - P4 Perf Pattern.
    d. Rulon International; Aluratone 700.
    e. USG Corporation; True Wood Accessible Reveal Panels.
    f. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

E. Linear Wood Planks: Composite wood core with wood veneer finish**<< Composite wood core with wood veneer finish; Solid wood; or _____>>**.
   1. Type: Individual linear planks with pre-attached acoustic fabric reveals.
      a. Plank Size: **<< 4 by 96 inches; 6 by 96 inches; or _____ by ____ inches>>**, nominal.
      b. Plank Thickness: 3/4 inch.
      c. Plank Spacing (Reveal): 3/4 inch.
      d. Acoustical Fabric: Manufacturer's standard non-woven fabric, black color.

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2. Veneer Species: **<< Red oak; Maple; Cherry; Beech; Walnut; Bamboo, natural; Bamboo, caramelized; or _____>>**.
   a. Veneer Cut: **<< Plain sliced; Quarter cut; Rift cut; or _____>>**.
   b. Veneer Matching: **<< Random matched; Book matched; Slip matched; or _____>>**.
   c. End/Edge Matching: Manufacturer's recommended matching.
   d. Factory Finish: **<< Clear sealer; Wood stain as selected, clear sealer top coat; As scheduled; or _____>>**.
3. NRC: 0.45 minimum, determined in accordance with **<<ASTM E1264>>**.
4. Suspension System: Type specified below.

F. Metal Suspension System:
1. General: Comply with **<<ASTM C635/C635M>>**; die cut and interlocking components, with **<< perimeter moldings; hold down clips; stabilizer bars; clips; splices; and _____>>** as required.
   a. Materials:
      1) Steel Grid: **<<ASTM A653/A653M>>**, **<< G30; G60; G90; or _____>>** coating, unless otherwise indicated.
2. Suspension System: **<< Hot-dipped galvanized steel; Aluminum; Stainless steel; or _____>>** grid and cap.
   a. Structural Classification: **<< Heavy-duty; Intermediate-duty; or _____>>**, when tested in accordance with **<<ASTM C635/C635M>>**.
   b. Profile: Tee; 15/16 inch face width. ******MCPS prefers 15/16 inch grid. MCPS does not want 9/16 inch grid.******
   c. Finish/Color: Baked enamel, black.
   d. Products: Provide suspension product approved by ceiling manufacturer for use with wood ceiling product specified.
      1) Armstrong World Industries; Prelude XL.
      2) Certainteed Corporation; 15/16 EZ Stab Classic System.
      3) Chicago Metallic Corporation; 1200 System / 211-219 Main Tee.
      4) USG Corporation; Donn Brand DX/DXL 15/16 System.
      5) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
3. Support Channels and Hangers: Galvanized steel; size and type to suit application, and ceiling system flatness requirement.

G. Accessories: Manufacturer's standard accessories for installation method indicated**<< seismic requirements; above-ceiling accessibility; and _____>>**.

2.02 FABRICATION

A. Shop fabricate wood ceiling components to the greatest extent possible.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Do not install ceiling until after interior wet work is dry.

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3.02 PREPARATION

A. Layout wood ceiling components in pattern according to reflected ceiling plan and as shown on shop drawings.

B. Acclimate wood ceiling materials by removing from packaging in installation area a minimum of 48 hours prior to installation.

3.03 INSTALLATION

A. General: Install suspended wood ceiling system in accordance with **<<CISCA (WC)>>**.

B. Suspension System:

1. Install suspension system in accordance with **<<ASTM C636/C636M>>**, **<<ASTM E580/E580M>>**, and manufacturer's instructions and as supplemented in this section.
2. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
3. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
   a. Do not hang suspension system directly from steel floor or roof deck.
4. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
5. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
6. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
7. Do not eccentrically load system or induce rotation of runners.

C. Wood Ceiling:

1. Install wood ceilings in accordance with manufacturer's instructions.
2. Fit wood components in place, free from damaged edges or other defects detrimental to appearance and function.
3. Install components in uniform plane, and free from twist, warp, and dents.
4. Cut to fit irregular grid and perimeter edge trim.
5. Make field cut edges of same profile as factory edges, seal and finish according to manufacturer.
6. Install **<< clips; stabilizer bars; other attachments; and _____>>** as indicated to secure wood ceiling components tight to the grid system.
7. Install acoustical backer above wood ceiling components; fit tight between grid members.

3.04 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

3.05 CLEANING

A. See Section **<< 017000 - Execution and Closeout Requirements>>** for additional requirements.

B. Clean and touch up minor finish damage. Remove and replace components that cannot be successfully cleaned and repaired.

END OF SECTION 095426

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SECTION 096400
WOOD FLOORING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.

B. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.

C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

F. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

G. CARB (ATCM) - Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products.

H. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.

I. EPA (TSCA); Title VI - Toxic Substances Control Act, Title VI: Formaldehyde Standards for Composite Wood Products.

J. MFMA (SPEC) - Guide Specifications for Maple Flooring Systems.

K. NWFA (IG) - Installation Guidelines.

L. NWFA/NOFMA - International Standards for Unfinished Wood Flooring.

M. SCAQMD 1113 - Architectural Coatings.

N. SCAQMD 1168 - Adhesive and Sealant Applications.

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1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meetings: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers; review preparation and installation procedures and coordination and scheduling necessary for related work.

1.03 SUBMITTALS

A. Product Data: Provide data for all components of wood flooring assembly, including flooring species, grade, and dimensions, subflooring, and finishing products.

B. Shop Drawings: Indicate flooring assembly construction, including total assembly depth, sleeper/subfloor components and spacing, floor joint pattern and termination details.

1. Indicate provisions for expansion and contraction, wall base, and floor access covers as applicable.
2. Indicate size and type of fasteners and anchors.

C. Selection Samples: Submit manufacturer's color charts of wood flooring and stain colors for Architect's initial selection

D. Verification Samples: Submit physical sample of selected flooring and stain, approximately 12 inches long.

E. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

F. Sustainability Submittals: Refer to Division 01, "Sustainable Design Requirements."

1.04 CLOSEOUT SUBMITTALS

A. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.
   1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
   2. Extra Flooring Material: 1 box for every 50 installed from the same production run as installed flooring.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with **<< MFMA (SPEC); NWFA (IG); NWFA/NOFMA; and _____>>**.
   1. For maple flooring, perform work of this section in accordance with **<<MFMA (SPEC)>>**.

B. Bio-Based Materials: Provide sustainably harvested wood; include chain-of-custody certification. Lumber and wood products shall be certified by American Tree Farm System (ATFS), Forest Stewardship Council (FSC), or Sustainable Forestry Initiative (SFI).

C. Low-Emitting Materials:
   1. Paints and Coatings: Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet applicable VOC limits of **<<CARB (SCM)>>** or **<<SCAQMD 1113>>**.
   2. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet the chemical content requirements of **<<SCAQMD 1168>>**.
   3. Composite Wood Products: Composite wood products installed inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet requirements for **<<CARB (ATCM)>>** ultra-low-emitting formaldehyde (ULEF) or **<<CARB (ATCM)>>** or **<<EPA (TSCA); Title VI>>** no added formaldehyde resins (NAF).

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver wood flooring to site in manufacturer's original, unopened packaging.

B. Do not expose wood flooring to moisture. Store in dry and warm weathertight space after installation of concrete, masonry, plaster, ceramic tile, and similar wet work.

1.07 FIELD CONDITIONS

A. Do not deliver or install wood flooring until wet construction work is complete and ambient humidity in installation space has stabilized at occupancy conditions.

B. Provide heat, light, and ventilation prior to installation.

C. Store materials in area of installation for minimum period of 7 days prior to installation.

D. Maintain minimum room temperature between **<< 65 degrees F>>** and 75 degrees for a period of seven days prior to delivery of materials to installation space, during installation, and after installation.

E. Move wood flooring to space where it shall be installed at the beginning of the conditioning period. Do not relocate wood flooring into the space after the conditioning period has commenced. Open manufacturer's packaging immediately after relocating wood flooring to

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allow acclimatization. Install wood flooring when it has adjusted to relative humidity and temperature of the space where it shall be installed.

F. Maintain temperature and relative humidity in space after wood flooring installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hardwood Strip and Plank Flooring:
   1. Anderson Tuftex.
   2. Armstrong World Industries, Inc.
   3. Somerset Hardwood Flooring.
   4. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**

2.02 SOURCE QUALITY CONTROL

A. Inspect and stamp species and grade on underside of each piece of wood flooring at factory.

2.03 MATERIALS

A. Wood Stage Flooring:
   1. Species: **<< Northern hard maple; White hard maple; Beech; White birch; or ____>>**.
   2. Grade: **<< Clear; Select and better; No. 1 Common and better; No. 2 Common and better; or ____>>**.
   3. Cut: **<< Edge grain; Plain sawn; Quarter sawn; Quarter/rift sawn; Rift sawn; or ____>>**.
   4. Actual Thickness: **<< 25/32 inch; 33/32 inch; 41/32 inch; or ____ inch>>**.
   5. Actual Width: **<< 1-1/2 inches; 2-1/4 inches; 3 inches; 3-1/4 inches; 3-1/2 inches; or ____ inches>>**.
   6. Edge: **<< Square; Tongue and groove; Bevelled; or _____>>**.
   7. End: **<< End matched; Square; or _____>>**.
   8. Length: Random, minimum of 9 inches.

B. Sleepers and Shims: Softwood lumber, pressure treated for moisture protection, 2 by 4 inch size, kiln dried to 15 percent maximum moisture content. Do not use and discard bowed and twisted pieces.

C. Subflooring: 23/32 inch thick plywood, APA Rated sheathing, with tongue and groove edges; Exposure 1**<< , sanded; , unsanded; or None - N/A>>**, fire-resistance treated; with machined anchor pockets for channels and factory applied resilient cushions.

D. Channels: Galvanized steel, 16-gauge; manufacturer's standard size and shape for system indicated.
   1. Channel Anchors: Steel drive pins, sized for minimum 1-inch penetration into concrete.

E. Resilient Cushioning: Manufacturer's standard hemisphere-shaped cushioning pads with air voids, factory-applied to bottom side of sleepers at manufacturer's standard spacing.
   1. Durometer Hardness: 60D or 70D or as determined.
   2. Material: EPDM.
   3. Thickness: 7/16 inch, unless indicated otherwise.

F. Vapor Retarder: **<<ASTM D4397>>**; Black polyethylene sheet, minimum 6 mil thick; 2 inch wide tape for joint sealing.

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G. Sheathing Paper: **<<ASTM D226/D226M>>** Type 1, Asphalt saturated felt, unperforated.

H. Fasteners and Anchors: Manufacturer's standard type and size to suit application.

2.04 ACCESSORIES

A. Ventilating Wood Base: Same species as flooring, 4 inch high.

B. Ventilating Resilient Base: Molded rubber, **<< 4 inch>>** high with a **<< 3 inch>>** toe, pre-molded outside corners; black color.

C. Threshold: Saddle profile metal trim, fire-rated and UL10b listed, complies with ADA requirements for thresholds.

D. Moisture Vapor Treatment: Where wood flooring and accessories are installed over concrete slabs, provide alkaline-resistant product designed to control excessive moisture vapor transmission through concrete slab, per the following:

1. Products: Provide product approved by flooring manufacturer and complying with performance requirements below, equivalent to one of the following:
   a. Duraamen Engineered Products, Inc.; Perdure MVT.
   b. Maxxon Corporation; Maxxon MVP.
   c. Tnemec Company Inc.; Epoxoprime MVT, Series 208.
2. Performance Requirements:
   a. Verify with flooring manufacturer that submitted product maintains compliance with all provisions of flooring manufacturer's warranty.
   b. Low-VOC: Provide product with VOC content less than 15 g/L.
   c. Bond Strength to Concrete: Minimum 400 psi per ASTM D 4541 (100% concrete failure).
   d. Permeance: Maximum 0.1 perm per ASTM E 96, and 0.10 grains/hr/ft^2/in-Hg, per ASTM F3010.
   e. Applications: Provide MVT for all concrete slabs on-grade and lightweight concrete elevated slabs.

E. Floor Finish: See Section 099100, color Black. ******MCPS prefers for HS and MS behind stage curtain. Not required for ES.******

F. Floor Finish: Polyurethane, to achieve **<< high gloss; low sheen; satin sheen; or _____>>** surface; type recommended by flooring manufacturer. ******MCPS prefers for HS, MS, and ES in front of stage curtain.******

G. Sealer and Wax: Types recommended by flooring manufacturer.

H. Adhesive: Types recommended by flooring manufacturer.

I. Subfloor Filler: Manufacturer's standard trowelable leveling and patching compound, latex-modified, hydraulic-cement-based formulation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions with installer before starting this work.

B. Verify that concrete subfloor surface is smooth and flat to manufacturer's requirements for moisture content, installation tolerances, and conditions for performance of wood flooring.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).

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1. Test as Follows: Perform one of each test per 1,000 sf of installation area.
   a. Alkalinity (pH): **<<ASTM F710>>** in accordance with manufacturer's instructions.
   b. Internal Relative Humidity: **<<ASTM F2170>>**, using in situ probes. Acceptable maximum of 75 percent relative humidity.
   c. Moisture Vapor Emission: **<<ASTM F1869>>**, anhydrous calcium chloride test. Acceptable maximum moisture vapor emission rate of 5 pounds of water for every 1000 square feet in 24 hours.
2. If test results are not within limits recommended by flooring manufacturer, apply moisture vapor treatment (MVT) in accordance with manufacturer's requirements.
3. After testing is complete, prepare concrete and install moisture vapor treatment (MVT) in accordance with manufacturer's written instructions. If testing indicates measurements are within acceptable levels for flooring installation with the need for MVT, the MVT may be omitted where approved by the Architect.

D. Verify that required floor-mounted utilities are in correct location.

E. Commence with installation after noncompliant conditions are corrected.

3.02 PREPARATION

A. Remove ridges and bumps in concrete substrate. Apply skim coat to fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.

B. Use mechanical methods to remove substances incompatible with adhesives, including soap, wax, oil, or silicone. Solvents may not be used.

C. Sleepers and Shims:
1. Place vapor retarder over entire subfloor surface, lapping edges and ends minimum 6 inches and tape seal; staple in place.
2. Place sleepers over vapor retarder at specified elevation; space sleepers at 12 inches on center. Secure sleepers 16 inches on center in rows.
3. Shim underside of sleepers to achieve level line of plus or minus 1/4 inch in 10 feet.
4. Allow minimum 1 inch space between sleepers and wall surface.

D. Secondary Subflooring: Place plywood subflooring over sleepers.
1. Lay perpendicular to the sleepers, with end joints over sleepers, and **<< nail; screw; or _____>>** at 12 inches on center.

E. Prepare substrate to receive wood flooring in accordance with **<< manufacturer's; MFMA; NWFA; and _____>>** instructions.

F. Sweep and vacuum clean substrate immediately prior to installing wood flooring.

3.03 INSTALLATION

A. Install wood flooring assembly in accordance with manufacturer's instructions.

B. Sheathing Paper: Place over wood subfloor; lap edges and ends **<< 2 inches>>**, staple in place.

C. Wood Flooring:
1. Install in accordance with **<< manufacturer's; NWFA; MFMA; and _____>>** instructions; predrill and blind nail to subfloor using a minimum of 2 nails. Use screws for flooring wider than 3 inches.
2. Lay flooring **<< parallel to length of room areas; parallel to width of room areas; in patterns indicated on drawings; or _____>>**. Verify alignment as work progresses.

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3. Arrange flooring with **<< end matched grain; square ends; or _____>>** set flush and tight.
4. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar; provide divider strips and transition strips in accordance with flooring manufacturer's recommendations and as indicated. Extend into toe spaces, door reveals, closets, and similar openings.
5. Install edge strips at unprotected or exposed edges, and where flooring terminates.
6. Secure edge strips before installation of flooring with stainless steel screws.
7. Install flooring tight to floor access covers.
8. Provide minimum 1 inch expansion space at fixed walls and other interruptions.

D. Install base at floor perimeter to cover expansion space in accordance with manufacturer's instructions. Miter inside and outside corners.

E. Finishing:
1. Fill nail and screw holes with wood filler.
2. Fill open-grained hardwoods, flooring seams, and defects.
3. Mask off adjacent surfaces before beginning sanding.
4. Sand flooring to smooth even finish with no evidence of sander marks in accordance with **<<NWFA/NOFMA>>**. Remove offsets, ridges, and cups. Take precautions to contain dust. Remove dust by vacuum or wipe down with clean tack cloth.
5. Apply finish in accordance with floor finish manufacturer's instructions. Apply manufacturer's recommended number of coats to a minimum of one coat of floor sealer and three coats of floor finisher.
6. Apply stain evenly to create a uniform color distribution.
7. Apply water-based finishes in accordance with manufacturer's instructions to minimize grain raise.
8. Apply first coat, allow to dry, then buff lightly with steel wool to remove irregularities. Vacuum clean and wipe with damp cloth before applying succeeding coat.
9. Lightly buff between coats with steel wool and vacuum clean before applying succeeding coat.
10. Apply last coat of finish.

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3.04 CLEANING

A. Clean and polish floor surfaces in accordance with floor finish manufacturer's instructions after last coat of finish has fully cured.

3.05 PROTECTION

A. Prohibit traffic on floor finish for 7 days after installation.

B. Pace durable and breathable protective coverings over finished floors. Prevent heavy wheeled traffic and foot traffic directly over wood flooring assembly.

C. Do not remove coverings until Date of Substantial Completion.

END OF SECTION 096400

SECTION 096453
STAGE FLOORING ASSEMBLY

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

C. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

E. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C.

F. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

G. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

H. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

I. NWFA (IG) - Installation Guidelines.

1.02 COORDINATION

A. Concrete Slab Recess Depth: Coordinate depressed slab depth required for submitted system with cast-in-place concrete installer prior to installation of concrete.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Polymer flooring material.
   2. Suflooring system, vapor barrier, and accessories.

B. Installation Instructions:
   1. Sleeper-type subflooring system manufacturer’s installation instructions.
   2. Performance flooring material manufacturer’s installation instructions.

C. Shop Drawings: Show project specific installation details including location and layout of performance floor assembly and accessories, including additional components as indicated on Drawings. Include the following:
   1. Sleeper-type subfloor system layout.
   2. Additional subfloor panel layer and polymer flooring material.
   3. Expansion provisions and trim details.

D. Samples for Verification: For polymer performance flooring; approximately 12 inches long and of same thickness and material indicated for the Work.

1.04 CLOSEOUT SUBMITTALS

A. Maintenance Data: For polymer performance flooring to include in maintenance manuals.

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B. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.
   1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
   2. Extra Flooring Material: 1 box for every 50 installed from the same production run as installed flooring.

1.05 QUALITY ASSURANCE

A. Single Installer Responsibility: Entire performance flooring system shall be installed by a single firm (herein called the Installer), for undivided responsibility. Include moisture barrier, anchorage system, subfloor assemblies, subflooring or underlayment, flooring, trim, expansion provisions, finish and other accessory items as indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver polymer performance flooring materials in protective packaging.

B. Protect polymer performance flooring from exposure to moisture.

C. Store polymer performance flooring materials in a dry, ventilated, weathertight location.

PART 2 PRODUCTS

2.01 POLYMER PERFORMANCE FLOORING

A. Polymer Performance Sheet Flooring: Synthetic panel flooring material.
   1. Basis-of-Design Product: Polyonyx+ Performance Flooring manufactured by Productions Unlimited, Inc.
      a. Thickness: 1/4-inch.
      b. Surface texture selected by Owner for exposed flooring.
   2. Physical Properties:
      a. Tensile Strength: 3540 psi.
      b. Shore D Hardness: 98.
      c. Water Absorption: Not absorbed.
      d. Compressive Strength: 1123 psi.
   3. Alternate Products: The following stage flooring products are acceptable alternates to the Basis-of-Design.
      a. Stageboard; Renew Resources. (Recycled synthetic floor panel)
      b. Stagelam; GRT Genesis. (Engineered panelboard floor panel)

2.02 SUBFLOOR MATERIALS

A. Plywood Subflooring: One layer of 23/32 inch APA, Exposure 1, Structural sheathing; with machined anchor pockets for channels and factory applied resilient cushions.

B. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Fortifiber Building Systems Group; Red Rosin Paper.
      b. Trimaco; #35145 Red Rosin Medium Weight Paper.
      c. W.R. Meadows Construction Products; No. 763 Sealtight Red Rosin Paper.

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2.03 SLEEPER-TYPE SUBFLOOR SYSTEM

A. Continuous Cushioned Sleeper-Type Subfloor Basis-of-Design System: Commercial subflooring system incorporating continuous plywood sleepers factory fastened to performance foam/shock pads, with 1/2-inch anchor sleepers set perpendicular to sleepers above and fastened to concrete subfloor with steel drive pins. Provide modifications to the basis-of-design system as necessary to provide all components indicated on Drawings. Basis-of-design slab depression is 2-1/4 inches; coordinate final slab depression depth of approved system with concrete subfloor installer.
   1. Coordinate with Division 09, "Wood Athletic Flooring."
   2. Design intent at stage is to provide subfloor system, single sourced with gym flooring system. Omit maple hardwood veneer from stage application indicated. On top of installed subfloor, provide 1/2-inch APA Exposure 1 plywood and 1/4-inch polymer stage flooring specified above.
   3. Subfloor and Sleeper Plywood Panels: APA rated, Exposure 1, structural sheathing of depths indicated.
   4. Shock Pad: Manufacturer’s standard resilient plastic or foam pads; of standard depth for flooring system.

2.04 ACCESSORY MATERIALS

A. Vapor Retarder: **<<ASTM D4397>>**, polyethylene sheet not less than 6.0 mils thick.

B. Fasteners: As recommended by manufacturer, but not less than that recommended in **<<NWFA (IG)>>**: "Wood Flooring.”

C. Resilient Wall Base: Molded, vented, rubber or vinyl cove base; 4 by 3 by 48 inches; with premolded outside corners.
   1. Color: Black.

D. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by sports-floor manufacturer.

E. Adhesive for Resilient Base: Manufacturer's standard for application indicated.

F. Wood Trim: Maple trim specified in Division 06, “Architectural Woodwork and Casework.” In same species and grade as wood flooring, unless otherwise indicated.

G. Sound Attenuation Mineral-Wool Fire Blanket Insulation: **<<ASTM C665>>**, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per **<<ASTM E84>>**; passing **<<ASTM E136>>** for combustion characteristics. Provide 2.5 pcf density.
   1. Acoustical Performance: Provide 0.85 NRC at 1-1/2-inch thickness tested in accordance with **<<ASTM C423>>** (Type A Mounting).
   2. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
      a. Johns Manville; MinWool.
      b. Roxul Inc.; AFB.
      c. Owens Corning; Thermafiber SAFB.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions with installer before starting this work.

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B. Verify that concrete subfloor surface is smooth and flat to manufacturer's requirements for moisture content, installation tolerances to plus or minus 1/4 inch in 10 feet, and conditions for performance of stage flooring.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).

1. Test as Follows: Perform one of each test per 1,000 sf of installation area.
   a. Alkalinity (pH): **<<ASTM F710>>** in accordance with manufacturer's instructions.
   b. Internal Relative Humidity: **<<ASTM F2170>>**, using in situ probes. Acceptable maximum of 75 percent relative humidity.
   c. Moisture Vapor Emission: **<<ASTM F1869>>**, anhydrous calcium chloride test. Acceptable maximum moisture vapor emission rate of 5 pounds of water for every 1000 square feet in 24 hours.
2. If test results are not within limits recommended by flooring manufacturer, apply moisture vapor treatment (MVT) in accordance with manufacturer's requirements.
3. After testing is complete, prepare concrete and install moisture vapor treatment (MVT) in accordance with manufacturer's written instructions. If testing indicates measurements are within acceptable levels for flooring installation with the need for MVT, the MVT may be omitted where approved by the Architect.

D. Verify that required floor-mounted utilities are in correct location.

E. Commence with installation after noncompliant conditions are corrected.

3.02 PREPARATION

A. Prepare substrate to receive wood flooring in accordance with manufacturer's instructions.

B. Remove ridges and bumps in concrete substrate. Apply skim coat to fill minor low spots, cracks, joints, holes, and other defects in subfloor filler to achieve smooth, flat, hard surface.

C. Use mechanical methods to remove substances incompatible with adhesives, including soap, wax, oil, or silicone. Solvents may not be used.

D. Sweep and vacuum clean substrate immediately prior to installing stage flooring.

3.03 INSTALLATION

A. General:

1. Tolerances: Level wood flooring system to a tolerance of 1/8" in 10'-0".
2. Expansion Spaces: Provide space as indicated or required by instructions and standards, at walls and other obstructions, interruptions and terminations of flooring. Cover spaces with bases, trim, saddles, and thresholds.
3. Coordination: Refer to Division 06, “Architectural Woodwork and Casework” for wood base, platform edge trim and wood stair treads and risers at platform.

B. Vapor Barrier: Cover entire slab with 6 mil polyethylene, sealing and lapping joints a minimum of 6 inches, and turning up 4 inches at walls.

C. Sleeper-Type Subfloor System:

1. Install subfloor system in accordance with manufacturer’s written installation instructions.
   a. Provide leveling measures and anchorage in accordance with subfloor system manufacturer’s requirements.
2. Install solid blocking at doorways, edges, and thresholds at boundary of recessed slab.

D. Provide mineral fiber sound attenuation blanket material as indicated. (Refer to

E. Subflooring:

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1. Provide rosin paper slip sheet over sleeper/subflooring.
2. Apply plywood panels over slip sheet, square with sleepers/subfloor and nail to sleepers/subflooring. Place panels with 1/8-inch space between edges of sheets and nail.
3. Provide 1-1/2" expansion voids at perimeter and all vertical obstructions.

F. Performance Flooring: Install polymer performance flooring by nailing to subfloor, running crosswise with sleepers and blind nailing.

G. Coordinate and cooperate with installation of related finish carpentry trim.

3.04 CLEANING

A. Clean and polish floor surfaces in accordance with floor finish manufacturer's instructions after last coat of finish has fully cured.

3.05 PROTECTION

A. Protect installed polymer performance flooring during remainder of construction period with covering of heavy kraft paper or other suitable material. Do not use plastic sheet or film that might cause condensation.

1. Do not move heavy and sharp objects directly over kraft-paper-covered wood flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 096453

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SECTION 096466
WOOD ATHLETIC FLOORING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.

B. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

C. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

D. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

E. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

F. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

G. ASTM F3010 - Standard Practice for Two-Component Resin Based Membrane-Forming Moisture Mitigation Systems for Use Under Resilient Floor Coverings.

H. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

I. CARB (ATCM) - Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products.

J. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.

K. DIN EN 14904 - Surfaces for Sports Areas – Indoor Surfaces for Multi-Sports Use – Specification.

L. EPA (TSCA); Title VI - Toxic Substances Control Act, Title VI: Formaldehyde Standards for Composite Wood Products.

M. MFMA (SPEC) - Guide Specifications for Maple Flooring Systems.

N. NWFA (IG) - Installation Guidelines.

O. NWFA/NOFMA - International Standards for Unfinished Wood Flooring.

P. SCAQMD 1113 - Architectural Coatings.

Q. SCAQMD 1168 - Adhesive and Sealant Applications.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate slab recess requirements for submitted wood flooring system with concrete installer.

B. Preinstallation Meetings: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers; review preparation and installation procedures and coordination and scheduling necessary for related work.

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1.03 SUBMITTALS

A. Product Data: Provide data for flooring, subflooring, floor finish materials, and resilient cushion, including construction details, material descriptions, and dimensions of components and profiles.

B. Shop Drawings: Indicate floor joint pattern and termination details.
   1. Indicate provisions for expansion and contraction, wall base, and game insert or socket devices.
   2. Indicate size and type of fasteners and anchors.
   3. Indicate location, size, design, and color of game markings.
   4. Indicate location of telescoping stands installed over wood athletic flooring assembly.

C. Samples: Submit samples in manufacturer's standard size of each wood atheltic flooring assembly and accessory showing full range of color and texture, finish, sheen, and game line and marker paint colors.

D. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

E. Sustainability Submittals: Refer to Division 01, "Sustainable Design Requirements."

F. Installer's qualification statement.

G. Warranty documentation.

1.04 CLOSEOUT SUBMITTALS

A. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.
   1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
   2. Extra Flooring Material: 12 boxes matching installed flooring from the same product run.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in installing products specified in this section similar in material, design, and scope with a successful record of performance.
   1. Minimum three years of documented experience.
   2. MFMA accredited and approved by flooring manufacturer.
   3. Responsibilities include field finishing the wood athletic flooring assembly and applying game lines and markers.

B. Perform work of this section in accordance with **<< MFMA (SPEC); NWFA (IG); NWFA/NOFMA; and _____>>**.
   1. For maple flooring, perform work of this section in accordance with **<<MFMA (SPEC)>>**.

C. Bio-Based Materials: Provide sustainably harvested wood; include chain-of-custody certification. Lumber and wood products shall be certified by American Tree Farm System (ATFS), Forest Stewardship Council (FSC), or Sustainable Forestry Initiative (SFI).

D. Low-Emitting Materials:
   1. Paints and Coatings: Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet applicable VOC limits of **<<CARB (SCM)>>** or **<<SCAQMD 1113>>**.
   2. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet the chemical content requirements of **<<SCAQMD 1168>>**.
   3. Composite Wood Products: Composite wood products installed inside the weatherproofing system shall be tested and determined compliant in accordance with

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<<CAL (CDPH SM)>> AND shall meet requirements for **<<CARB (ATCM)>>** ultra-low-emitting formaldehyde (ULEF) or **<<CARB (ATCM)>>** or **<<EPA (TSCA); Title VI>>** no added formaldehyde resins (NAF).

1.06 DELIVERY, STORAGE, AND HANDLING

A. See Section **<< 017419 - Construction Waste Management and Disposal>>** for packaging waste requirements.

B. Deliver materials in manufacturer's original, unopened packaging and store off the floor in a well-ventilated, weather-tight space.

C. Do not expose wood flooring to moisture. Store in dry and warm weathertight space after installation of concrete, masonry, plaster, ceramic tile, and similar wet work.

1.07 FIELD CONDITIONS

A. Do not deliver or install wood flooring until wet construction work is complete and ambient humidity in installation space has stabilized at occupancy conditions.

B. Provide heat, light, and ventilation prior to installation.

C. Store materials in area of installation for minimum period of 7 days prior to installation.

D. Maintain minimum room temperature between **<< 65 degrees F>>** and 75 degrees for a period of seven days prior to delivery of materials to installation space, during installation, and after installation.

E. Move wood flooring to space where it shall be installed at the beginning of the conditioning period. Do not relocate wood flooring into the space after the conditioning period has commenced. Open manufacturer's packaging immediately after relocating wood flooring to allow acclimatization. Install wood flooring when it has adjusted to relative humidity and temperature of the space where it shall be installed.

F. Maintain temperature and relative humidity in space after wood flooring installation.

1.08 WARRANTY

A. Special Warranty - Manufacturer, Installer, and Contractor: Submit warranty signed by manufacturer, installer, and Contractor agreeing to repair or replace wood athletic flooring which shrinks, warps, cracks, or otherwise deteriorates excessively, or which buckles, delaminates, or breaks its anchorage or bond with the substrate or otherwise fails to perform as required or represented by manufacturer due to failures of materials and/or workmanship and not due to unusual exposure to moisture or other abusive forces or elements not anticipated for this application. Installer and Contractor shall assume responsibility for obtaining adequate warranties on materials from manufacturers.

1. Warranty Period: 3 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wood Athletic Flooring:

1. Action Floor Systems.
2. Connor Sports Flooring.
3. Robbins Sports Surfaces; Air-Channel Star. ******MCPS preferred Basis of Design.******
4. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**

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2.02 WOOD ATHLETIC FLOORING

A. Provide wood athletic flooring in compliance with **<<DIN EN 14904>>**.

B. General: Wood athletic flooring, **<< MFMA (PUR) compliant for application indicated; ; or None - N/A>>**system components provided by single manufacturer.

C. System Description:

1. **<< Fixed; Floating; or _____>>**, cushioned sleeper with subfloor system, wood strip flooring.
2. Portable, floating, cushioned system, wood strip flooring, held in place with proprietary clip fasteners.
3. Fixed, pre-engineered subfloor anchored using **<< channels; retainers; clips; and _____>>**, wood strip flooring.

D. Coordinate depth of approved wood athletic flooring system with depression in concrete slab where wood athletic flooring shall be installed and with requirements of Division 03, "Cast-in-Place Concrete."

2.03 COMPONENTS

A. Wood Strip Flooring:

1. Provide MFMA grade-marked flooring, stamped as manufactured by MFMA member mill.
2. Species: Northern hard maple, kiln dried; tongue and groove edges, end matched.
3. Grade: **<< First; Second and better; Third and better; Third; or ____>>**.
4. Cut: Flat.
5. Thickness: **<< 25/32 inch; 33/32 inch; or ____ inch>>**.
6. Width: **<< 2-1/4 inches; 1-1/2 inches; or ____ inches>>**.
7. Backs: Channeled and kerfed for stress relief.

B. Sleepers: Softwood lumber, pressure treated for moisture protection, 2 by 4 inch size, kiln dried to 15 percent maximum moisture content. Do not use and discard bowed and twisted pieces.

C. Subflooring: One layer of 23/32 inch thick plywood, APA rated, Exposure 1, minimum span rating of 48/24; with machined anchor pockets for channels and factory applied resilient cushions.

1. Softwood lumber, **<< 2 by 4 inch; 2 by 3 inch; or _____ inch>>** nominal.
2. Confirm spacing of telescoping bleachers.

D. **<< Channels; Retainers; Clips; and _____>>**: Galvanized steel, 16-gauge; manufacturer's standard size and shape for system indicated.

1. Channel Anchors: Steel drive pins, sized for minimum 1-inch penetration into concrete.

E. Resilient Cushioning: Manufacturer's standard hemisphere-shaped cushioning pads with air voids, factory-applied to bottom side of sleepers at manufacturer's standard spacing with integral spacing device to reduce or eliminate routine spacing for expansion rows.

1. Durometer Hardness: 60D or 70D or as determined.
2. Material: EPDM.
3. Thickness: 7/16 inch, unless indicated otherwise.

F. Vapor Retarder: **<<ASTM D4397>>**; Polyethylene sheet, minimum 6mil thick; 2 inch wide tape for sealing sheet seams.

G. Fasteners and Anchors: Manufacturer's standard type and size to suit application.

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2.04 FINISHES

A. Floor Finishes: Types recommended by flooring manufacturer and complying with MFMA specifcations.
   1. Sealer: **<< Oil based urethane; Oil based oleoresinous; or Water based urethane>>**; pliable, penetratating type.
   2. Finish Coats: **<< Oil based urethane; Epoxy; or Water based urethane>>**; **<< high gloss; low sheen; or satin sheen>>**.
   3. Game Marking Paint: Manufacturer's standard industrial enamel compatible with sealer and finish coats; colors as indicated on drawings.

2.05 ACCESSORIES

A. Ventilating Base: Molded rubber, **<< 4 inch>>** high with a **<< 3 inch>>** toe, pre-molded outside corners; **<< black color; brown color; color as selected by Architect; or _____>>**.

B. Threshold: Saddle profile metal trim, fire-rated and UL10b listed, complies with ADA requirements for thresholds.

C. Edge Strip: **<< Angle; Tee; or _____>>**; **<< mill finish; anodized; or _____>>** aluminum.

D. Transition Strip: Same species and finish as flooring material; profiles indicated.

E. Game Socket or Insert Devices: Refer to Division 11, "Gymnasium Equipment."

F. Moisture Vapor Treatment: Where wood flooring and accessories are installed over concrete slabs, provide alkaline-resistant product designed to control excessive moisture vapor transmission through concrete slab, per the following:
   1. Products: Provide product approved by flooring manufacturer and complying with performance requirements below, equivalent to one of the following:
      a. Duraamen Engineered Products, Inc.; Perdure MVT.
      b. Maxxon Corporation; Maxxon MVP.
      c. Tnemec Company Inc.; Epoxoprime MVT, Series 208.
   2. Performance Requirements:
      a. Verify with flooring manufacturer that submitted product maintains compliance with all provisions of flooring manufacturer’s warranty.
      b. Low-VOC: Provide product with VOC content less than 15 g/L.
      c. Bond Strength to Concrete: Minimum 400 psi per **<<ASTM D4541>>** (100% concrete failure).
      d. Permeance: Maximum 0.1 perm per **<<ASTM E96/E96M>>**, and 0.10 grains/hr/ft^2/in-Hg, per **<<ASTM F3010>>**.
      e. Applications: Provide MVT for all concrete slabs on-grade and lightweight concrete elevated slabs.

G. Adhesives: Types recommended by flooring manufacturer.

H. Subfloor Filler: Manufacturer's standard trowelable leveling and patching compound, latex-modified, hydraulic-cement-based formulation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions with installer before starting this work.

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B. Verify that concrete subfloor surface is smooth and flat to manufacturer's requirements for moisture content, installation tolerances to plus or minus 1/4 inch in 10 feet, and conditions for performance of wood athletic flooring.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).

1. Test as Follows: Perform one of each test per 1,000 sf of installation area.
   a. Alkalinity (pH): **<<ASTM F710>>** in accordance with manufacturer's instructions.
   b. Internal Relative Humidity: **<<ASTM F2170>>**, using in situ probes. Acceptable maximum of 75 percent relative humidity.
   c. Moisture Vapor Emission: **<<ASTM F1869>>**, anhydrous calcium chloride test. Acceptable maximum moisture vapor emission rate of 5 pounds of water for every 1000 square feet in 24 hours.
2. If test results are not within limits recommended by flooring manufacturer, apply moisture vapor treatment (MVT) in accordance with manufacturer's requirements.
3. After testing is complete, prepare concrete and install moisture vapor treatment (MVT) in accordance with manufacturer's written instructions. If testing indicates measurements are within acceptable levels for flooring installation with the need for MVT, the MVT may be omitted where approved by the Architect.

D. Verify that required floor-mounted utilities are in correct location.

E. Commence with installation after noncompliant conditions are corrected.

3.02 PREPARATION

A. Prepare substrate to receive wood flooring in accordance with manufacturer's and MFMA instructions.

B. Remove ridges and bumps in concrete substrate. Apply skim coat to fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.

C. Use mechanical methods to remove substances incompatible with adhesives, including soap, wax, oil, or silicone. Solvents may not be used.

D. Sweep and vacuum clean substrate immediately prior to installing wood athletic flooring.

3.03 INSTALLATION

A. Place vapor retarder over concrete surface, overlap seams a minimum of 6 inches and seal with tape.

B. Sleepers with Plywood Subfloor:

1. Attach resilient pads to bottom of sleepers in accordance with manufacturer's instructions. Place sleepers at 90 degree angle to direction of finished floor; space 12 inches on center. Stagger end joints a minimum of 24 inches.
2. Anchor sleepers to concrete substrate with steel anchoring pins.
3. Fasten plywood subfloor over sleepers at 45 degree angle to direction of finished floor. Allow minimum 1/4 inch between plywood subfloor edges.

C. Install solid 7/8 inch blocking **<< at doorways; under stacked bleachers; under locations of heavy equipment; as shown on drawings; and _____>>** at a maximum of 12 inches on center, as applicable and in accordance with flooring manufacturer's recommendations. Attach resilient pads to bottom of blocking. Space to check floor deflection under bleachers.

D. Wood Flooring:

1. Install in accordance with manufacturer's and MFMA instructions.

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2. Lay flooring parallel to length of main playing area. Blind nail or staple perpendicular to subfloor to a tolerance of 1/8 inch in 10 feet from level.
3. Install edge strips at unprotected or exposed edges, and where flooring terminates.
4. Provide 2 inch expansion space at walls and other interruptions.

E. Install base at floor perimeter to cover expansion space in accordance with manufacturer's instructions. Miter inside corners.

F. Install floor **<< sockets; inserts; cover plates; and _____>>** in accordance with Division 11, "Gymnasium Equipment."

G. Finishing:
1. Fill nail and screw holes with wood filler.
2.
3. Mask off adjacent surfaces before beginning sanding.
4. Sand flooring to smooth even finish with no evidence of sander marks. Remove offsets, ridges, and cup. Take precautions to contain dust. Remove dust by vacuum or wipe down with clean tack cloth.
5. Apply finishes in accordance with floor finish manufacturer's and MFMA instructions.
6. Apply manufacturer's recommended number of coats to a minimum of 4 total with a minimum of 2 being finish coats.
7. Apply first coat, allow to dry, then buff lightly with recommended pad to remove irregularities. Vacuum clean and wipe with damp, lint-free cloth before applying succeeding coats.
8. Apply **<< game lines/markers; logos; and _____>>** in accordance with layout indicated on drawings **<< layout indicated on drawings; layout indicated on shop drawings; or _____>>**.
   a. Apply paint after masking flooring to produce lines and markers with sharp edges.
   b. Break minor lines where game lines cross. Do not overlap lines.
9. Apply last coat of finish after game lines are cured.

3.04 CLEANING

A. Clean and polish floor surfaces in accordance with floor finish manufacturer's instructions after last coat of finish has fully cured.

3.05 PROTECTION

A. Prohibit traffic on finished floor for 7 days after installation.

B. Place durable and breathable protective coverings over finished floors. Prevent heavy wheeled traffic and foot traffic directly over wood athletic flooring assembly.

C. Do not remove coverings until Date of Substantial Completion.

END OF SECTION 096466

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SECTION 096467
DANCE FLOORING ASSEMBLIES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.

B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

C. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

D. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

E. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

F. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.

G. DIN EN 14904 - Surfaces for Sports Areas – Indoor Surfaces for Multi-Sports Use – Specification.

H. EPA (TSCA); Title VI - Toxic Substances Control Act, Title VI: Formaldehyde Standards for Composite Wood Products.

I. MFMA (SPEC) - Guide Specifications for Maple Flooring Systems.

J. SCAQMD 1113 - Architectural Coatings.

K. SCAQMD 1168 - Adhesive and Sealant Applications.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate slab recess depth requirement and floor flatness tolerances for submitted wood flooring system with concrete installer prior to concrete slab installation.

B. Preinstallation Meetings: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers; review preparation and installation procedures and coordination and scheduling necessary for related work.

1.03 SUBMITTALS

A. Product Data: Provide data for all components of sprung dance floor assembly, including subflooring, resilient cushion, and floor finish materials.

B. Shop Drawings: Indicate flooring assembly construction, including total assembly depth, sleeper/subfloor components and spacing, floor joint pattern and termination details.

1. Indicate provisions for expansion and contraction, wall base, and floor access covers as applicable.
2. Indicate size and type fasteners and anchors.

C. Selection Samples: Submit manufacturer's color charts of resilient performance surface for Architect's initial selection.

D. Verification Samples: Submit physical samples of selected flooring in manufacturer's standard size.

E. Test Reports: Submit test reports showing compliance with DIN EN 18032 or ASTM F2772.

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F. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

G. Manufacturer's Instructions: Indicate standard and special installation procedures.

H. Sustainability Submittals: Refer to Division 01, "Sustainable Design Requirements."

1.04 CLOSEOUT SUBMITTALS

A. Maintenance Data: Include **<< maintenance procedures; recommended maintenance materials; a suggested schedule for cleaning; stripping and re-finishing recommendations; stain removal methods; polishes and waxes; and _____>>**.

B. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.

1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
2. Extra Flooring Material: 2 boxes matching installed flooring from same product run.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in installing products specified in this section.

1. Minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. See Section **<< 017419 - Construction Waste Management and Disposal>>** for packaging waste requirements.

B. Deliver materials and store off the floor in a well-ventilated, weather-tight space.

1.07 FIELD CONDITIONS

A. Do not deliver or install flooring until wet construction work is complete and permanent heat and air conditioning is installed and operating.

B. Maintain room temperature between 55 degrees and 75 degrees and relative humidity between 35 to 50 percent for a period of seven days prior to delivery of materials to installation space, during installation, and after installation.

C. Acclimate flooring components and materials to installation space for a minimum of 7 days prior to installation. Do not relocate flooring after conditioning period has commenced. Open manufacturer's packaging immediately after moving into space to acclimate. Install flooring when it has adjusted to relative humidity and temperature in the space where it shall be installed.

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PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Dance Flooring System:

1. Gerstung.
2. Stagestep.
3. Harlequin.
4. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**

2.02 VINYL DANCE FLOORING ASSEMBLY

A. Application: Dance room.

B. System Description:

1. Semi-permanent installation.

2. Sprung dance floor system, consisting of cushioned pads with plywood tongue-and-groove joint subfloor panels, and vinyl dance flooring surface.
3. All components of dance floor system shall be provided by the primary dance flooring manufacturer, or by a manufacturer specifically approved in writing by dance flooring manufacturer.
4. Vinyl performance surface appropriate for all dance types, including tap dance.
5. Basis-of-Design System: Harlequin Flexity Sprung Floor System with Reversable Pro vinyl performance surface.
6. **<< Fixed; Floating; or _____>>**, double layer subfloor system, vinyl performance flooring.

C. Bio-Based Materials: Provide sustainably harvested wood; includ chain-of-custody certification. Lumber and wood products shall be certified by American Tree Farm System (ATFS), Forest Stewardship Council (FSC), or Sustainable Forestry Initiative (SFI).

D. Low-Emitting Materials:
1. Paints and Coatings: Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet applicable VOC limits of **<<CARB (SCM)>>** or **<<SCAQMD 1113>>**.
2. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant with **<<CAL (CDPH SM)>>** AND shall meet the chemical content requirements of **<<SCAQMD 1168>>**.
3. Composite Wood Products: Composite wood products installed inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet requirements for **<<CARB (ATCM)>>** ultra-low-emitting formaldehyde (ULEF) or **<<CARB (ATCM)>>** or **<<EPA (TSCA); Title VI>>** no added formaldehyde resins (NAF).

2.03 COMPONENTS

A. Resilient Flooring:
1. Provide manufacturer's standard resilient performance surface.

B. Sleepers: Softwood lumber, pressure treated for moisture protection, kiln dried to 15 percent maximum moisture content. Do not use and discard bowed and twisted pieces.
1. Length: **<< 48 inches; 96 inches; or _____ inch>>**.
2. Softwood lumber, 2 by 4 inch nominal.
3. Plywood, 7/8 inch by 4 inch nominal.

C. Subflooring: One layer of 23/32 inch thick plywood, APA rated, exposure 1, fire-resistance treated; with machined anchor pockets for channels and factory applied resilient cushions.

D. Channels: Galvanized steel, 16-gauge; manufacturer's standard size and shape for system indicated.
1. Channel Anchors: Steel drive pins, sized for minimum 1-inch penetration into concrete.

E. Resilient Cushioning: Manufacturer's standard hemisphere-shaped cushioning pads with air voids, factory-applied to bottom side of sleepers at manufacturer's standard spacing.
1. Durometer Hardness: 60D or 70D or as determined.
2. Material: EPDM.
3. Thickness: 7/16 inch, unless indicated otherwise.

F. Vapor Retarder: **<<ASTM D4397>>** Polyethylene sheet, minimum 6 mil thick; 2 inch wide tape for sealing sheet seams.

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G. Fasteners and Anchors: Manufacturer's standard type and size to suit application.

2.04 FINISHES

A. Vinyl Performance Floor Finish: Black/Gray.

2.05 ACCESSORIES

A. Ventilating Base: Molded rubber, 4 inch high with a 3 inch toe, pre-molded outside corners; **<< black color; brown color; color as selected by Architect; or _____>>**.

B. Ramp: Provide type compatible with flooring system.

C. Edge Strip: **<< Angle; Tee; or _____>>**; **<< mill finish; anodized; or _____>>** aluminum.

D. Moisture Vapor Treatment: Where wood flooring and accessories are installed over concrete slabs, provide alkaline-resistant product designed to control excessive moisture vapor transmission through concrete slab, per the following:

1. Products: Provide product approved by flooring manufacturer and complying with performance requirements below, equivalent to one of the following:
   a. Duraamen Engineered Products, Inc.; Perdure MVT.
   b. Maxxon Corporation; Maxxon MVP.
   c. Tnemec Company Inc.; Epoxoprime MVT, Series 208.
2. Performance Requirements:
   a. Verify with flooring manufacturer that submitted product maintains compliance with all provisions of flooring manufacturer's warranty.
   b. Low-VOC: Provide product with VOC content less than 15 g/L.
   c. Bond Strength to Concrete: Minimum 400 psi per ASTM D 4541 (100% concrete failure).
   d. Permeance: Maximum 0.1 perm per ASTM E 96, and 0.10 grains/hr/ft^2/in-Hg, per ASTM F3010.
   e. Applications: Provide MVT for all concrete slabs on-grade and lightweight concrete elevated slabs.

E. Adhesives: Types recommended by flooring manufacturer.

F. Subfloor Filler: Manufacturer's standard trowelable leveling and patching compound, latex-modified, hydraulic-cement-based formulation.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions with installer before starting this work.

B. Verify that concrete subfloor surface is smooth and flat to manufacturer's requirements for moisture content, installation tolerances to plus or minus 1/4 inch in 10 feet, and conditions for performance of dance flooring.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).

1. Test as Follows: Perform one of each test per 1,000 sf of installation area.
   a. Alkalinity (pH): **<<ASTM F710>>** in accordance with manufacturer's instructions.
   b. Internal Relative Humidity: **<<ASTM F2170>>**, using in situ probes. Acceptable maximum of 75 percent relative humidity.

c. Moisture Vapor Emission: **<<ASTM F1869>>**, anhydrous calcium chloride test. Acceptable maximum moisture vapor emission rate of 5 pounds of water for every 1000 square feet in 24 hours.

2. If test results are not within limits recommended by flooring manufacturer, apply moisture vapor treatment (MVT) in accordance with manufacturer's requirements.
3. After testing is complete, prepare concrete and install moisture vapor treatment (MVT) in accordance with manufacturer's written instructions. If testing indicates measurements are within acceptable levels for flooring installation with the need for MVT, the MVT may be omitted where approved by the Architect.

D. Verify that required floor-mounted utilities are in correct location.

E. Commence with installation after noncompliant conditions are corrected.

3.02 PREPARATION

A. Prepare substrate to receive wood flooring in accordance with manufacturer's instructions.

B. Remove ridges and bumps in concrete substrate. Apply skim coat to fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.

C. Use mechanical methods to remove substances incompatible with adhesives, including soap, wax, oil, or silicone. Solvents may not be used.

D. Sweep and vacuum clean substrate immediately prior to installing dance flooring.

3.03 INSTALLATION

A. Place vapor retarder over prepared concrete surface, overlap seams a minimum of 6 inches and seal with tape.

B. Channels**<< with Plywood Subfloor; with Solid Lumber Subfloor; with _____; or None - N/A>>**:

1. Install subfloor assembly with channel sleepers at 90 degree angle to direction of finished floor. Stagger end joints a minimum of **<< 24 inches; or _____ inch>>**.
2. Anchor subloor assembs to concrete substrate with steel anchoring pins.

C. Install solid blocking **<< at doorways; under stacked bleachers; under locations of heavy equipment; as shown on drawings; and _____>>**, as applicable and in accordance with flooring manufacturer's recommendations.

D. Install floor sleeves and inserts to a depth sufficient to ensure flush top surface with floor surface.

E. Finishing:

1. Mask off adjacent surfaces before beginning sanding.
2. Sand flooring to smooth even finish with no evidence of sander marks. Remove dust by vacuum.
3. Apply finishes in accordance with **<< floor finish manufacturer's; MFMA; and _____>>** instructions.
4. Apply **<< one sealer coat; two sealer coats; _____; or None - N/A>>** and **<< three; two; or _____>>** finish coats.
5. Apply first coat, allow to dry, then buff lightly with **<< recommended pad; steel wool; or _____>>** to remove irregularities. Vacuum clean and wipe with damp, lint-free cloth before applying succeeding coats.
6. Apply **<< game lines/markers; logos; and _____>>** in accordance with **<< layout indicated on drawings; layout indicated on shop drawings; or _____>>**.

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7. Apply last coat of finish.

3.04 CLEANING

A. Clean floor surfaces in accordance with floor finish manufacturer's instructions.

3.05 PROTECTION

A. Prohibit traffic on finished floor for **<< 72 hours; 48 hours; or _____>>** after installation.

B. Place protective coverings over finished floors; do not remove coverings until Date of Substantial Completion.

END OF SECTION 096467

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SECTION 096500
RESILIENT FLOORING

PART 1 GENERAL

1.01 ~~RELATED REQUIREMENTS~~

A. ~~Section **<< 260526 - Grounding and Bonding for Electrical Systems>>**: Grounding and bonding of static control flooring to building grounding system.~~

1.02 DEFINITIONS

A. Grain: The apparent direction of a printed or inherent design of a tile.

B. Pattern: The color or geometric arrangement of multiple tiles on a surface.

1.03 REFERENCE STANDARDS

A. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

B. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

C. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.

D. ASTM F150 - Standard Test Method for Electrical Resistance of Conductive and Static Dissipative Resilient Flooring.

E. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

F. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile.

G. ASTM F1344 - Standard Specification for Rubber Floor Tile.

H. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

I. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

J. ASTM F3010 - Standard Practice for Two-Component Resin Based Membrane-Forming Moisture Mitigation Systems for Use Under Resilient Floor Coverings.

K. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

L. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.

M. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

N. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings.

O. SCAQMD 1113 - Architectural Coatings.

P. SCAQMD 1168 - Adhesive and Sealant Applications.

1.04 SUBMITTALS

A. Product Data: Provide data of specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

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B. Shop Drawings: Indicate **<< seaming plans; floor patterns; dye lot; layout of grounding strips and connections to the building grounding system; and _____>>**.
   1. Include diagrams indicating flooring product layouts, edges, columns, doorways, enclosing partitions, built-in casework, and cutouts.
   2. Indicate details of special patterns.

C. Product Schedule: For resilient flooring products. Use same abbreviations as drawings.

D. Selection Samples: Submit manufacturer's complete set of color samples for **<<Architect>>**'s initial selection.

E. Verification Samples: Submit two samples of indicated resilient flooring products in manufacturer's standard size illustrating color and pattern.

F. Sustainability Submittals: Refer to Division 01, "Sustainable Design Requirements."

G. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

B. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.
   1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
   2. Extra Flooring Material: 1 box for every 50 boxes of each type, pattern, size, and color from the same production run.
   3. Extra Wall Base: Minimum 10 linear feet for every 500 linear feet of each type, pattern, size and color from the same production run.

C. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver resilient flooring products in manufacturer's standard unopened packaging indicating manufacturer name, product name, project name, and shipping and handling instructions.

B. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.

C. Store all materials off of the floor in an acclimatized, weather-tight space.

D. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

E. Store tile products on a flat surface.

F. Protect roll materials from damage by storing on end.

1.08 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

B. Install resilient flooring products when they are the same temperature as the space they shall be installed.

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C. Prevent floor and wheeled traffic in space during resilient flooring installation and for a time after in accordance with manufacturer's instructions.

D. Install resilient flooring products after wet work is complete and dry.

E. Install resilient flooring on concrete slabs that have cured the requisite amount of time and demonstrate a moisture content in accordance with manufacturer's requirements for establishing an adhesive bond.

1.09 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Manufacturer's Warranty: Provide a ten (10) year manufacturer warranty, covering defective material and installation.

C. Installer's Warranty: Installer shall warrant that the products have been installed in accordance with manufacturer's instructions.

1. The installer shall provide a ten (10) year warranty against product failure due to excessive moisture vapor transmission through the slab.

PART 2 PRODUCTS

2.01 RESILIENT FLOORING - GENERAL

A. Source Limitations: Provide resilient base, stair accessories, and molding accessories through a single source from a single manufacturer.

B. Low-Emitting Materials:

1. Paints and Coatings: Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet applicable VOC limits of **<<CARB (SCM)>>** or **<<SCAQMD 1113>>**.
2. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet the chemical content requirements of **<<SCAQMD 1168>>**.

2.02 RESILIENT TILE FLOORING

A. Vinyl Composition Tile: Homogeneous, color and pattern throughout thickness. Through-color is not acceptable.

1. Manufacturers:
   a. AHF Contract; Iliad/Highlights.
   b. Armstrong Flooring; Standard Excelon Imperial Texture.
   c. Tarkett Flooring; VCT II.
   d. Vinylasa; Nova.
   e. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
2. Minimum Requirements: Comply with **<<ASTM F1066>>**, Class 2 .
3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with **<<ASTM E648>>** or **<<NFPA 253>>**.
4. Size: 12 by 12 inch.
5. Thickness: 0.125 inch.
6. Color and Pattern: To be selected by **<<Architect>>** from manufacturer's full range.

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B. Quartz Composition Tile: Homogeneous composition tile formulated of mined quartz suspended in vinyl matrix.
   1. Manufacturers:
      a. Altro Group; Altro Quartz Tile.
      b. Kahrs International; Quartz.
      c. Procedo Flooring; Versa Quartz US Collection.
      d. Rickett America; Quartz Tile.
      e. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
   2. Minimum Requirements: Comply with **<<ASTM F1066>>**, Class 2 - through pattern.
   3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with **<<ASTM E648>>** or **<<NFPA 253>>**.
   4. Size: 12 by 12 inch.
   5. Thickness: 0.125 inch.
   6. Color and Pattern: To be selected by **<<Architect>>** from manufacturer's full range.

C. Rubber Tile: Homogeneous, color and pattern throughout thickness.
   1. Manufacturers:
      a. American Biltrite; Marathon.
      b. Flexco, Inc; FlexTones.
      c. Mondo USA; Dharma.
      d. Nora Rubber Flooring; Norament.
      e. Roppe Corporation; Rubber Tile.
      f. Tarkett Flooring; Rubber Tile.
      g. VPI, LLC; Floor Products Division; Rubber Flooring.
      h. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
   2. Minimum Requirements: Comply with **<<ASTM F1344>>**, Class I-A (Homogeneous Rubber Tile, Solid Color).
   3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with **<<ASTM E648>>** or **<<NFPA 253>>**.
   4. Size: 18 by 18 inch, 20 by 20 inch, or 24 by 24 inch, nominal, as standard with manufacturer.
   5. Total Thickness: 0.125 inch.
   6. Texture: **<< Smooth; Raised circles; Raised squares; Hammered; Embossed; or _____>>**.
   7. Color and Pattern: To be selected by Architect .

D. Rubber Tile: Recycled SBR (styrene butadiene rubber) and colored EPDM (ethylene propylene diene monomer) granules with urethane binder.
   1. Manufacturers:
      a. Dinoflex Group; Evolution Commercial Flooring.
      b. Expanko Resilient Flooring, a Stonhard Brand; Reztec.
      c. Flexco Corporation; Tuflex Force Rubber Tile.
      d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
   2. Backing: Recycled black rubber, laminated to colored top layer.

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3. Critical Radiant Flux (CRF): Minimum **<< 0.45; 0.22; or ____>>** watt per square centimeter, when tested in accordance with **<<ASTM E648>>** or **<<NFPA 253>>**.
4. Size: 18 **<< ___by ___inch; 18 by 18 inch; 28-1/2 by 28-1/2 inch; 37 by 37 inch; or As indicated on drawings>>**.
5. Thickness: **<< 1/8 inch; 5/16 inch; 3/8 inch; or ____ inch>>** minimum.
6. Tile Edge: **<< Interlocking shape; Straight; or _____>>**.
7. Color and Pattern: To be selected by **<<Architect>>** from manufacturer's full range.

E. Static Control Tile: Homogeneous; color and pattern throughout thickness.
1. Manufacturers:
   a. Flexco Corporation; ESD Rubber.
   b. Nora; noramentgrano ED.
   c. Roppe Corporation; ESD Rubber Static Control Tile.
   d. StaticWorx; SD Architectural Rubber.
   e. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
2. Minimum Requirements: Rubber tile complying with **<<ASTM F1344>>**, Class 1, Type B.
3. Electrical Resistance:
   a. Dissipative Tile: Resistance between 1.0 megohms and 1000 megohms as tested in accordance with **<<ASTM F150>>**.
4. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with **<<ASTM E648>>** or **<<NFPA 253>>**.
5. Tile Size: Manufacturer's standard.
6. Total Thickness: 2 mm, minimum.
7. Color: To be selected by **<<Architect>>** from manufacturer's full range.

2.03 RESILIENT BASE

A. Resilient Base: **<<ASTM F1861>>**, Type TP, rubber, thermoplastic; Style B, Cove.
1. Products (Type TP):
   a. Armstrong World Industries, Inc.; Rubber Coved Toe Wall Base.
   b. Flexco (USA), Inc.; Flexco Base 2000 - Cove.
   c. Johnsonite, a Tarkett Company; Rubber Wall Base - Cove.
   d. Mannington Commercial; Burkebase Type TP - Coved.
   e. Nora Systems, Inc; nora wall base; Article 820.
   f. Roppe Corporation; 700 Series TPR Wall Base - Style B (Coved).
   g. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
2. Products (Type TS):
   a. Flexco (USA), Inc.; Wallflowers Premium - Cove.
   b. Johnsonite, a Tarkett Company; Baseworks; Coved (Toe) Profile.
   c. Mannington Commercial; Premium TS Molded Wall Base.
   d. Roppe Corporation; Pinnacle Rubber Wall Base - Cove Toe.
   e. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with **<<ASTM E648>>** or **<<NFPA 253>>**.

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4. Height: **<< 4 inch; or 6 inch>>**.
5. Thickness: 0.125 inch minimum.
6. Finish: Satin.
7. Length: Roll; manufacturer's standard length.
8. Color: To be selected by **<<Architect>>** from manufacturer's full range.

2.04 MOLDINGS, TRANSITIONS, AND EDGE STRIPS

A. Moldings, Transition and Edge Strips:
   1. Manufacturers:
      a. Flexco, Inc.
      b. Johnsonite.
      c. Mannington Commercial.
      d. R.C.A. Rubber Company (The).
      e. Roppe Corporation.
      f. VPI, LLC; Floor Products Division.
      g. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
   2. Molding/Transition Strip Profiles: Provide in sizes as required to suit flooring thicknesses and applications.
      a. Coved edge/cap for carpet.
      b. Joiner between carpet and resilient flooring or other materials with different heights.
      c. Transition strip between different types of materials that are the same height or between different styles/patterns of the same material.
      d. Slim transition strip with approximately 1/4-inch wide visible transition profile.
      e. Reducer strip at edges of flooring to reduce height to 0".
      f. Subfloor leveling accessory to transition between materials with height differences up to 1/2 inch.
   3. Material: Manufacturer's standard rubber or vinyl.
   4. Color: To be selected by Architect from manufacturer's full range.

2.05 ACCESSORIES

A. Leveling Compound: Blended cement mix, latex-modified, Portland cement based, or blended hydraulic-cement-based, for uses indicated.

B. Subfloor Filler: Type recommended by adhesive material manufacturer.

C. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer for resilient flooring products and indicated substrate conditions.
   1. For static-control flooring, provide types recommended by static control flooring manufacturer for maintaining static dissipative properties of flooring system and grounded connection.

D. Moisture Vapor Treatment: Where resilient flooring and accessories are installed over concrete slabs and where field testing indicates high moisture vapor testing through concrete slabs, provide alkaline-resistant product designed to control excessive moisture vapor transmission through concrete slab.
   a. Duraamen Engineered Products, Inc.; Perdure MVT.
   b. Maxxon Corporation; Maxxon MVP.
   c. Tnemec Company Inc.; Epoxoprime MVT, Series 208.

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2. Performance Requirements:
    a. Verify with flooring manufacturer that submitted product maintains compliance with all provisions of flooring manufacturer's warranty.
    b. Low-VOC: Provide product with VOC content less than 15 g/L.
    c. Bond Strength to Concrete: Minimum 400 psi per **<<ASTM D4541>>** (100% concrete failure).
    d. Permeance: Maximum 0.1 perm per **<<ASTM E96/E96M>>**, and 0.10 grains/hr/ft^2/in-Hg, per **<<ASTM F3010>>**.
    e. Applications: Provide MVT for all concrete slabs on-grade and lightweight concrete elevated slabs.

E. Copper Grounding Strips: Type and size as recommended by static control flooring manufacturer.

F. Filler for Stair Treads: Manufacturer's standard or recommended two-part epoxy filler for nosings not conforming to tread contours.

G. Floor Polish: Fluid-applied polish recommended by resilient flooring manufacturer.
    1. MCPS Preferred Basis of Design: Provide Essential Industries: Green Essence 8801FFX, Green G2 Finish or comparable product.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify with installer that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
    1. Test as Follows: Perform one of each test per 1,000 sf of installation area.
        a. Alkalinity (pH): **<<ASTM F710>>** in accordance with manufacturer's instructions.
        b. Internal Relative Humidity: **<<ASTM F2170>>**, using in situ probes. Acceptable maximum of 75 percent relative humidity.
        c. Moisture Vapor Emission: **<<ASTM F1869>>**, anhydrous calcium chloride test. Acceptable maximum moisture vapor emission rate of 5 pounds of water for every 1000 square feet in 24 hours.
    2. If test results are not within limits recommended by flooring manufacturer, apply moisture vapor treatment (MVT) in accordance with manufacturer's requirements.
    3. After testing is complete, prepare concrete and install moisture vapor treatment (MVT) in accordance with manufacturer's written instructions. If testing indicates measurements are within acceptable levels for flooring installation with the need for MVT, the MVT may be omitted where approved by the Architect.

C. Verify that required floor-mounted utilities are in correct location.

D. Commence with installation after noncompliant conditions are corrected.

3.02 PREPARATION

A. Remove existing resilient flooring and flooring adhesives; follow the recommendations of **<<RFCI (RWP)>>**.

B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

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C. Use mechanical methods to remove substances incompatible with adhesives, including soap, wax, oil, or silicone. Solvents may not be used.

D. Prepare concrete substrates in accordance with **<<ASTM F710>>**.

E. Install resilient flooring on dry substrates free of curing compounds, sealers, and hardeners.

F. Remove subfloor ridges and bumps. Apply skim coat to fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.

G. Prohibit traffic until filler is fully cured.

H. Sweep and vacuum clean substrate immediately prior to installing resilient flooring.

I. Examine substrates for evidence of moisture, alkalinity, carbonation, or dust. Correct these conditions prior to resilient flooring installation.

J. Apply primer to prevent telegraphing or interference with adhesion by substances that cannot be removed.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions for full spread adhesive application.

C. Final installation shall be free of open cracks, voids, raising, and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

D. Hand roll resilient flooring where indicated in accordance with manufacturer's instructions.

E. Adhesive-Applied Static-Dissipative Installation:

1. Place copper grounding strip in conductive adhesive and apply additional adhesive to top side of strip before installing static control flooring. Allow strip to extend beyond flooring in accordance with static control flooring manufacturer's instructions. Coordinate with Division 26 for grounding and bonding to building grounding system.
2. Fit joints and butt seams tightly.
3. Set flooring in place, press with heavy roller to attain full adhesion.

F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

G. Install edge/reducer strips at unprotected or exposed edges, where flooring terminates, and where indicated.

1. Metal Strips: Attach to substrate **<< before; after; or _____>>** installation of flooring using stainless steel screws.
2. Resilient Strips: Attach to substrate using adhesive.

H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

I. At movable partitions, install flooring under partitions without interrupting floor pattern.

J. Extend resilient flooring into toe spaces, door reveals, closets, and similar openings.

K. Indicate reference markers, holes, and openings for future cutting on installed resilient flooring to maintain placement using nonpermanent, non-staining devices.

L. Coordinate placement of resilient flooring with electrical ducts and devices and maintain pattern continuity with resilient flooring installed on top of floor covers and electrical devices. Adhere edges of resilient flooring tightly around and to covers.

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3.04 INSTALLATION - TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.
   1. Follow sequence of numbered tiles if indicated in manufacturer's instructions.

B. Lay flooring with joints and seams **<< parallel; at 45 degrees; or _____>>** to building lines to produce symmetrical pattern. Tiles on opposite extents of space shall be of equal width.

C. Do not use and discard broken, chipped, cracked, or deformed tiles.

D. Install square tile to **<< quarter-turn; ashlar; basket weave; or _____>>** pattern. Allow minimum 1/2 full size tile width at room or area perimeter.

E. Install plank tile with a random offset of at least 6 inches from adjacent rows.

3.05 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

B. Install base on solid backing. Bond tightly to wall and floor surfaces.
   1. Install base on permanent walls, columns, pilasters, and casework/cabinet knee and toe spaces, and other exposed vertical faces, unless noted otherwise.

C. Job form internal and external corners in accordance with manufacturer's instructions. Form corners by "V" cutting or scribing; do not bend material in a manner that creates stress whitening.

D. Scribe and fit to door frames and other interruptions.

E. Fill voids at top of base using manufacturer's recommended filler sealant or adhesive when installing on uneven substrates.

3.06 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

C. Immediately after resilient flooring installation:
   1. Clear exposed resilient flooring surfaces of adhesive and other blemishes.
   2. Thoroughly sweep and vacuum clean resilient flooring surfaces.
   3. Remove marks and oil by damp mopping.

D. Select a classroom for mockup cleaning prior to general cleaning of all spaces. Arrange for inspection and approval by MCPS Building Services Manager. Approved classroom shall be used as a basis for general cleaning.

E. Vinyl Composition Tile (VCT) and Rubber Flooring:
   1. Stripping:
      a. Strip floor using a slow speed floor machine and black stripping pad. Use Essential Industries, Green Essence 8881FX, Green Strip only.
      b. Rinse floor at least twice with clean water and let dry. Use wet-dry vacuum to remove stripping solution and water.
   2. Apply Finish:
      a. Apply six coats (2,000 to 2,500 sf/gal) of Essential Industries, Green Essence, 8201FF, Green G2 Finish with clean pre-rinsed rayon mop, allowing a minimum of one hour dry time between each coat.
      b. Allow final coat to dry for 24 hours before allowing traffic on finished floor.

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3.07 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

B. Cover resilient flooring and accessories with heavy-duty, breathable, temporary flooring protection and protect from heavy construction traffic and equipment to prevent mars, marks, indentations, and other damage until Date of Substantial Completion.

END OF SECTION 096500

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SECTION 096566
RESILIENT ATHLETIC FLOORING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension.

B. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness.

C. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

D. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

E. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

F. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

G. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

H. ASTM F3010 - Standard Practice for Two-Component Resin Based Membrane-Forming Moisture Mitigation Systems for Use Under Resilient Floor Coverings.

I. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.

J. CHPS (HPPD) - High Performance Products Database.

K. SCAQMD 1113 - Architectural Coatings.

L. SCAQMD 1168 - Adhesive and Sealant Applications.

M. SCS (CPD) - SCS Certified Products.

N. UL (GGG) - GREENGUARD Gold Certified Products.

1.02 SUBMITTALS

A. Product Data: Manufacturer's printed data sheets for products specified.

B. Shop Drawings: Fabrication and installation details. Include layout, color(s), dye lot, and orientation.

1. Indicate columns, electrical outlets, athletic equipment inserts, and other floor penetrations or items installed through resilient athletic flooring.
2. Indicate border tiles, floor patterns, seam location, layout, colors, and widths of game lines, graphics, and other markings.

C. Selection Samples: Manufacturer's color charts for flooring materials specified and game line paints, indicating full range of colors and textures available.

D. Verification Samples: Actual flooring material specified, of each selected color, in manufacturer's standard size square samples.

1. Include samples of game lines, illustrating colors selected.
2. Include samples of each vinyl sheet flooring color and pattern required; with seam running lengthwise and in center of 6 by 9 inch sample applied to a rigid backing and prepared by installer for this project.

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E. Installer's qualification statement.

F. Sustainability Submittals: Refer to Division 01, "Sustainable Design Requirements."

1.03 CLOSEOUT SUBMITTALS

A. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.
   1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
   2. Extra Flooring Material: 12 boxes matching installed flooring from same product run.

B. Maintenance Data: For resilient athletic flooring.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and certified/approved by flooring manufacturer for installation of specified flooring system.

1.05 DELIVERY, STORAGE, AND HANDLING

A. See Section **<< 017419 - Construction Waste Management and Disposal>>** for packaging waste requirements.

B. Deliver materials to project site in manufacturer's unopened containers clearly labeled with manufacturer's name and identification of contents.

C. Store materials in dry and clean location until needed for installation. Store tiles flat. Store rolls upright. During installation, handle in a manner that will prevent marring and soiling of finished surfaces.

1.06 FIELD CONDITIONS

A. Maintain temperature in spaces to receive adhesively installed resilient flooring within range of **<< 70 to 95 degrees F>>** for not less than 48 hours before the beginning of installation and for not less than 48 hours after installation has been completed. Subsequently, do not allow temperature in installed spaces to drop below **<< 50 degrees F>>** or to go above **<< 100 degrees F>>**.

PART 2 PRODUCTS

2.01 PREFORMED ATHLETIC FLOORING

A. Vinyl Sheet Flooring:
   1. Wearing Surface: Pure polyvinyl chloride, mechanically extruded and uniformly resilient material with uniform color throughout thickness.
   2. Backing: **<< None; Foamed plastic; Unfoamed plastic; or _____>>**.
   3. VOC Content: Certified as Low Emission by one of the following :
      a. Product listing in **<<UL (GGG)>>**.
      b. FloorScore certified product listing in **<<SCS (CPD)>>**.
   4. Sheet Thickness: Minimum 7.5 mm.
      a. Wear Layer Thickness: Minimum 2.0 mm.
   5. Sheet Width: Minimum **<< 48 inches; 78 inches; or __ inches>>**.
   6. Sheet Lengths: As necessary to **<< eliminate; or minimize>>** transverse seams.
   7. Shock Absorption: Class 3 (minimum 34%), when tested per **<<ASTM F2772>>**.
   8. Tensile Strength: Minimum 1000 psi, per **<<ASTM D412>>**.

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9. Durometer Hardness, Type A: Minimum of 65, when tested in accordance with **<<ASTM D2240>>**.
10. Seaming Method: Welding with **<< heat; or chemical>>**.
11. Surface Texture: Smooth.
12. Color: To be selected by Architect from manufacturer's full range.
13. Game Lines: Paint as approved by manufacturer of vinyl sheet flooring.
14. Top Coat: If required by manufacturer for additional UV protection, a clear polyurethane coating that protects game lines and wearing surface.
15. Products:
    a. Gerflor USA, Inc; Taraflex Sport M Plus with DryTex.
    b. Mondo America, Inc; Vinylsport.
    c. Tarkett Sports; Omnisports PurePlay with Tarkolay.
    d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Rubber Tile Flooring: Recycled rubber**<< and colored EPDM granules; or None - N/A>>** with urethane binder.
1. Backing: Recycled black rubber, laminated to colored top layer.
2. VOC Content: Certified as Low Emission by one of the following:
    a. Product listing in **<<UL (GGG)>>**.
    b. FloorScore certified product listing in **<<SCS (CPD)>>**.
    c. Product listing in **<<CHPS (HPPD)>>**.
3. Thickness: Nominal **<< 5/16 inch; 3/8 inch; 1/2 inch; or ___ inch>>**.
4. Size: Manufacturer's standard square tile.
5. Tensile Strength: Minimum 150 psi, per **<<ASTM D412>>**.
6. Tile Edge/Installation: Straight, adhesive installation.
7. Surface Texture: Smooth.
8. Color: To be selected by Architect from manufacturer's full range.
9. Products:
    a. Amarco; Sport-Fleck.
    b. American Floor Products Company (AFCO); Coronado 90 (FE-1015).
    c. Connor Sports; Elastimat.
    d. Dynamic Sports Construction, Inc.; DynaFit.
    e. Horner Sports Flooring; EcoTuff.
    f. Mats Inc.; Duo Tile.
    g. Mondo; Ramflex.
    h. Tarkett; Replay.
    i. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.02 ACCESSORIES

A. Low-Emitting Materials:
1. Paints and Coatings: Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet applicable VOC limits of **<<CARB (SCM)>>** or **<<SCAQMD 1113>>**.

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2. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet the chemical content requirements of **<<SCAQMD 1168>>**.

B. Leveling Compound: Provide manufacturer's recommended latex-modified cement formulation as recommended by flooring manufacturer for substrate conditions.

C. Moisture Vapor Treatment: Where resilient flooring and accessories are installed over concrete slabs, provide alkaline-resistant product designed to control excessive moisture vapor transmission through concrete slab, per the following:

1. Products: Provide product approved by flooring manufacturer and complying with performance requirements below, equivalent to one of the following:
   a. Duraamen Engineered Products, Inc.; Perdure MVT.
   b. Maxxon Corporation; Maxxon MVP.
   c. Tnemec Company Inc.; Epoxoprime MVT, Series 208.
2. Performance Requirements:
   a. Verify with flooring manufacturer that submitted product maintains compliance with all provisions of flooring manufacturer’s warranty.
   b. Low-VOC: Provide product with VOC content less than 15 g/L.
   c. Bond Strength to Concrete: Minimum 400 psi per **<<ASTM D4541>>** (100% concrete failure).
   d. Permeance: Maximum 0.1 perm per **<<ASTM E96/E96M>>**, and 0.10 grains/hr/ft^2/in-Hg, per **<<ASTM F3010>>** ASTM F3010.
   e. Applications: Provide MVT for all concrete slabs on-grade and lightweight concrete elevated slabs.

D. Flooring Adhesive: Waterproof; types recommended by flooring manufacturer.

E. Game Line and Marker Paint: Provide paint type recommended by flooring manufacturer for compatibility and adhesion.

1. Provide two colors, selected by Architect from manufacturer's full range; primary (basketball) and secondary (volleyball).

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates with installer for conditions detrimental to installation of athletic flooring. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of athletic flooring to substrate.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).

1. Test as Follows: Perform one of each test per 1,000 sf of installation area.
   a. Alkalinity (pH): **<<ASTM F710>>** in accordance with manufacturer's instructions.
   b. Internal Relative Humidity: **<<ASTM F2170>>**, using in situ probes. Acceptable maximum of 75 percent relative humidity.
   c. Moisture Vapor Emission: **<<ASTM F1869>>**, anhydrous calcium chloride test. Acceptable maximum moisture vapor emission rate of 5 pounds of water for every 1000 square feet in 24 hours.

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2. If test results are not within limits recommended by flooring manufacturer, apply moisture vapor treatment (MVT) in accordance with manufacturer's requirements.
3. After testing is complete, prepare concrete and install moisture vapor treatment (MVT) in accordance with manufacturer's written instructions. If testing indicates measurements are within acceptable levels for flooring installation with the need for MVT, the MVT may be omitted where approved by the Architect.

D. Verify that required floor-mounted utilities are in correct location.

E. Commence with installation after noncompliant conditions are corrected.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove ridges and bumps in concrete substrate. Apply skim coat to fill minor low spots, cracks, joints, holes, and other defects with leveling compound as necessary to achieve substrate flatness of plus or minus 1/8 inch within 10 ft radius.

C. Use mechanical methods to remove substances incompatible with adhesives, including soap, wax, oil, or silicone. Solvents may not be used.

D. Sweep and vacuum clean areas to receive athletic flooring immediately before beginning installation.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Resilient Sheet Flooring:
1. Unroll flooring and allow to relax before beginning installation.
2. Mix adhesive thoroughly and apply to substrate with notched trowel. Roll flooring into fresh adhesive, overlapping end seams and double cutting, butting factory edges and compression fitting.
3. Roll entire flooring surface with steel roller to assure adhesion to substrate and eliminate air bubbles.
4. Immediately remove any adhesive from flooring surface, using chemical recommended by flooring manufacturer.
5. Weld seams using techniques and equipment recommended by manufacturer.
6. Lay out game lines using tape and taping machine approved by flooring manufacturer. Obtain Owner approval of layout prior to paint application. Apply game line paint with roller, and allow to dry before removing tape.
7. Apply transparent top coat over flooring if recommended by manufacturer, to achieve a uniform finished appearance.

D. Rubber Tile Flooring:
1. Lay out center lines in spaces to receive tile flooring, based on location of principal walls. Start tile installation from center, and adjust as necessary to avoid tiles less than one-half width at perimeter.
2. Lay tiles square with room axis, unless otherwise indicated, matching for color and pattern by selecting from cartons and mixing as recommended by manufacturer. Do not used broken, cracked, chipped, or deformed tiles.
3. Spread only enough adhesive to permit installation of materials before initial set.
4. Fit joints and butt seams tightly; press with heavy roller to attain full adhesion.

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E. Extend flooring into accessory spaces (such as closets, wall recesses, or toe spaces) and to center line of cased openings or center line of door leaf at door openings, unless otherwise indicated. Where transitions occur between resilient athletic flooring and other flooring types, extend or cut flooring to suit transition.

3.04 CLEANING

A. Clean flooring using methods recommended by manufacturer.

3.05 PROTECTION

A. Protect finished athletic flooring from construction traffic to ensure that it is without damage upon Date of Substantial Completion.

END OF SECTION 096566

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SECTION 096623
RESINOUS MATRIX TERRAZZO FLOORING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar.

B. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation.

C. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

D. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

E. NTMA (EPOXY) - Epoxy Terrazzo Specifications.

F. NTMA (GRAD) - Aggregate Gradation Standards.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting at the Project site one week before starting work of this section. Require attendance by concrete subcontractor and any other relevant installers.

1. Review the work of this section, including substrate requirements, including slab recesses, control joints, and preparation.
2. Review scheduling, material deliveries, and temporary facilities and equipment that will be required, and installation procedures.
3. Review specialty finishes, aggregates, patterns and designs. Review special conditions such as stair treads and nosings.
4. Review protection of the finished work, including traffic limitations and protection measures.

1.03 SUBMITTALS

A. Product Data: Provide data for **<< divider strips; control joint strips; expansion joints; sealer; and _____ >>**; include printed copy of current NTMA recommendations for type of terrazzo specified.

1. Include product data for manufacturer's moisture vapor treatment product.

B. Shop Drawings: Indicate complete terrazzo layout, including patterns and colors. Indicate divider strip and control and expansion joint layout, and details of adjacent components.

1. Include details of Owner's logo / seal.
2. Include stair tread, riser, and landing details.
3. For precast units, detail profile, edge, and anchorage requirements.

C. Verification Samples: Include terrazzo samples approximately 6 inches square illustrating project-specific colors, chip size and variation, chip gradation, and matrix color. Include samples of divider strips

D. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

E. Manufacturer's Qualification Statement.

F. Installer's Qualification Statement.

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G. Cleaning and Maintenance Data: Include procedures for stain removal, stripping, and sealing. Include specific cleaners and chemicals that should not be used on terrazzo.

H. Manufacturer's Inspection Reports.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with NTMA's "Terrazzo Specifications and Design Guide" and with recommendations as posted at their web site at www.ntma.com.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section.
   1. Associate member firm of the National Terrazzo and Mosaic Association, Inc.

C. Installer Qualifications: Company specializing in performing the type of work specified in this section.
   1. Contractor member of the National Terrazzo and Mosaic Association, Inc.

D. Coordination: Epoxy terrazzo flooring manufacturer shall review and approve cast-in-place concrete contractor's quality control measures and shop drawings to ensure concrete slab placement, slab recesses, and finish are acceptable for application of terrazzo.

1.05 MOCK-UP

A. Construct mock-up of terrazzo illustrating appearance of finished work in each configuration required. Size mock-up to be not less than 100 square feet.
   1. Include control joint(s) with divider strip, and include multiple adjacent colors to verify color selections, as applicable.
   2. Include a section with terrazzo wall base.
   3. Include a mockup of, at minimum, three stair treads/risers.
   4. Construct mockup directly adjacent to existing terrazzo, to demonstrate material and color match and workmanship of blending to existing.

B. Locate where directed.

C. Approved mock-up may remain as part of the work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store terrazzo materials in a dry, secure area.

B. Maintain minimum temperature of 60 degrees F.

C. Keep products away from fire or open flame.

1.07 FIELD CONDITIONS

A. Do not install terrazzo when temperature is below 50 degrees F or above 90 degrees F.

B. Prior to and during each day of installation, the terrazzo contractor shall verify that the dew point is at least 5 degrees F less than the slab and air temperature.

C. Maintain temperature within specified range 24 hours before, during, and 72 hours after installation of flooring.

D. Provide ambient lighting with permanent lighting or with lighting that simulates facility's permanent lighting.

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PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Resinous Matrix Terrazzo Flooring:
1. Crossfield Products Corp.; Dex-O-Tex Division; Cheminert.
2. Key Resin Company; Key Epoxy Terrazzo System.
3. Master Terrazzo Technologies LLC; Morricite.
4. Quadrant Chemical Corporation; Quadset Epoxy Terrazzo.
5. Sherwin-Williams High Performance Flooring; Terrazzo 1100.
6. Sika Corporation; Sikafloor Terrazzo.
7. TEC Specialty Construction Brands, Inc; Tuff-Lite Epoxy Terrazzo.
8. Terrazzo & Marble Supply Companies; Terroxy Resin Systems.
9. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.02 EPOXY MATRIX TERRAZZO APPLICATIONS

A. Floors:
1. Thickness: **<< 3/8 inch>>**, nominal.
2. Color(s): **<< As selected by Architect; Match Architect's sample; Match existing; or As indicated on drawings>>** Match **<<Architect>>**'s sample.

B. Wall Base: **<< Integral epoxy terrazzo; Precast epoxy terrazzo; or None - N/A>>**.
1. Thickness: **<< 3/8 inch; 1/4 inch; or ___ inch>>**, minimum.
2. Style: **<< Coved; or _____>>**.
3. Color(s): Same as adjacent floor.
4. Color(s): As indicated on drawings.
5. Aggregate Type and Size: Same as floors.

C. Stairs - **<< Treads; Risers; Stringers; Landings; and _____>>**: Precast epoxy terrazzo. Landings: Poured epoxy terrazzo.
1. Thickness: **<< 1/2 inch; 1-1/2 inch; or ___ inch>>**, minimum.
2. Color(s): **<< Same as adjacent floor; or As indicated on drawings>>**.
3. Aggregate Type and Size: Same as floors.

D. Tile - Elevator cab floors: Precast epoxy terrazzo.
1. Thickness: **<< 1/2 inch>>**, minimum.
2. Color(s): **<< Same as adjacent floor; or As indicated on drawings>>**.
3. Aggregate Type and Size: Same as floors.

2.03 MATERIALS

A. Epoxy Matrix Terrazzo: Aggregate and matrix mix applied to substrate, troweled flat, and ground smooth.
1. Mix Proportions: As required to achieve appearance specified.

B. Matrix: Two component resin and epoxy hardener with mineral filler and color pigment, non-volatile, thermo-setting.

C. Aggregate: Type as indicated; sized in accordance with NTMA aggregate gradation standards; color(s) as indicated, uniform in color.
1. Color 1**<< - Field; or None - N/A>>**: **<< 100>>** percent marble chips.
2. Color 2**<< - Accent Field; or None - N/A>>**: **<< 100>>** percent marble chips.

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3. Color x**<< - Special Accent; or None - N/A>>**: **<< 80>>** percent marble chips, **<< 10>>** percent glass, and **<< 10>>** percent mother of pearl.
4. Color x**<< - Basic Accent; or None - N/A>>**: **<< 80>>** percent marble chips, **<< 20>>** percent glass.
5. Color x**<< - Basic Accent; or None - N/A>>**: **<< 80>>** percent marble chips, **<< 20>>** percent glass.
6. Color x**<< - Basic Accent; or None - N/A>>**: **<< 80>>** percent marble chips, **<< 20>>** percent glass.
7. Color x**<< - Basic Accent; or None - N/A>>**: **<< 80>>** percent marble chips, **<< 20>>** percent glass.
8. Color x**<< - Basic Accent; or None - N/A>>**: **<< 80>>** percent marble chips, **<< 20>>** percent glass.

D. Finishing Grout: Epoxy, color to match terrazzo matrix.

E. Precast Epoxy Terrazzo Units: Fabricate to sizes and profiles indicated on drawings.
1. Setting Material: **<< Latex Portland cement mortar, ANSI A118.4; Epoxy adhesive, ANSI A118.3; or _____>>**.
2. Crack Isolation Material: Polyethylene sheet membrane, **<<ANSI A118.12>>**.

2.04 ACCESSORIES

A. Divider Strips: 1/8 inch thick zinc exposed top strip, zinc coated steel concealed bottom strip, with anchoring features.

B. Control Joint Strips:1/8 inch nominal width zinc exposed top strips, zinc coated steel concealed bottom strips, **<< 1/8 inch; 1/4 inch; or _____ inch>>** wide neoprene filler strip between vertical strips, with anchoring features.

C. **<< Divider; and Control Joint>>** Strip Height: To suit thickness of terrazzo topping, with allowance for grinding.

D. Base Cap, Base Divider Strip, and Separator Strip: Match divider strips.

E. Non-Slip Inserts: Provide channel-shaped inserts filled with a mixture of resin and fine, abrasive aggregate.

F. Anchors and Reinforcement for Precast Units: As recommended by manufacturer for type of installation.

G. Sealer: Colorless, non-yellowing, non-strippable, penetrating liquid urethane type to completely seal matrix surface, not detrimental to terrazzo components.
1. Products:
a. Essential Industries, Inc; T-Rx.
b. Master Terrazzo Technologies; Morricite WB Urethane Sealer 158.
c. Terrazzo & Marble Supply Companies; Terroxy WB Urethane Sealer.

H. Concrete Subfloor Flexible Joint Reinforcement and Crack Isolation Membrane: Manufacturer's standard resinous type with fiberglass scrim.

I. Primer: Manufacturer's recommended product; compatible with indicated substrate.

J. Moisture Vapor Treatment: Provide terrazzo manufacturer's recommended alkaline-resistant product designed to control excessive moisture vapor transmission through concrete slab, per the following:
1. Performance Requirements:

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a. Verify with flooring manufacturer that submitted product maintains compliance with all provisions of flooring manufacturer's warranty.
b. Low-VOC: Provide product with VOC content less than 15 g/L.
c. Bond Strength to Concrete: Minimum 400 psi per **<<ASTM D4541>>** (100% concrete failure).
d. Permeance: Maximum 0.3 perm per **<<ASTM E96/E96M>>**.
e. Applications: Provide MVT for all concrete slabs on-grade and lightweight concrete elevated slabs.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive terrazzo.

B. Cementitious Subfloor Surfaces: Install manufacturer's recommended moisture vapor treatment at all locations to receive terrazzo floor finish in accordance with manufacturer's instructions.

C. Verify that any required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Clean substrate of foreign matter.

B. Prepare concrete subfloor by shot-blasting surface in accordance with manufacturer's instructions, and according to ICRI Technical Guidelines for CSP 3 or 4 surface profile.
1. Acid washing and/or grinding of concrete slabs is not allowed.
2. Review vacuum blasted concrete slab substrate for cracks with the terrazzo manufacturer's technical representative. Rout out and fill significant non-moving cracks with epoxy resin, and patch lesser non-moving cracks with fine mesh strip set into wet primer and embedded in epoxy resin as recommended by technical representative.
3. Provide an epoxy or cementitious pre-fill material manufactured or recommended by epoxy flooring manufacturer and compatible with flooring system to fill low slab areas to attain acceptable substrate. This companion material is considered part of the epoxy terrazzo flooring system and shall be included in the system warranty. Gypsum composition underlayment pre-fill material is not acceptable.

C. Apply partial coverage of flexible reinforcing membrane to cracks and construction joints in the concrete subfloor in accordance with manufacturer's instructions. Reinforce with fiberglass scrim.
1. Use a full coverage application under intricate designs including, but not limited to, curves, logos, county seals, or areas with multiple color transitions in accordance with manufacturer's instructions. ******Leave this paragraph in if doing a logo insert, a highly complicated design, or a lot of curves.******

D. Apply primer in accordance with manufacturer's instructions.

3.03 INSTALLATION

A. Install control joint strips straight and flat to locations indicated.

B. Install divider strips according to pattern approved on shop drawings.

C. Install non-slip inserts in **<< floors; stair treads; and _____>>** where indicated.

D. Install recessed **<< floor mat; floor access panel; and _____>>** frames.

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E. Install base**<< and border; or None - N/A>>** divider**<< and control joint; or None - N/A>>** strips to match floor pattern.

F. Install terminating cap strip at top of base; attach securely to wall substrate.

G. Place terrazzo mix over substrate to thickness indicated.

H. Anchor precast units as indicated on drawings.

I. Install precast units using specified setting material.

3.04 FINISHING

A. Finish terrazzo to NTMA requirements.

B. Grind terrazzo surfaces with power disc machine; sequence with coarse to fine grit abrasive to a minimum of **<< 800; 400; 1200; or _____>>** grit level for final finish, **<< using a wet method; using a dry grinder with vacuum to control dust; or _____>>**. ******800 grit level produces a decent shine. Go down to 400 grit for projects with smaller budgets. Go up to 1200 or higher grit for extremely polished floors if budget allows.******

C. Apply grout to fill voids exposed from grinding.

D. Remove grout coat by grinding, using a fine grit abrasive.

E. Hand grind vertical and curved surfaces similarly.

3.05 TOLERANCES

A. Maximum Variation from Flat Surface: 1/4 inch in 10 feet.

B. Maximum Variation from Level (Except Surfaces Sloping to Drain): 1/8 **<< 1/8 inch; or ____ inch>>**.

3.06 FIELD QUALITY CONTROL

A. Provide on-site inspection by terrazzo manufacturer's representative at minimum two times during installation of this work. Installing Contractor shall notify manufacturer of installation start date and scheduling. Manufacturer's representative shall provide written copies of inspection reports within 10 days of inspection date.

1. The first inspection shall be of the mockup, or, if no mockup is specified, of the first 100 square feet of the install.
2. The second inspection shall be at substantial completion.
3. The installing contractor shall be responsible for immediate repairs or corrections to the work.

3.07 CLEANING

A. Scrub and clean terrazzo surfaces with neutral pH cleaner in accordance with manufacturer's instructions. Let dry.

B. Immediately after terrazzo has dried, apply sealer in accordance with NTMA and manufacturer's instructions.

C. Polish surfaces in accordance with manufacturer's instructions.

3.08 PROTECTION

A. Do not allow traffic on installed terrazzo for the period required by manufacturer's instructions, or 24 hours, whichever is longer.

B. Protect finished terrazzo from damage due to subsequent construction until Date of Substantial Completion.

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C. Leave the finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective terrazzo work. Repair or replace defective terrazzo work to attain the specified NTMA standards for finished work. **<< The party responsible for the damaged or otherwise non-conforming work shall be responsible for the cost of repairs.; or None - N/A>>**

END OF SECTION 096623

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SECTION 096700
RESINOUS FLOORING AND WALLS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

B. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

F. ASTM F3010 - Standard Practice for Two-Component Resin Based Membrane-Forming Moisture Mitigation Systems for Use Under Resilient Floor Coverings.

G. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

H. SCAQMD 1113 - Architectural Coatings.

1.02 ADMINSTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene at project site seven calendar days prior to scheduled beginning of construction activities of this section to review section requirements.

1. Require attendance by representatives of manufacturer's technical representative, **<< installer; _____; and other entities directly affecting, or affected by, construction activities of this section>>**.
2. Review preparation, primers, installation methods, curing requirements, protection measures, and project cleaning requirements for each resinous system.
3. Notify Owner and **<<Architect>>** seven calendar days in advance of scheduled meeting date.

1.03 SUBMITTALS

A. Product Data: Provide technical data on specified products, describing physical and performance characteristics, sizes, patterns and colors available.

B. Selection Samples: Provide manufacturer's color charts illustrating full range of patterns and colors for each flooring material.

C. Verification Samples: Manufacturer's standard size physical samples, on rigid backing, illustrating each selected pattern and color. Verify that texture, clear coating thickness, and sheen is acceptable to the Owner and Architect prior to installation.

D. Sustainability Submittals: Refer to Division 01, "Sustainable Design Requirements."

E. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

F. Manufacturer's Installation Instructions: Indicate **<< special procedures; perimeter conditions requiring special attention; application rate for each coat; and _____>>**.

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G. Manufacturer's Qualification Statement: Include signed certificates of each resinous flooring component.

H. Applicator's Qualification Statement.

I. Field Quality Control Reports: Submit inspection reports of manufacturer's technical representative.

1.04 CLOSEOUT SUBMITTALS

A. Maintenance Data: Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.

B. Warranty Documentation.

1.05 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the work of this section; certified and approved by manufacturer in writing.
   1. Approved and certified by manufacturer for application of resinous systems.
   2. Employs persons trained and approved by manufacturer for application of resinous systems.

1.06 MOCK-UPS

A. Construct mock-up(s) of fluid applied flooring to serve as basis for evaluation of texture and workmanship.
   1. Number of Mock-Ups to be Prepared: One.
   2. Use same materials and methods for use in the work.
   3. Use approved design samples as basis for mock-ups.
   4. Locate where directed by Architect.
   5. Minimum Size: 48 inches by 48 inches.

B. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

C. Obtain approval of mock-up by **<<Architect>>** before proceeding with work.

D. Approved mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver in manufacturer's original unopened packaging and containers with manufacturer's name and instructions for storing.

B. Store resin materials in a dry, secure area.

C. Store materials for three days prior to installation in area of installation to achieve temperature stability.

1.08 FIELD CONDITIONS

A. Maintain minimum temperature in storage area of 55 degrees F.

B. Store materials in area of installation for minimum period of 24 hours prior to installation.

C. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

D. Provide or simulate permanent lighting conditions during installation.

E. Prevent traffic during resinous system application for a minimum of 24 hours or manufacturer's suggested time, whichever is greater.

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1.09 WARRANTY

A. Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of resinous flooring system that fail in materials or workmanship withing a period of 3 years from date of acceptance by Owner or Substantial Completion, whichever is later.

PART 2 PRODUCTS

2.01 SOURCE LIMITATIONS

A. Obtain primary system components from a single source and a single manufacturer. Primary system materials include, but are not limited to, primers, resins, hardening agents, grouting coats, topcoats, and decorative flakes.

B. Obtain secondary system components from manufacturer's recommended source. Secondary system materials include, but are not limited to, patching and fill material, joint sealant, and repair materials.

2.02 FLUID-APPLIED FLOORING<< AND WALL; OR NONE - N/A>> SYSTEMS

A. ******MCPS prefers this product for stairs. Solid color polyurethane cement slurry. Use also in kitchens and showers.****** Fluid-Applied Flooring: Polyurethane cement slurry base coat(s) with broadcast aggregate.
   1. Aggregate: Fine silica sand.
   2. System Thickness: 1/4 inch, nominal, dry film thickness (DFT).
   3. VOC Content: Maxiumum 50 g in accordance with **<<SCAQMD 1113>>**.
   4. Texture: Slip resistant.
   5. Sheen: **<< High gloss; Gloss; Satin; Matte; or _____>>**.
   6. Color: To be selected by **<<Architect>>** from manufacturer's full range.
   7. Products:
      a. Elite Crete Systems; Hermetic 4.8S Urethane Cement Slurry.
      b. FlowResin, a Key Resin Company; FlowFresh SR System.
      c. Key Resin Company; Key Urecon SLT System.
      d. Neogard; Neocrete SL.
      e. PPG Flooring; 700 SL Urethane Cement with 700 UV Urethane top coat.
      f. Resinwerks; Bio-Chem SL.
      g. Sherwin-Williams Company; Poly-Crete SLB.
      h. Sika Corporation; Sikafloor PurCem Self-Leveling Broadcast System. ******MCPS preferred Basis of Design.******
      i. TNEMEC; Ultra-Tread ExcellaThane Pigmented High-Wear System.
      j. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. ******Decorative flake polyurethane cement slurry. Use for stairs, locker rooms, and group bathrooms.****** Fluid-Applied Flooring : Cementitious polyurethane moisture tolerant with broadcase aggregate.
   1. Aggregate: Vinyl flakes and fine silica sand.
   2. Top Coat: Manufacturer's recommended polyurethane.
   3. System Thickness: 1/8 inch, nominal, dry film thickness (DFT).
   4. VOC Content: Maximum 50 g/L in accordance with **<<SCAQMD 1113>>**.

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5. Texture: Slip resistant.
6. Sheen: **<< <u>High gloss</u>; Matte; or _____>>**.
7. Color: To be selected by **<<Architect>>** from manufacturer's full range.
8. Products:
   a. FlowResin, a Key Resin Company; FlowFresh Ultra Flakes System.
   b. Key Resin Company; Key Urecon Chip/Flake #100 System.
   c. Neogard; Neoflake All Polyurethane System.
   d. Sika Corporation; Sikafloor Decoflake UEF System.
   e. Stonhard, Inc; Stontec TRF.
   f. TNEMEC; Ultra-Tread ExcellaThane Flake System.
   g. Substitutions: **<< <u>See Section 016000 - Product Requirements</u>; or Not permitted>>**.

C. ******Waterproofing system, solid color polyurethane or epoxy system. Use for stacked group bathrooms, stacked showers, or locker rooms at indoor pools.****** Fluid-Applied Flooring: Waterproof, crack-bridging, elastomeric epoxy or polyurethane with urethane top coat.
1. System Thickness: 1/8 inch, nominal, dry film thickness (DFT).
2. VOC Content: Maximum 50g/L in accordance with **<<SCAQMD 1113>>**.
3. Texture: Slip resistant.
4. Sheen: **<< <u>High gloss</u>; Matte; or _____>>**.
5. Color: To be selected by **<<Architect>>** from manufacturer's full range.
6. Products:
   a. Neogard; Peda-Gard.
   b. Sherwin-Williams Company; Resuflor Gard MR.
   c. Sika Corporation; Sikafloor Merflex-PS.
   d. Stonhard, Inc; Stongard MD.
   e. TNEMEC; Sub-Flex EP MER System.
   f. Substitutions: **<< <u>See Section 016000 - Product Requirements</u>; or Not permitted>>**.

D. ******Wall system, integrates seamlessly with floor resinous system. Use on shower walls.****** Fluid-Applied Wall System: Polyurethane or epoxy primer**<< <u>and CMU block filler</u>; or None - N/A>>** base coat(s) and pigmented polyurethane top coats. ******Indicate CMU block filler for CMU walls or None for gypsum walls.******
1. System Thickness: 11 mils, nominal, dry film thickness (DFT).
2. VOC Content: Maximum 50 g/L in accordance with **<<SCAQMD 1113>>**.
3. Texture: **<< Slip resistant; Orange peel; <u>Smooth</u>; or _____>>**.
4. Sheen: **<< High gloss; Gloss; <u>Satin</u>; Matte; or _____>>**.
5. Color: To be selected by **<<Architect>>** from manufacturer's full range.
6. Products:
   a. Key Resin Company; Epoxy/Urethane Wall System.
   b. Neogard; Wall-Gard HD.
   c. Sherwin-Williams; Resuwall Aqua.
   d. Sika Corporation; Sikagard-WB.
   e. TNEMEC; Enviro-Glaze Series 297 Top Coat with Enviro-Crete Series 156 Primer and Block Filler.

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f. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.03 ACCESSORIES

A. Base Caps: **<< Zinc; Brass; Extruded anodized aluminum; Extruded mill finished aluminum; Extruded rigid PVC; or _____>>** with projecting base of 1/8 inch; color as selected by Architect. ******Indicate base caps when wall finish is a different thickness than base.******

B. Feathered Base: Integral wall base feathered down to transition seamlessly to the wall finish. ******Indicate feathered base when base dies into adjacent wall finish.******

C. Fillet Strips: Molded of flooring resin material.

D. Crack Isolation: Manufacturer's recommended urethane elastomer membrane for protecting fluid-applied floor system against cracking.

E. Joint Control: Manufacturer's recommended polyurethane sealant and backer rod to limit damage from moving joints in the floor.

F. Subfloor Filler: Type recommended by fluid-applied flooring manufacturer.

G. Block Filler: Type recommended by fluid-applied material manufacturer for concealing stricklines in CMU walls.

H. Primer: Type recommended by fluid-applied flooring manufacturer.

I. Moisture Vapor Treatment: Where fluid-applied flooring and accessories are installed over concrete slabs, provide alkaline-resistant product designed to control excessive moisture vapor transmission through concrete slab, per the following:

1. Products: Provide product approved by flooring manufacturer and complying with performance requirements below, equivalent to one of the following:
   a. Duraamen Engineered Products, Inc.; Perdure MVT.
   b. Maxxon Corporation; Maxxon MVP.
   c. Tnemec Company Inc.; Epoxoprime MVT, Series 208.
2. Performance Requirements:
   a. Verify with flooring manufacturer that submitted product maintains compliance with all provisions of flooring manufacturer’s warranty.
   b. Low-VOC: Provide product with VOC content less than 15 g/L.
   c. Bond Strength to Concrete: Minimum 400 psi per **<<ASTM D4541>>** (100% concrete failure).
   d. Permeance: Maximum 0.1 perm per **<<ASTM E96/E96M>>**, and 0.10 grains/hr/ft^2/in-Hg, per **<<ASTM F3010>>**.
   e. Applications: Provide MVT for all concrete slabs on-grade and lightweight concrete elevated slabs.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive flooring.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive flooring.

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C. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of materials to subfloor surfaces, including laitance, glaze, efflorescence, curing compounds, form-release agents, grease, and oil.

D. Cementitious Subfloor Surfaces: Install manufacturer's recommended moisture vapor treatment at all locations to receive fluid-applied floor finish in accordance with manufacturer's instructions.

E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Remove subfloor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with subfloor filler.

B. Prepare concrete surfaces according to **<<ICRI 310.2R>>**, CSP 4, minimum, unless otherwise required by manufacturer's installation requirements.

1. Abrade the concrete surface through shot-blasting by vacuum pickup and in accordance with manufacturer's instructions.
2. Repair damaged and deteriorated surfaces to a quality acceptable by manufacturer for resinous system installation.
3. Test as Follows: Perform one of each test per 1,000 sf of installation area.
   a. Alkalinity (pH): **<<ASTM F710>>** in accordance with manufacturer's instructions.
   b. Internal Relative Humidity: **<<ASTM F2170>>**, using in situ probes. Acceptable maximum of 75 percent relative humidity.
   c. Moisture Vapor Emission: **<<ASTM F1869>>**, anhydrous calcium chloride test. Acceptable maximum moisture vapor emission rate of 5 pounds of water for every 1000 square feet in 24 hours.
4. If test results are not within limits recommended by flooring manufacturer, apply moisture vapor treatment (MVT) in accordance with manufacturer's requirements.
5. After testing is complete, prepare concrete and install moisture vapor treatment (MVT) in accordance with manufacturer's written instructions. If testing indicates measurements are within acceptable levels for flooring installation with the need for MVT, the MVT may be omitted where approved by the Architect.

C. Apply crack isolation compound to concrete slab in accordance with flooring manufacturer's instructions.

D. Apply, trowel, and float filler to achieve smooth, flat, hard floor surface. Grind irregularities above the surface level **<< Grind irregularities above the surface level. ; or None - N/A>>**Prohibit traffic until filler is cured.

E. Apply, trowel, and float block filler to achieve smooth, flat, hard wall surface. Grind irregularities above the surface level. Protect wall until filler is cured.

F. Vacuum clean substrate.

G. Apply primer to surfaces required by flooring manufacturer.

H. Mix resinous system components in accordance with manufacturer's instructions.

3.03 INSTALLATION - ACCESSORIES

A. Install fillet strips at base of walls and corners where flooring is to be extended up wall as base.

B. Install joint control sealant and backer rod where indicated on Drawings in accordance with flooring manufacturer's instructions.

C. Install terminating cap strip at top of base; attach securely to wall substrate.

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3.04 INSTALLATION - FLOORING<< AND WALLS; OR NONE - N/A>>

A. Apply in accordance with manufacturer's instructions.

B. Apply each coat to minimum thickness required by manufacturer and confirm optimum adhesion between coats and to substrate.

C. Finish to smooth level surface.

D. Install flooring to the center of cased openings, and into door openings such that the transition to other floor material occurs under the center of the door leaf. Where transitions occur to another flooring material, extend resinous flooring to suit transition.

E. Cove at vertical surfaces and corners**<< and cap with metal base trim; and feather top of base for a seamless transition; or None - N/A>>**.

F. Allow the recommended amount of time for curing and prevent contamination of system while it cures.

3.05 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Provide services of manufacturer's technical representative to inspect for proper installation of fluid-applied flooring system and submit inspection report.

C. Owner may require material samples for testing in compliance with requirements at any time and as frequently as desired.

1. Owner shall engage qualified third party testing agency to take and test samples for compliance with requirements in accordance with referenced testing standards or manufacturer's product data.
2. Contractor shall pay for samples resulting in noncompliance, removal of noncomplying materials, preparation of surfaces, and reapplication of resinous systems in compliance with requirements.

3.06 PROTECTION

A. Prohibit traffic on floor finish for minimum 48 hours after installation. Cover flooring with materials in accordance with manufacturer's instructions.

B. Barricade area to protect flooring**<< and wall system; or None - N/A>>** until fully cured.

END OF SECTION 096700

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SECTION 096813
TILE CARPETING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials.

B. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

C. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

D. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.

E. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

F. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

G. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

H. ASTM F3010 - Standard Practice for Two-Component Resin Based Membrane-Forming Moisture Mitigation Systems for Use Under Resilient Floor Coverings.

I. CRI (GLP) - Green Label Plus Testing Program - Certified Products.

J. ILFI (DEC) - International Living Future Institute 'Declare' Program.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Substitutions/Prequalification: Manufacturers seeking consideration to bid their product as an acceptable alternative shall provide full product data and full range of selection samples during the bid period. Products that do not meet the technical and aesthetic criteria will not be accepted. No substitutions shall be permitted for carpet tile after receipt of bids.

1.03 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

B. Shop Drawings: Indicate **<< layout of joints; direction of carpet pile; dye lot; location of edge moldings; layout of flat wire system; and _____>>** and transition strips.

1. Where multiple carpet tile products are specified (including multiple products in a single space installed in an indicated pattern), indicate on the shop drawings the locations where each product is being installed.

C. Selection Samples: Submit manufacturer's color charts indicating full range of colors for carpet tiles and for accessories.

D. Verification Sample: Submit full size sample for each required color, pattern, and texture.

1. Submit samples in manufacturer's standard size for each accessory product.

E. Sustainable Design Submittal: Submit VOC content documentation for adhesives.

F. Sustainable Design Submittal: Submit a copy of **<<ILFI (DEC)>>** Declare Label for each product.

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G. Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
   1. Include specific procedures and materials that are not recommended, including those that may be harmful to carpet tile or that would void warranty.

H. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.
   1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
   2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.04 QUALITY ASSURANCE

A. Critical Radiant Flux: All carpet tiles shall be Class I rated, with a minimum CRF of 0.45 watts/sq cm, when tested by an independent testing agency in accordance with **<<ASTM E648>>** or **<<NFPA 253>>**.

1.05 FIELD CONDITIONS, STORAGE AND HANDLING

A. Comply with the Carpet and Rug Institute (CRI) Publication "CRI 104 - Standard for Installation of Commercial Carpet." Comply with Section 4.0 for storage and handling, Section 7.0 for ambient temperature and ventilation, and Section 9.0 for Product Acclimation.

1.06 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Carpet Tile Warranty: Provide a ten (10) year manufacturer warranty, covering defective material and faulty installation.
   1. Warranty shall cover excessive surface wear (defined as more than 10% loss by weight of face fiber), edge raveling, backing separation, shrinking, stretching, cupping, doming, static electricity, or color loss or fading.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Tile Carpeting: Provide the basis-of-design carpet tiles or a prequalified alternate tile. No substitutions will be considered after the award of Contract. ******If using this paragraph, turn off Manufacturers paragraph below.******

B. Manufacturers:
   1. Bentley Mills.
   2. EF Contract.
   3. Interface, Inc.
   4. J&J Flooring.
   5. Mannington Commercial.
   6. Milliken & Company.
   7. Mohawk Group.
   8. Patcraft.
   9. Shaw Contract.
   10. Tarkett.
   11. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

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2.02 MATERIALS

A. Tile Carpeting: **<< Tufted; Fusion bonded; or _____>>**, manufactured in one color dye lot.
   1. Product: **<< _____>>** manufactured by **<< _____>>**.
   2. Tile Size: **<< 12 by 24 inch; 24 by 24 inch; 9 by 36 inch; 18 by 18 inch; 18 by 36 inch; or ____by____ inch>>**, nominal.
   3. Color: **<< _____>>**.
   4. Pattern: **<< _____>>**.
   5. Critical Radiant Flux: Minimum of 0.45 watts/sq cm, when tested in accordance with **<<ASTM E648>>** or **<<NFPA 253>>**.
   6. Surface Flammability Ignition: Pass **<<ASTM D2859>>** (the "pill test").
   7. Sustainability Requirement: Provide **<<ILFI (DEC)>>** certified Red-List Free product.
   8. VOC Content: Provide **<<CRI (GLP)>>** certified product**<< ; in lieu of labeling, independent test report showing compliance is acceptable; or None - N/A>>**.
   9. Pile Weight: **<< ____ oz/sq yd>>**.
   10. Primary Backing Material: **<< Polypropylene; or Manufacturer's standard; recycled vinyl with fiberglass reinforcing>>**.

2.03 ACCESSORIES

A. Subfloor Filler: Type recommended by flooring material manufacturer.

B. Edge Strips: **<< Embossed aluminum; or Rubber>>**, color as selected by Architect.

C. Moisture Vapor Treatment: Where carpeting and accessories are installed over concrete slabs, provide alkaline-resistant product designed to control excessive moisture vapor transmission through concrete slab, per the following:
   1. Products: Provide product approved by flooring manufacturer and complying with performance requirements below, equivalent to one of the following:
      a. Duraamen Engineered Products, Inc.; Perdure MVT.
      b. Maxxon Corporation; Maxxon MVP.
      c. Tnemec Company Inc.; Epoxoprime MVT, Series 208.
   2. Performance Requirements:
      a. Verify with flooring manufacturer that submitted product maintains compliance with all provisions of flooring manufacturer's warranty.
      b. Low-VOC: Provide product with VOC content less than 15 g/L.
      c. Bond Strength to Concrete: Minimum 400 psi per **<<ASTM D4541>>** (100% concrete failure).
      d. Permeance: Maximum 0.1 perm per **<<ASTM E96/E96M>>**, and 0.10 grains/hr/ft^2/in-Hg, per **<<ASTM F3010>>**.
      e. Applications: Provide MVT for all concrete slabs on-grade and lightweight concrete elevated slabs.

D. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

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B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
   1. Test as Follows: Perform one of each test per 1,000 sf of installation area.
      a. Alkalinity (pH): **<<ASTM F710>>**.
      b. Internal Relative Humidity: **<<ASTM F2170>>**.
      c. Moisture Vapor Emission: **<<ASTM F1869>>**.
   2. If test results are not within limits recommended by flooring manufacturer, apply moisture vapor treatment (MVT) in accordance with manufacturer's requirements.
   3. After testing is complete, prepare concrete and install moisture vapor treatment (MVT) in accordance with manufacturer's written instructions. If testing indicates measurements are within acceptable levels for flooring installation with the need for MVT, the MVT may be omitted where approved by the Architect.

D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Remove existing carpet tile.

B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

C. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.

D. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install carpet tile in accordance with manufacturer's instructionsand**<<CRI 104>> << and CRI 104 (Commercial); and CRI 105 (Residential); and _____; or None - N/A>>**.

C. To ensure minimal color variation, ensure that each space/room uses only carpet from the same dye lot.

D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

E. Lay carpet tile in square pattern, with pile direction **<< parallel; or alternating>>** to next unit, set **<< parallel to building lines; aligned as indicated on shop drawings; or _____>>**, unless otherwise indicated.

F. Locate change of color or pattern between rooms or at transitions to other finish flooring material directly under the door leaf centerlines, or at the center of cased openings.

G. Fully adhere carpet tile to substrate.

H. Install carpet tile into wall recesses, knee spaces under cabinets or countertops, closets, and other similar spaces.

I. Trim carpet tile neatly at walls and around interruptions.

J. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING AND PROTECTION

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

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B. Clean and vacuum carpet surfaces.

C. Protect installed carpet in accordance with CRI 104, Section 13.7 "Post Installation."

END OF SECTION 096813

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SECTION 096817
TEXTILE COMPOSITE FLOORING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AATCC Test Method 16 - Colorfastness to Light.

B. AATCC Test Method 134 - Test Method for Electrostatic Propensity of Carpets.

C. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials.

D. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

E. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

F. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.

G. ASTM E662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.

H. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

I. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

J. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

K. ASTM F3010 - Standard Practice for Two-Component Resin Based Membrane-Forming Moisture Mitigation Systems for Use Under Resilient Floor Coverings.

L. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

M. CRI (GLP) - Green Label Plus Testing Program - Certified Products.

N. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

O. SCAQMD 1168 - Adhesive and Sealant Applications.

1.02 DEFINITION

A. Textile Composite Flooring: A hybrid floor covering consisting of a tufted loop nylon or polyester fiber wear layer thermally fused to a cushioned polyester backing, commonly referred to as textile composite flooring (TCF), vinyl cushion tufted textile (VCTT), or tufted textile flooring.

1.03 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

B. Shop Drawings: Showing the extent of installation, seam direction of TCF, and accessories. Check pattern match, if any, for matching during installation and possible waste factors in ordering required amounts. Show TCF dye lot. Indicate built in items such as casework, columns, and doorways, and locations where cutouts are required in TCF.

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1. Maintain a copy of approved shop drawings on site during installation, available for review by Owner and Architect.

C. Selection Samples: Submit manufacturer's standard color charts illustrating color and pattern design for each TCF product specified.

D. Sustainable Design Submittal: Submit VOC content documentation for adhesives.

E. Manufacturer's Installation Instructions: Indicate **<< special procedures; perimeter conditions requiring special attention; and _____>>**.

F. Manufacturer's Qualification Statement.

G. Installer's Qualification Statement.

H. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

I. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.
1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
2. Extra TCF Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed, but not less than 10 square yards.

J. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified textile composite flooring. Manufacturer shall have a technical field representative available for field observation and inspection.

B. Installer Qualifications: Company specializing in installing textile composite flooring, and complying with following:
1. Installer shall be a specialty contractor normally engaged in the installation of TCF flooring, with prior experience installing these floor materials. Flooring contractor shall submit a list of installers certified by TCF manufacturer prior to bid.
2. Flooring contractor shall be responsible for proper product installation, including floor substrate testing and preparation, in accordance with manufacturer's requirements and specifications.

1.05 FIELD CONDITIONS

A. Do not deliver or install until building is enclosed and HVAC system is operating at occupancy conditions.

B. Store materials in area of installation for minimum period of 24 hours prior to installation.

1.06 WARRANTY

A. Manufacturer's Warranty: The TCF warranty shall be the sole source responsibility of the manufacturer. Second source warranties or warranties that involve parties other than the TCF manufacturer are unacceptable.
1. Warranty Term: 10 years minimum.
2. In the event of failure due to material or workmanship, the warranty shall cover either repair or removal and replacement at manufacturer's discretion.
3. The warranty shall not exclude TCF installed on stairs, provided the product installation was approved by manufacturer's field representative during final inspection, and provide the product was properly maintained.

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4. Wear Layer Warranty: Shall specifically define and cover against the following:
   a. Product performance.
   b. Colorfastness to light and crocking.
   c. Stain removal.
   d. Static protection.
   e. Zippering.
5. Backing Layer Warranty: Shall specifically define and cover against the following:
   a. Edge ravel.
   b. Delamination.
   c. Dimensional stability.
6. A 'tuft bind' warranty in lieu of edge ravel and zippering is not acceptable.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Textile Composite Flooring ("TCF"):
   1. J&J Flooring Group, Inc.; Kinetex.
   2. EF Contract Flooring; Kinetex.
   3. Forbo Flooring, Inc.; Flotex.
   4. Patcraft; Walk Right In II.
   5. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.02 PERFORMANCE CHARACTERISTICS

A. The following performance characteristics shall be met by all products:
   1. Critical Radiant Flux: Minimum of 0.45 watts/sq cm, when tested in accordance with **<<ASTM E648>>** or **<<NFPA 253>>**.
   2. Surface Flammability Ignition: Pass Federal Flammability CPSC FF 1-70 (also referenced as **<<ASTM D2859>>** - the "pill test").
   3. Maximum Electrostatic Charge: Pass **<<AATCC Test Method 134>>** (Step & Scuff): 3 Kv. or less at 20 percent relative humidity.
   4. Smoke Density: **<<ASTM E662>>** / NFPA 258: < 450 Flaming Mode.
   5. Static Coefficient of Friction: ASTM C1028: Passes ADA Guidelines for Accessible Routes (Minimum 0.60).
   6. Delamination of Secondary Backing of Pile Floor Coverings: ASTM D3936: Minimum 15 lbs.
   7. Lightfastness: **<<AATCC Test Method 16>>**: > 4 @ 100 hours.
   8. Vetterman Drum: ASTM D5417: Minimum 3 @ 22,000 cycles.
   9. Seam Integrity: Seam to remain intact after 50,000 cycles per Phillips Chair Test.

B. Low-Emitting Materials:
   1. Flooring Products: Flooring products shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>**.
   2. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet the chemical content requirements of **<<SCAQMD 1168>>**.

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2.03 MATERIALS

A. Textile Composite Flooring: Tufted or flocked, manufactured in one color dye lot.
   1. Product: **<< _____>>** manufactured by **<< _____>>**.
   2. Tile Size: **<< 24 by 24 inch; 18 by 36 inch; or ____by____ inch>>**, nominal.
   3. Color: **<< _____; or As selected by Architect from manufacturer's full range>>**.
   4. Pattern: **<< _____>>**.
   5. VOC Content: Provide **<<CRI (GLP)>>** certified product; in lieu of labeling, independent test report showing compliance is acceptable.
   6. Wear Layer: Manufacturer's standard, polyester or nylon.
   7. Primary Backing Material: 100% polyester felt cushion.

2.04 ACCESSORIES

A. Subfloor Filler: Type recommended by flooring material manufacturer.

B. Edge Strips: **<< Embossed aluminum; or Rubber>>**, color as selected by Architect.

C. Moisture Vapor Treatment: Where textile composite floor and accessories are installed over concrete slabs, provide alkaline-resistant product designed to control excessive moisture vapor transmission through concrete slab, per the following:
   1. Products: Provide product approved by flooring manufacturer and complying with performance requirements below, equivalent to one of the following:
      a. Duraamen Engineered Products, Inc.; Perdure MVT.
      b. Maxxon Corporation; Maxxon MVP.
      c. Tnemec Company Inc.; Epoxoprime MVT, Series 208.
   2. Performance Requirements:
      a. Verify with flooring manufacturer that submitted product maintains compliance with all provisions of flooring manufacturer's warranty.
      b. Low-VOC: Provide product with VOC content less than 15 g/L.
      c. Bond Strength to Concrete: Minimum 400 psi per **<<ASTM D4541>>** ASTM D 4541 (100% concrete failure).
      d. Permeance: Maximum 0.1 perm per **<<ASTM E96/E96M>>**, and 0.10 grains/hr/ft^2/in-Hg, per **<<ASTM F3010>>**.
      e. Applications: Provide MVT for all concrete slabs on-grade and lightweight concrete elevated slabs.

D. Adhesive: Recommended by textile composite flooring manufacturer; releasable type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive textile composite flooring.

B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
   1. Test as Follows: Perform one of each test per 1,000 sf of installation area.
      a. Alkalinity (pH): **<<ASTM F710>>**.

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b. Internal Relative Humidity: **<<ASTM F2170>>**.

c. Moisture Vapor Emission: **<<ASTM F1869>>**.

2. After testing is complete, prepare concrete and install moisture vapor treatment (MVT) in accordance with manufacturer's written instructions. If testing indicates measurements are within acceptable levels for flooring installation with the need for MVT, the MVT may be omitted where approved by the Architect.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.

C. Apply moisture vapor treatment (MVT) in accordance with manufacturer's instructions.

D. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install TCF in accordance with manufacturer's instructions.

C. Cut TCF tile clean. Fit TCF tight to intersection with vertical surfaces without gaps.

D. Lay TCF tile in square pattern, with pile direction **<< parallel; or alternating>>** to next unit, set **<< parallel to building lines; aligned as indicated on shop drawings; or _____>>**.

E. To ensure minimal color variation, ensure that each space/room uses only carpet from the same dye lot.

F. Locate change of color or pattern or transition trim between rooms under door centerline.

G. Fully adhere TCF tile to substrate.

1. Free-lay and stretch-in installations are not acceptable.

H. Trim TCF neatly at walls and around interruptions.

I. Complete installation of edge strips, concealing exposed edges.

3.04 FIELD QUALITY CONTROL

A. Engage manufacturer's technical field representative to observe during substrate preparation and during installation, and to provide a final inspection after completion.

B. Remove and replace TCF where manufacturer's field inspection indicates that installation is not in compliance with the specified requirements or with manufacturer's instructions.

3.05 CLEANING AND PROTECTION

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum TCF surfaces.

C. Protect installed TCF from heavy construction traffic, soiling, and damage for the remainder of the construction period.

END OF SECTION 096817

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SECTION 097200
WALL COVERINGS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Coating Systems.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

C. ASTM F793/F793M - Standard Classification of Wall Coverings and Ceiling Coverings by Use Characteristics.

D. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

E. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.

F. GA-214 - Levels of Finish for Gypsum Panel Products.

G. SCAQMD 1168 - Adhesive and Sealant Applications.

1.02 SUBMITTALS

A. Product Data: Manufacturer's data sheets for wall covering**<< and adhesive; _____; or None - N/A>>**. Indicate compliance with specified flame spread and smoke developed ratings.

B. Shop Drawings: Indicate wall elevations with seaming layout.

C. Selection Samples: Provide manufacturer's full range of color and pattern information.

D. Verification Samples: Submit physical samples of each type of wall covering, illustrating color, finish, and texture; samples shall be full width by minimum 36 inches long.

E. Manufacturer's Instructions: Indicate installation **<< special procedures; perimeter conditions requiring special attention; and _____>>**.

F. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in project maintenance:

1. See Section **<< 016000 - Product Requirements>>** for additional provisions.
2. Extra Stock Materials: 25 feet of each color and pattern of wall covering.
   a. Package and label each roll by manufacturer, color, pattern, and destination room number.

1.03 MOCK-UPS

A. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

B. Provide panel, approximately 10 feet wide, full height, illustrating installed **<< wall covering; joint seaming technique; and _____>>**. Include inside and outside corner, as applicable.

C. Locate where directed by Architect.

D. Mock-up may remain as part of work.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Inspect roll materials for damage upon arrival.

B. Protect packaged adhesive from temperature cycling and cold temperatures.

C. Do not store roll goods on end.

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1.05 FIELD CONDITIONS

A. Maintain adhesive and wall covering manufacturer's recommended temperature ranges 24 hours before, during, and after installation.

B. Provide lighting level of 80 fc measured mid-height at substrate surfaces.

PART 2 PRODUCTS

2.01 WALL COVERINGS

A. Performance Requirements:

1. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 50, maximum, when tested in accordance with **<<ASTM E84>>**.
2. Chemical and Stain Resistance: No visible staining or discoloration and no damage to surface texture when tested in accordance with **<<ASTM D1308>>**.
3. Low-Emitting Materials:
   a. Paints and Coatings: Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet applicable VOC limits of **<<CARB (SCM)>>** or **<<SCAQMD 1113>>**.
   b. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet the chemical content requirements of **<<SCAQMD 1168>>**.

B. Wall Covering: Fabric-backed vinyl roll stock.

1. Comply with **<<ASTM F793/F793M>>**, Category **<< V, Type II; VI, Type III; or _____>>**.
2. Roll Width: 52 inches, minimum.
3. Backing: **<< Woven, osnaburg; Nonwoven, synthetic; or _____>>** fabric.
4. Backing Color: White.
5. Pattern: .
6. Pattern Match: **<< As indicated on drawings; Book; Random; Straight; or _____>>**.
7. Repeat: **<< 1 inch; 52 inches; or _____ inches>>**, **<< horizontally; vertically; or _____>>**.
8. Surface Texture: **<< Embossed; Smooth; or _____>>**.
9. Overcoating: Manufacturer's standard coating for stain resistance.
10. Manufacturers:
    a. F. Schumacher & Co.
    b. Koroseal/RJF International.
    c. Momentum Wallcoverings
    d. MDC Wallcoverings.
    e. National Wallcovering.
    f. Wolf-Gordon.
    g. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.02 DRY ERASE WALLCOVERINGS

A. Dry Erase Wallcovering: White pigmented vinyl or polyethylene sheet with dry erase film top layer on woven or paper backing.

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1. Type II wallcovering.
2. Sheen: Manufacturer's standard gloss or semi-gloss.
3. Products:
   a. Koroseal Interior Products, LLC; Walltalkers, Just-Rite White 60 inch - #JR60-00.
   b. MDC Interior Solutions; Standard Dry Erase Wallcovering - #DEW15105.
   c. Wolf-Gordon, Inc; Wink, SCRIBE Wallcovering.
   d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Dry Erase Wallcovering with Magnet: White pigmented vinyl or polyethylene sheet bonded to ferrous sheet with dry erase film top layer on woven or paper backing.
1. Type II wallcovering.
2. Sheen: Manufacturer's standard gloss or semi-gloss.
3. Products:
   a. Koroseal Interior Products, LLC; Walltalkers, Mag-Rite White 48 - #M248-00.
   b. MDC Interior Solutions; Magnet-Receptive Dry Erase Wallcovering - #DEW15103.
   c. Wolf-Gordon, Inc; Wink, MAGNETIC Wallcovering.
   d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

C. Adhesive: **<< Flexible dry erase surface manufacturer's approved heavy-duty pre-mixed clay-based wallcovering adhesive; Flexible dry erase surface manufacturer's approved heavy-duty clay adhesive or extreme tack/vinyl over vinyl adhesives; ___; or None - N/A>>**.

D. Substrate Primer/Sealer: white acrylic base stain-blocking primer and sealer formulated for use with vinyl and/or polyester flexible dry erase surfaces in accordance with manufacturer's recommendations.

E. Aluminum Finishing Pieces:
1. Tray: Manufacturer's standard anodized snap-on marker and eraser tray with clips and end caps.
2. Trim: Manufacturer's standard anodized snap-on trim with clips.
3. J-Cap: Manufacturer's standard anodized low profile wallcovering trim.
4. Display rail: Manufacturer's standard anodized clip rail.

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2.03 ACCESSORIES

A. Adhesive: Type recommended by wall covering manufacturer.

B. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify substrate surfaces are primed and meet manufacturer's requirements to receive work.

B. Measure moisture content of substrates with electronic moisture meter. Do not apply wall coverings if moisture content of substrate exceeds level recommended by wall covering manufacturer.

C. Verify flatness tolerance of surfaces does not vary more than 1/8 inch in 10 feet or at rate greater than 1/16 inch/ft.

D. Notify **<<Architect>>** of detrimental conditions affecting wall covering installation.

E. Correct detrimental conditions before starting installation.

F. Wall surfaces receiving dry erase wallcovering shall be prepared to a Level 5 finish in accordance with **<<GA-214>>**.

3.02 PREPARATION

A. Remove wall plates and accessories impeding wall covering installation.

B. Wash impervious surfaces with **<< tetra-sodium; tri-sodium; or _____>>** phosphate; rinse and neutralize; wipe dry.

C. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings before preparing surfaces or finishing.

D. Surfaces: Correct defects and clean surfaces that affect work of this section. Remove existing coatings that exhibit loose surface defects.

E. Vacuum surfaces to remove loose particles.

3.03 INSTALLATION - WALLCOVERING

A. Apply adhesive and wall covering in accordance with manufacturer's instructions.

B. Apply adhesive to wall immediately before applying wall covering.

C. Use wall covering **<< in roll number sequence; in pattern sequence; or _____>>**.

D. Razor trim edges of wall covering. Do not razor trim on gypsum board surfaces.

E. Smoothly apply wall covering without wrinkles, gaps, or overlaps. Eliminate air pockets and ensure full bond to substrate surface.

F. Butt edges tightly.

G. Do not seam within 2 inches of internal corners or within 6 inches of external corners.

H. Install wall covering before installing **<< bases; cabinets; hardware; and _____>>** and items attached to, abutting, or located within 1 inch of wall surface.

I. Do not install wall covering more than 1/4 inch below top of resilient base.

J. Apply wall covering to **<< electrical; telephone; and _____>>** wall plates before replacing plates.

K. Remove excess adhesive from seams while wet and before proceeding to next wall covering sheet.

3.04 INSTALLATION - DRY ERASE WALLCOVERING

A. Install dry erase wallcovering in accordance with manufacturer's written instructions that are packaged with each roll of wallcovering.

B. Apply manufacturer's recommended primer to wall surface.

C. Apply manufacturer's recommended adhesive to wall surface immediately prior to application of dry erase wallcovering.

D. Razor trim edges on flat work table. Do not razor cut on the gypsum board surfaces.

E. Do not crease the dry erase surface.

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F. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface using a wallcovering smoother wrapped with a soft cloth. Do not use sharp edged smoothers on dry erase surface.

G. Butt edges tightly.

H. Seam the material out of the main writing and viewing areas of the wall. Do not seam within 2 inches of internal corners or within 6 inches of external corners.

I. Install dry erase wallcovering prior to installing aluminum trim, wall base, wall protection, or wainscot.

J. Remove excess adhesive immediately using a soft cloth in accordance with manufacturer's recommendations.

K. Allow wallcovering to cure for a minimum of 72 hours prior to initial use of dry erase surface.

L. Install aluminum trim in accordance with manufacturer's instructions.

3.05 CLEANING

A. See Section **<< 017000 - Execution and Closeout Requirements>>** for additional requirements.

B. Clean wall coverings of dust, dirt, excess adhesive, and other contaminants.

3.06 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 097200

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SECTION 098430
SOUND-ABSORBING WALL AND CEILING UNITS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

B. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

D. ASTM E795 - Standard Practices for Mounting Test Specimens during Sound Absorption Tests.

1.02 SUBMITTALS

A. Product Data: Manufacturer's printed data sheets for products specified.

B. Shop Drawings: Fabrication and installation details, **<< panel layout; fabric orientation; wood grain orientation; and _____>>**.

C. Selection Samples: Manufacturer's color charts for fabric covering, indicating full range of fabrics, colors, and patterns available.

D. Verification Samples: Fabricated samples of each type of panel specified; 12 inch by 12 inch, showing construction, edge details, and fabric covering.

E. Test Reports: Certified test data from an independent test agency verifying that panels meet specified requirements for acoustical and fire performance.

F. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.

1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
2. Extra Panels: Quantity equal to 5 percent of total installed, but not less than one of each type.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation.

B. Store units flat, in dry, well-ventilated space; do not stand on end.

C. Protect edges from damage.

1.04 MOCK-UPS

A. See Section **<< 014000 - Quality Requirements>>** for additional mock-up requirements.

B. Construct mock-up of acoustical units at location as indicated by **<<Architect>>**.

1. Minimum mock-up dimensions; 96 by 96 inches.
2. Mock-up may remain as part of work.

1.05 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Correct defective work within a two-year period for failure of materials or workmanship **<< _____; or failure of materials or workmanship>>** commencing on the Date of Substantial Completion.

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1. Failures include but are not limited to acoustic performance, fabric separation from core or fabric sagging, panel distortion or warping.

PART 2 PRODUCTS

2.01 FABRIC-COVERED SOUND-ABSORBING UNITS

A. Manufacturers:
   1. Acoustical Panel Systems, Inc. (APS); APS-R.
   2. Acoustical Solutions, Inc.; AlphaSorb.
   3. Armstrong Ceiling & Wall Solutions; Soundsoak.
   4. AVL Systems, Inc.; AcousTech.
   5. Decoustics, Ltd.; AP Acoustics Panel.
   6. LAMVIN; Sonic Standard Panel.
   7. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. General:
   1. Prefinished, factory assembled fabric-covered panels.
   2. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with **<<ASTM E84>>**.

C. Fabric-Covered Acoustical Panels for Walls:
   1. Panel Core: Manufacturer's standard rigid or semi-rigid fiberglass core.
   2. Core Density: 6 to 7 lb/cu ft.
   3. Sound Absorption: Noise Reduction Coefficient (NRC) of 0.80 or greater when tested in accordance with **<<ASTM C423>><< for Type A mounting, per ASTM E795; for Type E-400 mounting, per ASTM E795; or None - N/A>>**.
   4. Panel Size: **<< 24 inches by 48 inches; or As indicated on Drawings>>**.
   5. Panel Thickness: 1 inch, unless otherwise required by manufacturer for acoustic performance.
   6. Edges: Perimeter edges reinforced by **<< a formulated resin hardener; an aluminum frame; a galvanized steel frame; or _____>>**.
   7. Corners: **<< Radiused; Square; Mitered; As detailed; or _____>>**.
   8. Fabric: **<< Woven polyester; Non-woven polyester; Perforated vinyl; Polyolefin; or _____>>**.
   9. Color: To be selected by **<<Architect>>** from manufacturer's full range.
   10. Patterns: Where fabric with directional or repeating patterns or fabric with directional weave is used, mark for installation in same direction.
   11. Mounting Method: Back-mounted with mechanical fasteners.

2.02 WOOD VENEER SOUND-ABSORBING UNITS

A. Manufacturers:
   1. ASI Architectural; Microperf Wood
   2. Armstrong World Industries; Woodworks Walls.
   3. Murano Acoustics USA, by Bartley Group, Inc; Perforated Acoustic Wood Panels.
   4. RPG Acoustical Systems, Inc; Perfecto Micro Panel.
   5. Rulon International; Aluratone 7X0.
   6. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

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B. Wood Veneer Acoustical **<< Baffles; Panels; and _____>>** for **<< Walls; Ceilings; and _____>>**: Medium density fiberboard (MDF) core panels with prime grade, finished face veneer and nonwoven acoustical fabric adhered to back of panel.

1. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with **<<ASTM E84>>**.
2. Sound Absorption: Noise Reduction Coefficient (NRC) of 0.80 minimum when tested in accordance with **<<ASTM C423>><< for Type A mounting, per ASTM E795; for Type E-400 mounting, per ASTM E795; for Type ____ mounting, per ASTM E795; or None - N/A>>**.
3. Acoustic Back-Up Material: Natural cotton panels, consisting of recycled denim, 100 percent formaldehyde free, **<< 4.5 lbs/cu ft>>** density.
   a. Color: Black
   b. Overall Thickness: 1 inch.
4. Panel Size: 24 by 48 inches.
5. Panel Thickness: 3/4 inch.
6. Provide MDF with no added urea formaldehyde (NAUF).
7. Surface Veneer Species: **<< Oak; Maple; Cherry; Sapele; Beech; Anigre; Walnut; Bamboo Wheat; Bamboo Natural; Bamboo Caramelized; or _____>>**.
   a. Grain Direction: **<< Flat; Vertical; or _____>>**.
   b. Factory Finish: **<< Clear sealer; Wood stain as selected; Opaque paint as selected; Semi-transparent paint as selected; As scheduled; or _____>>**.
8. Perforated Panel:
   a. Hole Diameter: Manufacturer's standard microperforation.
   b. Spacing: Manufacturer's standard.
9. Mounting: Use fixing clips to attach to **<< wood furring strips; metal hat channels; or _____>>** anchored to wall substrate.
   a. Edge Profile: **<< Reveal; Square; Tongue and groove; or _____>>**.

2.03 WOOD FIBER SOUND-ABSORBING UNITS

A. Manufacturers:

1. Armstrong World Industries, Inc; Tectum Direct-Attach.
2. Sound Seal; EchoWool Acoustical Wall and Ceiling Panels.
3. Cardinal Acoustics; Direct Attached Panel.
4. Conwed; Arborcoustic.
5. Troy Acoustics Corporation; Troy Board.
6. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Wood Fiber Acoustical Panels for Walls: Cementitious wood fiber.

1. Size: **<< 24 by 24 inches; 24 by 48 inches; or _____ by _____ inches>>**.
2. Thickness: **<< 1 inch; 1-3/8 inches; 1-1/2 inches; 2 inches; or ____ inches>>**.
3. Noise Reduction Coefficient (NRC): 0.80 **<< 0.70 to 0.80; 0.80 to 0.90; or 0.80 minimum>>** when tested in accordance with **<<ASTM C423>><< for Type A mounting, per ASTM E795; for Type E-400 mounting, per ASTM E795; for Type C-20 mounting, per ASTM E795; or None - N/A>>**.
4. Panel Edge: **<< Square; or Beveled>>**.
5. Surface Pattern: Coarse.

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6. Surface Color: **<< White; Natural; Custom color; As indicated on drawings; or Manufacturer's standard; panels shall be field-painted>>**.
7. Installation Method (Wall): Direct-attached over **<< 1 inch; or 2 inch>>** depth furring strips and 3 lb rigid/semi-rigid glass fiber acoustic board.
   a. Fiberboard Insulation: Rigid/semi-rigid mineral fiber, **<<ASTM C612>>**, unfaced flame spread index of 0 (zero) when tested in accordance with **<<ASTM E84>>**.
8. Mounting: Use fixing clips to attach to **<< wood furring strips; metal hat channels; or _____>>** anchored to wall substrate.

2.04 PLASTIC SOUND-DIFFUSING UNITS

A. Manufacturers:
   1. Acoustical Solutions, Inc.; AlphaDiffuser Fabric Wrapped Sound Diffuser.
   2. AVL Systems, Inc.; Disorb Convex Diffuser-Absorber.
   3. Conwed; Diffusers: Barrel.
   4. Lamvin; Pyramid Diffuser.
   5. RPG Acoustical Systems, Inc; Clearsorber Panel.
   6. Wenger; Lay-In Convex Ceiling Diffuser Panel.
   7. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Thermoformed Copolymer Plastic Acoustical Panels for Ceilings:
   1. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with **<<ASTM E84>>**.
   2. Panel Size: **<< 24 inches by 24 inches; 48 inches by 48 inches; or _____ inches by _____ inches>>**, unless otherwise indicated.
   3. Surface Pattern: **<< Pyramid shapes; Barrel shapes; or _____>>**.
   4. Mounting: Lay-in panel for suspended ceiling system, exposed grid.
      a. Suspension System: See Section **<< 095100>>**.

2.05 POLYESTER (FELT) ACOUSTIC PANELS

A. Manufacturers:
   1. 3Form
   2. Acoufelt.
   3. Kirei USA.
   4. MDC.
   5. Novaform.
   6. Turf Design.

B. Polyester Acoustic Panels: 100% polyester.
   1. Size: As indicated on Drawings.
   2. Thickness: 9- to 12-mm baffle, as standard with manufacturer.
   3. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with **<<ASTM E84>>**.
   4. Noise Reduction Coefficient (NRC): 0.60 at 24 mm panel thickness when tested in accordance with **<<ASTM C423>><< for Type E mounting, per ASTM E795; _____; or None - N/A>>**.
   5. Color: Solid color as selected from manufacturer's full range of available colors.
   6. Mounting Method (Wall): Back-mounted with Z-clips and mechanical fasteners.

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7. Mounting Method (Ceiling): Manufacturer's standard system fabricated of aluminum cross runners, aircraft cable and manufacturer's standard joinery and connection hardware to fasten baffles to suspension system. Cable and joinery shall allow for fine adjustment to ensure a level installation at height indicated.
    a. In lieu of aluminum cross runners, manufacturer may mount suspension system to 1-5/8" by 7/8" slotted channel framing or directly to structural joists/framing; refer to Section **<< 055000 - Metal Fabrications; or _____>>** for slotted channel.
    b. Suspension system shall mount to cross runner, galvanized slotted track, or directly to structural joists/framing. Do not mount directly to steel roof deck.

2.06 FABRICATION

A. Fabric Wrapped, General: Fabricate panels to sizes and configurations as indicated, with fabric facing installed without sagging, wrinkles, blisters, or visible seams.
    1. Where radiused or mitered corners are indicated, install fabric to avoid seams or gathering of material.

B. Tolerances: Fabricate to finished tolerance of plus or minus 1/16 inch for thickness, overall length and width, and squareness from corner to corner.

C. Factory-applied finishes on wood veneer panels to be uniform, smooth, and without blemishes.

2.07 ACCESSORIES

A. Back-Mounting Accessories: Manufacturer's standard accessories for concealed support, designed to allow panel removal, and as follows:
    1. Two-part clip and base-support bracket system; brackets designed to support full weight of panels and clips designed for lateral support, with one part mechanically attached to back of panel and the other attached to substrate.
    2. Z-clip hanger and magnet system with magnets recessed into panel frame and designed to engage steel mounting plates secured to substrate with screws.
    3. Mechanically Mounted Metal-Framed Panels: Metal panel-clip system designed to engage metal framing of panels.

B. Fixing Clips: Manufacturers standard for application as indicated.

C. Furring Strips: Metal hat channel.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates for conditions detrimental to installation of acoustical units. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install acoustical units in locations as indicated, following manufacturer's installation instructions.

B. Install mounting accessories and supports in accordance with shop drawings.

C. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.

D. **<< Suspend; or Attach>>** ceiling baffles at locations and heights as indicated.

E. Furring Mounted Wood Veneer Panels:

1. Install furring strip along meeting edges of adjacent panels to ensure they are attached to same furring strip along abutted edge; **<< 24 inch>>** on center, maximum.
2. Install acoustic back-up material between furring as required for application.
3. Adhere first panel from edge to furring strip, and attach subsequent panels using fixing clips.

F. Furring-Mounted Cementitious Wood Fiber Panels:
1. Install furring strip along meeting edges of adjacent panels to ensure they are attached to same furring strip along abutted edge; **<< 24 inches>>** on center, maximum.
2. Install acoustic insulation between furring as indicated on drawings.
3. Adhere first panel from edge to furring strip; attach subsequent panels using fasteners.

G. Install acoustical units to construction tolerances of plus or minus 1/16 inch for the following:
1. Plumb and level.
2. Flatness.
3. Width of joints between panels; where applicable.

3.03 CLEANING

A. Clean sound-absorptive panels upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

3.04 PROTECTION

A. Provide protection of installed acoustical panels until Date of Substantial Completion.

B. Replace panels that cannot be cleaned and repaired to satisfaction of the **<<Architect>>**.

END OF SECTION 098430

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SECTION 099100
PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish exterior and interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated. Specific items include (but are not limited to) the following:

1. Fire- and Smoke-Rated Wall Identification: Permanently label fire- and smoke-rated walls, partitions, and barriers per requirements of applicable building code. Labeling shall include fire-resistance rating, type of assembly, and instruction to protect openings/penetrations. Example text: "ONE HOUR FIRE BARRIER - PROTECT ALL OPENINGS".
    a. Locate lettering in concealed accessible floor, floor-ceiling plenums, and attic spaces, located no more than 15 feet from end of wall and at horizontal intervals not exceeding 30 feet, with stenciled lettering not less than 3 inches high with minimum 3/8-inch strokes. Locate directly inside of access doors or panels that provide access to rated walls. Do not paint walls where exposed to view except in support spaces (mechanical / electrical rooms and similar spaces).
    b. Refer to the life safety plans and partition schedule on the drawings for rated wall and partition locations.
2. Exposed side and exposed edges of plywood backboards for electrical and telecom equipment before installing equipment.
3. Elevator pit ladders.
4. Prime surfaces to receive wall coverings.
5. Mechanical and Electrical:
    a. **<< In finished areas; In all areas; or _____>>**, paint **<< insulated and exposed pipes; conduit; boxes; insulated and exposed ducts; hangers, brackets, collars and supports; mechanical equipment; electrical equipment; and _____>>**, unless otherwise indicated.
    b. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
    c. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
6. Shop-Primed Items: **<< In finished areas; In all areas; or _____>>**, paint shop-primed items. Unless specifically indicated that additional field primer is not required, provide a tie coat primer over the shop primer before top coat(s) are applied.

D. Do Not Paint or Finish the Following Items:

1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
2. Items indicated to receive other finishes.
3. Items indicated to remain unfinished.
4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.

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5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.
6. Marble, granite, slate, and other natural stones.
7. Floors, unless specifically indicated.
8. Ceramic and other tiles.
9. Brick, architectural concrete, architectural precast, cast stone, and integrally colored plaster, fiberglass, or stucco.
10. Glass.
11. Acoustical materials, unless specifically indicated.
12. Concealed pipes, ducts, and conduits.

1.02 REFERENCE STANDARDS

A. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials.

B. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual.

D. SSPC-SP 1 - Solvent Cleaning.

E. SSPC-SP 6 - Commercial Blast Cleaning.

F. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning.

1.03 SUBMITTALS

A. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
   2. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

B. Certification: By manufacturer that paints and finishes comply with VOC limits specified.

C. Manufacturer's Instructions: Indicate **<< special surface preparation procedures; substrate conditions requiring special attention; and _____>>**.

D. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.
   1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
   2. Extra Paint and Finish Materials: 1 gallon of each **<< color; type; surface texture; and _____>>**; from the same product runstore where directed.
   3. Label each container with **<< color; type; texture; room locations; and _____>>** in addition to the manufacturer's label.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of **<< 45 degrees F>>** and a maximum of **<< 90 degrees F>>**, in ventilated area, and as required by manufacturer's instructions.

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1.05 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than **<< 5 degrees F>>** above the dew point, or to damp or wet surfaces.

D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Paints:
   1. Benjamin Moore.
   2. PPG Paints.
   3. Sherwin-Williams Company.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Supply each paint material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Low-Emitting Materials (Paints and Coatings): Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet applicable VOC limits of **<<CARB (SCM)>>** or **<<SCAQMD 1113>>**.

C. Flammability: Comply with applicable code for surface burning characteristics.

D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by **<<Architect>>** from the manufacturer's full line.

E. Colors: **<< To be selected from manufacturer's full range of available colors; As indicated on drawings; As indicated in Color Schedule; or _____>>**.
   1. Selections shall be made by Owner and Architect after award of contract.
   2. **<< In finished areas; In all areas; or _____>>**, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.

2.03 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

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C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:

1. Gypsum Wallboard: 12 percent.
2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
3. Interior Wood: 15 percent, measured in accordance with **<<ASTM D4442>>**.
4. Concrete Floors and Traffic Surfaces: 8 percent.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or repair existing paints or finishes that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Concrete:

1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

G. Masonry:

1. Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.

H. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

I. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

J. Aluminum: Remove surface contamination and oils and wash with solvent according to **<<SSPC-SP 1>>**.

K. Copper: Remove contamination by steam, high-pressure water, or solvent washing.

L. Galvanized Surfaces and Non-Ferrous Metals:

1. Remove surface contamination and oils and wash with solvent according to **<<SSPC-SP 1>>**.

M. Ferrous Metal:

1. Solvent clean according to **<<SSPC-SP 1>>**.

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2. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to **<<SSPC-SP 6/NACE No.3>>** "Commerical Blast Cleaning". Protect from corrosion until coated.

N. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

O. Metal Doors to be Painted: Prime metal door top, side, and, bottom edge surfaces if not primed by manufacturer.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.

G. Sand **<< wood; metal; and _____>>** surfaces lightly between coats to achieve required finish.

H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

3.06 EXTERIOR PAINT SCHEDULE

A. General: Provide the following Paint systems for the various substrates, as indicated. Dry film thickness is noted as “DFT.” Provide compatibility test areas on existing painted substrates.

B. Zinc-Coated or Zinc-rich Primer-Coated Metal with Direct to Metal (“DTM”) Gloss Acrylic Enamel Finish: 2 topcoats of DTM gloss enamel over primer, with min. total DFT of 2.5 mils.

1. Prime Coat (Tie-Coat): Lead-free, acrylic base interior/exterior galvanized metal primer, premium grade. Apply over shop primer.
   a. Moore: HP04 Ultra Spec HP Acrylic Metal Primer.
   b. PPG: 90-1908 Pitt-Tech Plus EP Acrylic Primer/Finish.
   c. S-W: B66W1310 Pro Industrial Pro-Cryl Universal Acrylic Primer.
2. First and Second Coats: DTM Acrylic Gloss Enamel.

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a. Moore: HP28 Ultra Spec HP Acrylic Gloss Enamel.
b. PPG: 90-1510 Pitt-Tech Plus EP DTM Acrylic Gloss.
c. S-W: B66W1051 Pro Industrial DTM Acrylic Coating (Gloss).

C. Field-Applied Coatings for Ferrous Metal (AESS): Aliphatic urethane system of intermediate coat and topcoat**<< with clear finish coat; or <u>None - N/A</u>>>**. Provide scheduled products for exposed steel fabrications indicated as AESS.
1. Field Touch-up: Match moisture curing urethane zinc-rich shop primer.
2. Intermediate Coat: Moisture curing urethane and micaceous iron oxide or epoxy.
a. Moore: Corotech V160 Epoxy Mastic Coating.
b. PPG: PMC Amerlock 600.
c. S-W: Macropoxy 646 Fast Cure Epoxy, B58-600/B58v600.
3. Top Coat: Aliphatic urethane at 2.0 – 3.0 mils DFT.
a. Moore: Corotech V500 Aliphatic Acrylic Urethane.
b. PPG: 95-812 Pitthane Ultra Gloss Urethane Enamel.
c. S-W: Corothane I Aliphatic Finish Coat B65.

D. Coatings to Repaint Exterior Ferrous Metal: Aliphatic urethane topcoat system over surface-tolerant epoxy mastic. Provide to repaint existing exposed steel fabrications with extended weather exposure deterioration and surface rust.
1. Preparation: Clean steel to SSPC SP-3 Power Tool Cleaning to remove all rust scale, mill scale and loose rust, oil, grease and other contaminants.
2. Primer: Surface-tolerant fast curing polyamide epoxy (mastic). 5.0 – 10.0 mils DFT.
a. Moore: P45 Mastic Epoxy Gloss Coating.
b. PPG: PMC Amerlock 600.
c. S-W: Macropoxy 646 Fast Cure Epoxy.
3. First and Second Top Coats: Aliphatic urethane at 3.0 – 4.0 mils DFT per coat
a. Moore: P74 Aliphatic Acrylic Urethane.
b. PPG: 95-8930 Pitthane Ultra LS.
c. S-W: B65-300 Series / B60V30 Hi-Solids Polyurethane.

E. Concrete: Acrylic latex satin finish, two finish coats over alkali-resistant primer with minimum total DFT of not less than 3.5 mils.
1. Prime Coat: Exterior Acrylic weathered masonry sealer/primer.
a. Moore: 608 Ultra Spec Masonry Int/Ext 100% Acrylic Sealer/Primer.
b. PPG: 4-603 Perma-Crete Int/Ext Alkali Resistant Primer.
c. S-W: A24w8300, Loxon Concrete & Masonry Primer.
2. First and Second Finish Coats: Exterior 100% Acrylic – Satin sheen; premium grade.
a. Moore: N401 Regal Select Exterior Paint High Build Low Lustre Finish.
b. PPG: 76-45 Sun-Proof Ext House & Trim, Satin.
c. S-W: A82 Series A-100 Exterior Latex Satin.

F. Concrete Masonry Units: Acrylic latex satin finish, two finish coats over primer with minimum total DFT of not less than 3.5 mils.
1. Prime Coat: Exterior Acrylic weathered masonry sealer/primer.
a. Moore: 571 Ultra Spec Hi-Build Masonry Block Filler.
b. PPG: 6-15 Speedhide Int/Ext Acrylic Masonry Block Filler.
c. S-W: A24W200 Loxon Block Surfacer.

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2. First and Second Finish Coats: Exterior 100% Acrylic – Satin sheen; premium grade.
    a. Moore: N401 Regal Select Exterior Paint High Build Low Lustre Finish.
    b. PPG: 76-45 Sun-Proof Ext House & Trim, Satin.
    c. S-W: A 82 Series A-100 Exterior Latex Satin.

G. Exterior Gypsum Soffit Board with Smooth Finish 100% Acrylic Coating: Top coat(s) for total DFT of 10.0 mils minimum over primer-sealer.
1. Prime Coat (Tie-Coat): Bonding primer-sealer.
    a. Moore: N023 Fresh Start All Purpose 100% Acrylic Int/Ex Latex Primer.
    b. PPG: 17-921 Seal-Grip Gripper Interior/Exterior 100% Acrylic Latex Primer.
    c. S-W: B51-450, Multi-Purpose Primer.
2. First and Second Finish Coats: Exterior 100% Acrylic – Flat finish; premium grade.
    a. Moore: N400 Regal Select Exterior Paint High Build Flat Finish.
    b. PPG: 72-45 Sun-Proof Ext House & Trim. Flat Latex 100% Acrylic
    c. S-W: A6 Series A-100 Exterior Latex Flat

H. General Painted Wood and Plywood with Acrylic Latex Satin Finish: 2 finish coats over primer with total DFT not less than 3.5 mils.
1. Prime Coat: Alkyd-based wood sealer/primer.
    a. Ben Moore: 024 Fresh Start Multi-Purpose Oil Based Primer.
    b. PPG: 17-941 Seal-Grip Interior/Exterior Alkyd Universal Primer.
    c. S-W: Y24W8020 Exterior Oil Wood Primer.
2. First and Second Finish Coats: Exterior 100% Acrylic – Satin sheen; premium grade.
    a. Moore: N401 Regal Select Exterior Paint High Build Low Lustre Finish.
    b. PPG: 76-45 Sun-Proof Ext House & Trim, Satin.
    c. S-W: A82 Series A-100 Exterior Latex Satin.

I. Exterior Wood Dumpster Enclosure Siding and Trim with Solid Color Latex-Emulsion Stain: 2 Finish coats.
1. Stain Coat: Acrylic latex solid color stain.
    a. Moore: 610 ArborCoat Exterior Stain - Solid Ultra Flat.
    b. Cabot: Cabot O.V.T. Solid Color Acrylic Stain.
    c. PPG: FLD820, Flood Solid Color 100% Acrylic Latex Base Stain.
    d. S-W: A16, Woodscapes Exterior Solid Acrylic Stain.

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3.07 INTERIOR PAINT SCHEDULE

A. General: Provide the following paint systems for the various substrates, as indicated. Dry film thickness is noted as “DFT.” Provide compatibility test areas on existing painted substrates.

B. Concrete Masonry Units: Low-VOC Acrylic Semi-Gloss Finish. Provide 2 finish coats over 2 block filler coats, with total DFT not less than 2.5 mils. (Provide for CMU except where “epoxy finish” is indicated.)
1. Block Filler Coats, 100% Acrylic. Apply filler coat at a rate to ensure complete coverage. Brush, spray or roller apply and back roll or squeegee for smooth, pinhole-free treatment.
    a. Moore: 571 Ultra Spec Hi-Build Masonry Block Filler.
    b. PPG: 16-90 Pitt Glaze WB Acrylic Interior Exterior Block Filler.
    c. S-W: B46W150 Pro Industrial Heavy Duty Block Filler. (PrepRite not acceptable)

2. Waterproofing Filler Coats – Showers & Wet Applications: Cementitious resin or epoxy block filler applied by brush, spray or roller and back rolled or squeegeed for smooth, pinhole-free treatment.
    a. Moore: P31 Waterborne Epoxy Block filler.
    b. PPG: 95-217 Epoxy Ester Cementitious Waterproofing Block Filler.
    c. S-W: B42W400/B42V401 Kem Cati-Coat HS Epoxy Filler/Sealer.
3. Bonding Primer (previously painted): Acrylic bonding primer for exceptional adhesion to hard, glossy surfaces. Test for adhesion. Brush, spray or roller apply and back roll.
    a. Moore: Stix Bonding Primer.
    b. PPG: 17-921 PPG Seal Grip Acrylic Universal Primer/Sealer.
    c. S-W: B51W150 Extreme Bond Interior/Exterior Primer.
4. First & Second Finish Coats: Commercial Interior Low-VOC Acrylic Semi-gloss Finish. Provide for wall finishes unless noted or directed otherwise.
    a. Moore: N539 Ultra Spec 500 Interior Semi-Gloss Finish.
    b. PPG: 6-500ZV Speedhide Interior Semi-Gloss Latex.
    c. S-W: B31-2600 ProMar 200 Zero VOC Interior Latex Semi-Gloss.

C. Concrete Masonry Units - Semi-Gloss Water-Borne Epoxy Finish: 2 finish coats over 2 block filler coats:
1. Block Filler Coats: Acrylic-latex or as required by manufacturer for topcoat. Brush, spray or roller apply and back roll for smooth pinhole-free treatment.
    a. Moore: 571 Ultra Spec Hi-Build Masonry Block Filler.
    b. PPG: 6-15 Speedhide Int/Ext Acrylic Masonry Block Filler.
    c. PPG: 16-90 Pitt-Glaze WB Int/Ext Block Filler Latex.
    d. S-W: B46W150 Pro Industrial Heavy Duty Block Filler.
2. First & Second Finish Coats: Two-component, semi-gloss water born polyamide epoxy enamel applied at a DFT of 1.5 to 4.0 mils per coat.
    a. Moore: Corotech V400 Polyamide Epoxy Coating.
    b. PPG: 98E-xx Base / 98E-100 Aquapon WB EP Water Based Epoxy – Semi-Gloss.
    c. S-W: B73W360 / B73V300 Pro Industrial Water Based Catalyzed Epoxy.

D. Concrete Floor with Semi-Gloss Water-Base Acrylic Floor Enamel: 2 Coats over primer on cured surface. Concrete must cure a minimum of 30 days before painting and have pH of 10.0 or lower. Prepare per SSPC-SP13, shot blast or prepare floor by other means acceptable to paint manufacturer (accepted in writing) prior to painting.
1. Primer Coat: Acrylic, self-priming finish enamel; brush or roller applied over prepared concrete.
    a. Moore: 122 Moore's Latex Floor and Patio Enamel (thinned 1 pint/gallon).
    b. PPG: 3-510 Pittsburgh Floor, Porch & Deck Satin Latex.
    c. S-W: B90 Armorseal Tread-Plex.
2. First and Second Finish Coats: Semi-gloss water-based acrylic floor enamel or comparable performance enamel. Provide 1.5 - 2.0 mils DFT per coat.
    a. Moore: 122 Moore’s Latex Floor and Patio Enamel.
    b. PPG: 3-510 Pittsburgh Floor, Porch & Deck Satin Latex.
    c. S-W: B90 Armorseal Tread-Plex.

E. Concrete Floor with Gloss Water-Base Epoxy Floor Enamel: 2 Coats over primer on cured surface. Concrete must cure a minimum of 30 days before painting and have pH of 10.0 or

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lower. Prepare per SSPC-SP13, shot blast or prepare floor by other means acceptable to paint manufacturer (accepted in writing) prior to painting.

1. Primer Coat: Epoxy primer, brush or roller applied over prepared concrete. Provide 1.5 - 2.0 mils DFT per coat or as recommended by manufacturer.
    a. Moore: P41 Fast Dry Epoxy Floor Sealer/Finish.
    b. PPG: 98E-1 Series Aquapon WB EP Water Base Epoxy 2.0 mils to 3.0 mils DFT per coat.
    c. S-W: B70-8100/B70V8100 Armorseal 8100 Water based Epoxy Floor Coating.
2. Two Finish Coats: Two-component waterborne catalyzed polyamide epoxy floor enamel or comparable performance enamel. Provide 1.5 - 2.0 mils DFT per coat or as recommended by manufacturer.
    a. Moore: P42 Waterborne Polyamide High Gloss Epoxy Enamel 2.0 mils to 3.0 mils DFT per coat.
    b. PPG: 98E-1 Series Aquapon WB EP Water Base Epoxy 2.0 mils to 3.0 mils DFT per coat.
    c. S-W: B70-8100/B70V8100 Armorseal 8100 Water based Epoxy Floor Coating.

F. Gypsum Board Systems with Latex Finish: Semi-gloss finish at walls and flat finish on ceilings except as indicated otherwise. Provide 2 finish coats over 2 filler coats. Provide best commercial Zero-VOC formulation with 0 VOC per EPA test method 24.
    1. Filler Coats: 0 VOC (per EPS test method 24) Latex Primer.
        a. Moore: N534 Ultra Spec 500 Interior Latex Primer.
        b. PPG: 9-900 Pure Performance Interior Latex Primer.
        c. S-W: B28-2600 ProMar 200 Zero VOC Interior Latex Primer.
    2. First & Second Finish Coats: Interior Zero-VOC Acrylic Semi-Gloss Finish. Provide for wall finishes unless indicated otherwise.
        a. Moore: N539 Ultra Spec 500 Interior Semi-Gloss Finish.
        b. PPG: 6-500ZV Speedhide Interior Semi-Gloss Latex.
        c. S-W: B31-2600 ProMar 200 Zero VOC Interior Latex Semi-Gloss.
    3. First & Second Finish Coats: Interior Zero-VOC Acrylic Flat Finish. Provide for ceiling applications unless indicated otherwise.
        a. Moore: N536 Ultra Spec 500 Interior Flat.
        b. PPG: 6-70ZV Speedhide Interior Latex Flat.
        c. S-W: B30-2600 ProMar 200 Zero VOC Interior Latex Flat or B30-4650 ProMar 400 Zero VOC Interior Latex Flat.

G. Gypsum Board Systems with Water-Borne Polyamide Epoxy Finish (“EPX”): Provide 2 finish coats over 2 filler coats.
    1. Filler Coats: Manufacturer’s recommended primer.
        a. Moore: 217 Fresh Start Alkyd Enamel Underbody.
        b. PPG: 6-2 Speedhide Interior Latex Sealer.
        c. S-W: B28W2600 ProMar 200 Zero VOC Primer.
    2. First and Second Coats: Two-component, water born polyamide epoxy enamel applied at a DFT of 1.5 to 4.0 mils per coat. Provide semi-gloss finish unless directed otherwise.
        a. Moore: Corotech V440 Waterborne Amine Epoxy.
        b. PPG: 98E-xx Base / 98E-100 Aquapon WB EP Water Based Epoxy – Semi-Gloss.
        c. S-W: B73W360 / B73V300 Water Based Catalyzed Epoxy.

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H. Gypsum Board Systems with “Dry-Erase Coating” Finish: Gloss finish designed for use as a dry-erase marker surface.**<< Prepare gypsum board with Level 5 finish.; or None - N/A>>**
   1. Filler Coat: **<< Primer as specified for gypsum board with latex finish; or Dry erase coating manufacturer’s recommended primer>>**.
   2. Finish Color Coat: Interior Low-VOC Acrylic Satin Finish as specified for CMU/gypsum board with latex finish.
   3. Dry-Erase Surface Coat: Interior Gloss Finish developed for dry-erase whiteboard application. Roller-**<< or spray-; or None - N/A>>**apply coating to WFT of 4 – 8 mils (2 – 4 mils DFT). 10-year warranty on application.
      a. DesignTex.: “WriteUp 1”**<< Clear; or None - N/A>>**.
      b. MDC: “Ideapaint” **<< White; Clear; or None - N/A>>** (non-isocyanate).
      c. Master Coating: “Wink.”
      d. S-W: KB65C2000 “Dry Erase Coating”**<< Clear; or None - N/A>>** (2-component WB polyurethane).

I. Gypsum Board Systems with “Chalkboard” Finish: Eggshell/flat finish designed for use as a chalkboard surface. **<< Prepare gypsum board with Level 5 finish.; or None - N/A>>**
   1. Filler Coat: **<< Primer as specified for gypsum board with latex finish; or Chalkboard coating manufacturer’s recommended primer>>**.
   2. Chalkboard Surface Coat: Acrylic-latex interior eggshell/flat black finish developed for chalkboard application. Roller-**<< or spray-; or None - N/A>>**apply coating to manufacturer's recommended thickness. 10-year warranty on application.
      a. Ben Moore: 308 ben Chalkboard Paint.
      b. Rust-Oleum: 206540 ChalkBoard.
      c. S-W: K05223000 Krylon Chalkboard Paint.

J. Gypsum Board Systems with “Abuse-Resistant Coating” Finish: Satin (egg-shell) sheen abuse-resistant finish.
   1. Filler Coat:
      a. Moore: N534 Ultra Spec 500 Interior Latex Primer.
      b. Master Coating: Scuffmaster “Primemaster” Primer/Sealer.
      c. S-W: B28W2600 ProMar 200 Zero VOC Primer.
   2. First & Second Finish Coats: Interior Satin Finish. (Low lustre/Satin = 25-45% @60°) Provide for abuse-resistant wall finishes indicated.
      a. Moore: 485 Ultra Spec “SCUFF-X” proprietary single component acrylic copolymer.
      b. Master Coating: Scuffmaster “Scrubtough” 2-component polyurethane-fortified coating.
      c. S-W: S23W0051 Scuff Tuff Interior Waterbased Enamel.

K. Ferrous Metal with Latex Dry Fog Finish: One finish coat over primed exposed construction. Provide nominal 50 square foot sample area to test for paint compatibility with substrates.
   1. Prime Coat: (Acrylic or recommended VOC-compliant metal primer for surfaces not pre-primed.) 2.0 mils DFT.
      a. Moore: N110 Superkote 5000 DryFall Latex Flat.
      b. PPG: 90-1908 Pitt-Tech Plus EP Acrylic Primer/Finish.
      c. S-W: B66-1300 Series Pro Industrial Pro-Cryl Universal Acrylic Primer.
   2. Top Coat: All exposed structure as scheduled. Acrylic Dry Fog 3.0 mils DFT. Provide color finish as selected by Architect from manufacturer's full range.
      a. Moore: N110 Superkote 5000 DryFall Latex Flat.

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b. PPG: 6-725XI Speedhide Super Tech WB Int. Dry-Fog Flat Latex Flat.
c. S-W: B42W1181 / B42B81 Waterborne Acrylic Dry Fall, Flat.

L. Ferrous Metal: Direct to Metal ("DTM") Acrylic Enamel Finish: 2 Coats over primer, with total DFT not less than 2.5 mils. **<< Provide satin finish at hollow metal steel doors and frames, and semi-gloss at other applications.; or _____>>**
1. Prime Coat: Lead-free, acrylic base primer. Not required on shop primed items.
a. Moore: HP29 Ultra Spec HP DTM Acrylic Semi-Gloss.
b. PPG: 90-1908 Pitt-Tech Plus EP Acrylic Primer/Finish.
c. S-W: B66W11 Pro Industrial DTM Acrylic Primer/Finish (or B66 W200).
2. Bonding Primer (previously painted): Acrylic bonding primer designed for previously painted ferrous metal to ensure secure bond. Brush, spray or roller apply and back roll.
a. Moore: SXA-110 Insl-X Waterborne Bonding Primer.
b. PPG: 90-1908 Pitt-Tech Plus EP Acrylic Primer/Finish.
c. S-W: B66A50 DTM Bonding Primer.
3. First and Second Coat: DTM Acrylic Semi-Gloss Enamel. (30-40 units @ 60°)
a. Moore: HP29 Ultra Spec HP DTM Acrylic Semi-Gloss.
b. PPG: 90-1610 Pitt-Tech Plus EP DTM Acrylic Semi-Gloss.
c. S-W: B66W1151 Pro Industrial DTM Acrylic Semi-Gloss Coating.
4. First and Second Coat: DTM Acrylic Satin Enamel. **<< Provide for hollow metal steel doors and frames.; or _____ >>** (15-25 units @ 60°)
a. Moore: HP25 Ultra Spec HP DTM Acrylic Low Lustre.
b. PPG: 90-1710 Pitt-Tech Plus EP DTM Acrylic Satin.
c. S-W: B66W1251 Pro Industrial DTM Acrylic Eg-Shel.

M. Zinc-Coated Metal: Semi-Gloss Direct to Metal ("DTM") Acrylic Enamel Finish: 2 Coats over primer, with min. total DFT of 2.5 mils.
1. Prime Coat: Lead-free, acrylic base interior galvanized metal primer, premium grade.
a. Moore: HP04 Ultra Spec HP Acrylic Metal Primer.
b. PPG: 90-1908 Pitt-Tech Plus EP Acrylic Primer/Finish.
c. S-W: B66W1151 Pro Industrial DTM Acrylic Semi-Gloss Coating.
2. First and Second Coats: DTM Acrylic Semi-Gloss Enamel. Same as for ferrous metal.

N. Intumescent Mastic-Coated Metal: Semi-Gloss Direct to Metal ("DTM") Acrylic Enamel Finish as approved by intumescent coating manufacturer: 2 Coats, with min. total DFT of 2.5 mils.

O. Painted Woodwork and Hardboard: Semi-Gloss Acrylic Enamel Finish: Two topcoats over undercoater. Provide at painted wood shelving, electrical panel boards, and as noted.
1. Prime Coat: Interior Oil Undercoat.
a. Moore: 024 Fresh Start Multi-Purpose Interior/Exterior Oil Based Primer.
b. PPG: 17-941NF Seal Grip Int/Ext. Alkyd Universal Primer.
c. S-W: B49 W8820 Multi-Purpose Oil-Based Primer.
2. Prime Coat: Interior Latex Undercoat, for medium-duty, low-VOC formulation.
a. Moore: N023 Fresh Start Multi-Purpose Latex Primer.
b. PPG: 17-921 Seal Grip Int/Ext Acrylic Universal Primer.
c. S-W: B28 W811 Premium Wall & Wood Primer.
3. First and Second Finish Coats: DTM Acrylic Semi-Gloss Enamel. DFT 3.5 Mils min.
a. Moore: HP29 Ultra Spec DTM Acrylic Semi-Gloss.

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b. PPG: 90-1110 Pitt-Tech Int/Ext Satin DTM Industrial Enamel.
c. S-W: B66W1150 Series Pro Industrial DTM Acrylic Semi-Gloss Coating.

4. First and Second Finish Coats: Premium Acrylic Semi-Gloss Enamel <150 g/L. DFT 3.5 Mils min.
   a. Moore: 551 Regal Select Semi-Gloss.
   b. PPG: 87-6 Manor Hall Interior Semi-Gloss Acrylic Latex.
   c. S-W: B31W20 ProClassic Waterborne.

P. Stained woodwork with transparent finish is specified in Division 6 Sections by woodworker.

END OF SECTION 099100

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SECTION 101100
VISUAL DISPLAY UNITS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ANSI A135.4 - Basic Hardboard.

B. ANSI A208.1 - American National Standard for Particleboard.

C. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling.

D. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.02 SUBMITTALS

A. Product Data: Provide manufacturer's data on **<< porcelain enamel steel markerboard; tackboard; tackboard surface covering; trim; and accessories>>**.

B. Shop Drawings: Indicate wall elevations, dimensions, joint locations, and special anchor details.

C. Sustainable Design Requirements:

D. Selection Samples: Color charts for selection of color and texture of **<< tackable surface covering; and composition cork>>**.

E. Verification Samples: Provide physical samples, nominal 8 x 12 inches, for each selected color of materials indicated above.

F. Test Reports: Show compliance to specified surface burning characteristics requirements.

G. Maintenance Data: Include data on regular cleaning, stain removal**<< , and _____; or None - N/A>>**.

1.03 DELIVERY, STORAGE AND HANDLING

A. Factory-fabricate visual display units and deliver as fully assembled units to greatest extent possible.

B. Deliver and store visual display units with protective packaging. Do not remove protective covers until ready to install.

C. Store visual display units in a dry, enclosed space. Do not install until installation spaces are enclosed and conditioned at occupancy conditions.

1.04 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Provide fifty year warranty for **<< chalkboard; and markerboard>>** porcelain face surface to include warranty against **<< discoloration due to cleaning; crazing or cracking; staining; and _____>>**.

PART 2 PRODUCTS

2.01 VISUAL DISPLAY UNITS

A. Porcelain Enamel Steel Markerboards: Magnetic, porcelain-enamel steel face sheet bonded to nominal 3/8-inch MDF or particleboard core.

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1. Color: White.
2. Backing: Provide with 0.005-inch aluminum foil backer, laminated to core.
3. Height: 60 inches, unless otherwise indicated on Drawings.
4. Length: **<< 6 feet; 8 feet; 10 feet; 12 feet; 16 feet; or ___ inches>>**, in one piece. ******Refer to MCPS ED Spec for length requirements.******
5. Frame: Extruded aluminum, with concealed fasteners.
6. Frame Finish: Anodized, natural.
7. Accessories: Provide full length **<< marker tray; map rail; flag holder; and ____>>**. ******MCPS prefers no marker trays on gymnasium boards.******
8. Special Markings: Provide markerboards with the following integral markings at locations indicated. Markings shall be factory-painted or fused to surface of porcelain enamel.
   a. Music staff lines.
9. Products:
   a. AARCO Products, Inc.
   b. ASI Visual Display Products.
   c. Bangor Cork Company, Inc.
   d. Claridge Products and Equipment, Inc.
   e. Egan Visual Corporation.
   f. Ghent; a GMI Company.
   g. Marsh Industries, Inc; Visual Products Group.
   h. MooreCo, Inc.
   i. Nelson Adams NACO.
   j. Platinum Visual Systems.
   k. Polyvision Corporation.

B. Tackboards: **<< Fine-grained, homogeneous natural cork; Composition cork; Fabric laminated to cork; Fabric laminated to fiberboard; or ____>>**.
   1. Cork Thickness: **<< 1/8 inch; 1/4 inch; 7/32 inch; or ___ inch>>**.
   2. Fabric: **<< Non-woven PVC-free coated fabric; Vinyl-coated fabric; Burlap; or _____>>**. ******MCPS prefers fabric cover in kitchens.******
   3. Color: To be selected by Architect from manufactuter's **<< full; or standard>>** range.
   4. Backing: **<< Fiberboard; Hardboard; or _____>>**, **<< 1/4 inch; 3/8 inch; or ___ inch>>** thick, laminated to tack surface.
   5. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with **<<ASTM E84>>**.
   6. Height: 48 inches, unless otherwise indicated on Drawings.
   7. Length: **<< 6 feet; 8 feet; 10 feet; 12 feet; 16 feet; or ___ inches>>**, in one piece. ******Refer to MCPS ED Spec for length requirements.******
   8. Frame: Extruded aluminum, with concealed fasteners.
   9. Frame Profile: As indicated on drawings.
   10. Frame Finish: Anodized, natural.
   11. Accessories: Provide **<< map rail; flag holder; and ____>>**.
   12. Products:
      a. AARCO Products, Inc.
      b. ASI Visual Display Products.
      c. Bangor Cork Company, Inc.

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d. Claridge Products and Equipment, Inc.
e. Egan Visual Corporation.
f. Ghent; a GMI Company.
g. Marsh Industries, Inc; Visual Products Group.
h. MooreCo, Inc.
i. Nelson Adams NACO.
j. Platinum Visual Systems.
k. Polyvision Corporation.

C. Tackable Wall Panels: **<< Fine-grained, homogeneous natural cork; Fabric laminated to fiberboard; or ____>>**; factory-fabricated.
1. Color, Pattern, and Texture: To be selected by Architect from manufacturer's full range.
2. Backing: **<< Fiber board; or _____>>**, **<< 1/2 inch; 3/4 inch; or ___ inch>>** thick, laminated to tack surface.
3. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with **<<ASTM E84>>**.
4. Size: As indicated on drawings.
5. Height: **<< Full height of room or wall; As indicated on drawings; or ___ inches>>**; no horizontal seams.
6. Edge Treatment: Square edge unless detailed otherwise.
7. Edge Molding: Provide metal "J-mold" type edge trim for exposed edges at door and window openings and similar conditions.
8. Adhesives: Provide manufacturer's recommended adhesive, primer, and sealer, produced for use on substrate shown on drawings. Provide materials which are mildew-resistant and non staining to wallcovering.
9. Products:
a. Claridge Products and Equipment, Inc; Tack Walls.
b. Koroseal Interior Products; Walltalkers Tac-Wall.
c. MDC Interior Solutions; Cork.
d. National Solutions; TackNow.

D. Tackstrips: **<< Fine-grained, homogeneous natural cork; Linoleum-modified cork; Vinyl laminated to cork; or ____>>**.
1. Cork Thickness: **<< 1/8 inch; 1/4 inch; 7/32 inch; or ___ inch>>**.
2. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with **<<ASTM E84>>**.
3. Height: **<< 1 inch; 2 inches; or ___ inches>>**.
4. Length: **<< ___ inches; or As indicated on drawings>><< , in one piece; None - N/A; or ____>>**. Where indicated to be installed over markerboard, match length of markerboard.
5. Frame and End Stops: Extruded aluminum with concealed fasteners.
6. Frame Profile: **<< As indicated on drawings; Manufacturer's standard; or _____>>**.
7. Frame Finish: Anodized, natural.

E. Bulletin Board Cabinets: Factory-fabricated **<< wood-framed; aluminum-framed; or _____>>** unit with tackable panel on back inside surface and glazed doors at front.
1. Manufacturers:
a. Claridge Products and Equipment, Inc.

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b. Ghent, a GMI Company.
c. Platinum Visual Systems.

2. Location: **<< Interior; Exterior; or _____>>**.
3. Mounting: **<< Recessed; Surface mounted; or _____>>**.
4. Width: **<< 3 feet; 4 feet; 5 feet; 6 feet; 8 feet; 10 feet; 12 feet; _____ feet; or As indicated on drawings>>**.
5. Height: **<< 3 feet; 4 feet; ____ feet; or As indicated on drawings>>**.
6. Depth: **<< 3 inches; 4 inches; ____ inches; As indicated on drawings; Manufacturer's standard; or _____>>**.
7. Aluminum Frames: Extruded aluminum, with concealed fasteners. **<< Anodized, natural; Anodized, medium bronze; Anodized, dark bronze; Anodized, ____; Baked enamel, ____; Powder coat, ____; or _____>>** finish.
   a. Exterior Bulletin Boards: Weather-resistant construction with vents to dissipate trapped moisture, weather-resistant tackable panels, and weather-stripped hinged doors.
8. Frame Profile: **<< Square; Radiused; or _____>>** frame section with **<< square; radiused; or _____>>** cabinet corners.
9. Components:
   a. Glazed Doors: **<< Sliding; Hinged; or _____>>**, **<< tempered glass; clear acrylic sheet; or _____>>**.
      1) Number of Doors: **<< One pair; Two pair; Three pair; Four pair; As indicated on drawings; or _____>>**.
   b. Tackable Back Panel: **<< Fine-grained, homogeneous natural cork; Composition cork; Fabric laminated to cork; Fabric laminated to fiberboard; or ____>>**.
   c. Lighting: LED**<< Fluorescent; LED; _____; or None>>**.

2.02 MATERIALS

A. Porcelain Enameled Steel Sheet: **<<ASTM A424/A424M>>**, Type I, Commercial Steel, with fired-on vitreous finish.

B. **<< Non-woven PVC-free Coated; Vinyl-Coated ; or None - N/A>>** Fabric: Roll stock, complying with the following:
   1. Content: **<< Polyurethane; Silicone; PVC-free Vinyl; Vinyl; or _____>>**.
   2. Color: As selected by Architect from manufacturer's full range.
   3. Manufacturers:
      a. Architex.
      b. Arc-Com.
      c. Carnegie.
      d. Designtex.
      e. Maharam.
      f. Momentum Textiles and Wallcovering.
      g. Pallas.
      h. Wolf-Gordon, Inc.

C. Natural Cork: Natural ground cork, homogeneous and self-healing, laminated to manufacturer's standard backer with no additional resin or plastic additive.

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D. Composition Cork: Natural ground cork mixed with resinous or polymeric binders, linseed oil, and color pigments laminated to manufacturer's standard backer to create a seamless, self-sealing sheet.

E. Burlap: Tightly woven, flame retardant treated.

F. Hardboard for Cores: **<<ANSI A135.4>>**, Class 1 - Tempered, **<< S2S (smooth two sides); S1S (smooth one side); or _____>>**.

G. Particleboard: **<<ANSI A208.1>>**; wood chips, shavings, or flakes, set with waterproof resin binder, sanded faces.

H. Fiber Board: **<<ASTM C208>>**, cellulosic fiber board.

I. Foil Backing: Aluminum foil sheet, 0.005 inch thick. Provide foil backing on units indicated to be mounted on exterior walls.

J. Aluminum Sheet Backing: 27 gauge, 0.014 inch thick.

K. Adhesives: As recommended by manufacturer.

2.03 ACCESSORIES

A. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert and runners for accessories**<< ; 1 inch wide overall; ; ___ inch wide; or None - N/A>> << , full width of frame; or None - N/A>>**.

B. Map Supports: Formed aluminum sliding **<< hooks; roller brackets; and _____>>** to fit map rail.

C. Temporary Protective Cover: Sheet polyethylene, **<< 8 mil; or ____ mil>>** thick.

D. Flag Holders: Cast aluminum bored to receive 1 inch diameter flag staff, bracketed to fit top rail of board. Provide one per classroom.

E. Cleaning Instruction Plate: Provide instructions for **<< markerboard; chalkboard; or _____>>** cleaning on a **<< metal; plastic; or _____>>** plate fastened to perimeter frame near **<< chalkrail; marker rail; or _____>>**.

F. **<< Marker; Chalk; or _____ >>** Tray: Aluminum**<< , manufacturer's standard profile; , manufacturer's standard extruded profile; , manufacturer's standard formed profile; , style as indicated on drawings; , _____; or None - N/A>><< , one piece full length of markerboard; , one piece full length of chalkboard; , _____; or None - N/A>><< , molded ends; , closed ends; , _____ ends; or None - N/A>>**, **<< concealed fasteners; manufacturer's standard fastening method; or _____>>**, **<< same finish as frame; or _____>>**.

G. Mounting Brackets: Concealed.

H. Mounting Accessories and Fasteners: Provide concealed Z-clips and hangers, and stainless steel screws or anchors for mechanical attachment of visual display units.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as **<< indicated on shop drawings; instructed by the manufacturer; or _____>>**. Refer to Division 6 Section "Rough Carpentry."

C. Verify flat wall surface for frameless adhesive-applied boards.

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3.02 PREPARATION

A. Acclimatize tackable wall panels by removing from packaging in installation area not less than 24 hours before application.

B. Remove switchplates, wall plates, and surface-mounted fixtures where tackable wall paneling is applied. Reinstall items on completion of installation.

C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install boards in accordance with manufacturer's instructions.

B. Install with bottom of perimeter frame **<< top of marker tray; or bottom of perimeter frame>>** at **<< 18 inches; 24 inches; 36 inches; or ___ inches>>** above finished floor. ******MCPS prefers 18 inches for Pre-K and K, 24 inches for Grade 1-5, 24 inches for ES Art/Music/Gym/Dual Purpose Rooms, and 36 inches for HS, MS, and Staff Areas.******

1. Mount continuous tackstrip directly above each porcelain markerboard in all classrooms.

C. Secure units level and plumb.

D. Adhesive Attachment: Install continuous bottom angle using mechanical fasteners at heights indicated. Install all markerboard and tackboard units with golf-ball size globs of heavy-duty construction adhesive at approximate 12 inch spacing. Do not apply adhesive closer than 6 inches to any edge. Set visual display unit on bottom angle and press firmly to the wall.

1. Provide secondary securement of board with mechanical fasteners through bottom trim and through bottom angle.
2. Brace board against wall for minimum 48 hours to ensure adhesive is fully dried.

E. Install porcelain markerboards and tackboards with backs mounted directly against wall surface.

F. Install tackable wall panels in accordance with manufacturer's recommendations on specified substrates with concealed attachments.

1. Fabricate re-wrapped edges where partial panels abut each other, or adjacent surfaces or trim.
2. Re-wrap top, bottom or side edges for cutting panels around door or window openings, abutting trim, protruding objects, and at other openings, including x-cut at receptacles, light switches, and other openings.
   a. Wrap minimum **<< 2 inches>>** around back of panel.

3.04 CLEANING

A. Clean board surfaces in accordance with manufacturer's instructions.

B. Cover with protective cover, taped to frame.

C. Remove temporary protective cover at Date of Substantial Completion.

END OF SECTION 101100

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SECTION 101200
DISPLAY CASES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AAMA 611 - Specification for Anodized Architectural Aluminum.

B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

C. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

D. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

F. AWS D1.2/D1.2M - Structural Welding Code - Aluminum.

1.02 SUBMITTALS

A. Product Data: Submit complete printed data and installation details indicating products to be provided as specified.

B. Shop Drawings: Submit complete installation details. Include dimensioned elevations.

C. Selection Samples: Submit color charts indicating manufacturer's full range of available options for tackable fabric panels.

D. Verification Samples: Submit physical samples, manufacturer's standard size, of each selected color of tackable fabric material, and of trim material, to illustrate finish, color, and texture.

E. Manufacturer's Qualification Statement.

F. Installer's Qualification Statement.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing factory-fabricated display cases as specified in this section.

B. Installer Qualifications: Installation crew directly employed by manufacturer of products, or a company approved by manufacturer for installation of specified products.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver display cases and materials to the Project site with manufacturer’s protective crate covering and do not open until ready for use.

B. Protect display cases before, during, and after installation. In case of damage, immediately provide necessary repairs and replacements.

1.05 FIELD CONDITIONS

A. Field Measurements: Verify field measurements for recessed application for display cases before preparation of shop drawings and before fabrication to ensure proper installation.

1.06 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

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B. Provide **<< five; or ____>>** year manufacturer warranty against defects and in materials, finish product and workmanship; beginning at the Date of Substantial Completion.

PART 2 PRODUCTS

2.01 DISPLAY CASES

A. Manufacturers:
1. Claridge Products and Equipment, Inc.
2. MooreCo, Inc.
3. Nelson Adams NACO.
4. Platinum Visual Systems.
5. Poblocki Sign Company, LLC.
6. The Tablet & Ticket Co. (Basis-of-Design).

B. General: Provide only factory-fabricated and factory-assembled display cases. Display cases that are "stick-built" at the Project site or that are shipped disassembled for assembly on site are not acceptable.
1. Provide welded aluminum frames with tight mitered joints. Comply with **<<AWS D1.2/D1.2M>>** for welding aluminum. Clean and finish exposed welds to remove flux and blend surfaces smooth so that welded surface matches adjacent surface.
2. Fabricate display cases with no visible fasteners.

C. Recessed Display Case: Factory-fabricated aluminum-framed display case with adjustable glass shelves, finished interior, and **<< wood; aluminum; or _____>>** trim on face to cover edge of recessed opening.
1. Dimensions: As indicated on Drawings.
2. Components:
a. Glazed Doors: **<< Sliding; Hinged; or _____>>**.
1) Number of Doors: **<< One pair; Two pair; Three pair; Four pair; As indicated on drawings; or _____>>**.
b. Side, Top, and Bottom Panels: **<< Stained veneer plywood; Laminate-faced substrate; or _____>>**.
c. Back Panel: **<< Tackable; Laminate-faced; Stained veneer plywood; or _____>>** fabric over cork.
d. Top Panel: **<< Stained veneer plywood; Laminate-faced substrate; or _____>>**.
e. Bottom Panel: **<< Stained veneer plywood; Laminate-faced substrate; or _____>>**.
f. Lighting: LED.

D. Semi-Recessed Display Case: Factory-fabricated aluminum-framed display case with adjustable glass shelves, finished interior, and **<< wood; aluminum; or _____>>** trim on face to cover edge of recessed opening.
1. Dimensions: As indicated on Drawings.
2. Components:
a. Glazed Doors: **<< Sliding; Hinged; or _____>>**.
1) Number of Doors: **<< One pair; Two pair; Three pair; Four pair; As indicated on drawings; or _____>>**.
b. Side Panels: **<< Stained veneer plywood; Laminate-faced substrate; or _____>>**.

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c. Back Panel: **<< Tackable; Laminate-faced; Stained veneer plywood; or _____>>** fabric over cork.
d. Top Panel: **<< Stained veneer plywood; Laminate-faced substrate; or _____>>**.
e. Bottom Panel: **<< Stained veneer plywood; Laminate-faced substrate; or _____>>**.
f. Lighting: LED.

E. Surface-Mounted Display Case: Factory-fabricated **<< wood-framed; aluminum-framed; or _____>>** display case with adjustable glass shelves, finished interior.
1. Dimensions as indicated on Drawings.
2. Components:
a. Glazed Doors: **<< Sliding; Hinged; or _____>>**.
1) Number of Doors: **<< One pair; Two pair; Three pair; Four pair; As indicated on drawings; or _____>>**.
b. Side Panels: **<< Tempered clear glass; Stained veneer plywood; Laminate-faced substrate; Extruded aluminum; or _____>>**.
c. Back Panel: **<< Tackable; Laminate-faced; Tempered clear glass; or _____>>**.
d. Top Panel: **<< Stained veneer plywood; Laminate-faced substrate; Extruded aluminum; or _____>>**.
e. Bottom Panel: **<< Stained veneer plywood; Laminate-faced substrate; Extruded aluminum; or _____>>**.
f. Lighting: LED.

2.02 COMPONENTS

A. Wood Case Construction: 3/4 inch 7-ply **<< maple; oak; cherry; walnut; or _____>>** veneer plywood with manufacturer's **<< standard; custom; or _____>>** stain.

B. Aluminum Framed Case Construction: 1-1/2 inch by 2 inch extruded aluminum tube frame with **<< tempered glass; laminate-faced; stained veneer plywood; and _____>>** (white maple) panels at top, bottom, and sides.

C. Face Frame Trim for Recessed Installation: **<< 2 inch; 3-1/2 inch; 4 inch; or _____ inch>> << flat; radiused; or _____>>** face dimension extruded aluminum trim mitered with corner clips and mechanical fasteners.

D. Glazed Sliding Doors:
1. 3/8 inch clear tempered glass with plastic finger pulls.
2. Door track: Extruded aluminum glass shoe with bottom rollers and top plastic guide.
3. Lock: **<< Glass door cylinder lock; Track plunger lock; Ratchet lock; or _____>>**.

E. Glazed Hinged Doors:
1. 1/4 inch clear tempered glass framed with 1/2 inch by 1 inch extruded aluminum trim.
2. Hinges: 1 inch by 0.040 inch nickel-plated steel-continuous piano hinges.
3. Lock: **<< Glass door cylinder lock; Track plunger lock; Ratchet lock; or _____>>**.

F. Glass Shelves:
1. 3/8 inch clear tempered glass with flat-polished edges.
2. Shelf Depth: **<< 4 inches; 6 inches; 8 inches; 10 inches; 12 inches; _____ inches; or As indicated on drawings>>**.
3. Shelves per Unit: **<< Two; Three; As indicated on drawings; or _____>>**.

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G. Shelf Standards and Brackets: Single-slotted channel standards for brackets adjustable in **<< 1 inch>>** increments along entire length of standard, drilled and countersunk for screws.
   1. Standards Mounting: Recess-mounted into back panel.
   2. Face Width: 5/8 inch.
   3. Material: Minimum 16 gauge, 0.0589 inch sheet steel.
   4. Standard Lengths: Extend all standards full height of display cases.
   5. Brackets: Boltless with lip front; minimum **<< 16 gauge, 0.0598 inch>>** sheet steel, reinforced, locking into slots; size to suit shelves; same finish as standards.

H. Tackable Back Panel: **<< Fine-grained, homogeneous natural cork; Composition cork; Linoleum-modified cork; Fabric laminated to cork; Fabric laminated to fiberboard; Vinyl laminated to cork; Vinyl laminated to fiberboard; or ____>><< None - N/A; on hardboard; on fiberboard; or _____>>**.
   1. Cork Thickness: **<< 1/8 inch; 1/4 inch; 7/32 inch; or ___ inch>>**.
   2. Fabric: **<< Vinyl fabric; Non-woven PVC-free fabric; Burlap; or _____>>**; minimum fabric weight: **<< 13 oz/sq yd; 15 oz/sq yd; 16 oz/sq yd; 25 oz/sq yd; or ___ oz/sq yd>>**.
   3. Color, Texture, Weave, and Pattern: **<< As selected from manufacturer's full range; As indicated on drawings; or _____>>**.
   4. Backing: **<< Fiberboard; Hardboard; or _____>>**, **<< 1/4 inch; 3/8 inch; 1/2 inch; or ___ inch>>** thick, factory laminated to tack surface.
   5. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of **<< 450; or ___ >>**, maximum, when tested in accordance with **<<ASTM E84>>**.

I. Laminate Back Panel: High-pressure laminate on one face of **<< plywood; hardboard; or _____>>** substrate.
   1. Laminate Color and Texture: **<< As selected from manufacturer's full range; As indicated on drawings; or _____>>**.

J. Lighting: Manufacturer's standard LED light fixture housed at top of case with louvered aluminum access door with keyed lock.
   1. Surface Mounted: Under cabinet type fixture.
   2. Controls: On/Off using **<< dedicated wall switch; switch mounted on display case; room overhead lighting switch; or _____>>**.

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2.03 MATERIALS

A. Aluminum Extrusions: **<<ASTM B221>>** (**<<ASTM B221M>>**), **<< 6063; or ____>>** alloy, **<< T5; or ____>>** temper.
   1. Finish: Factory anodized; **<<AAMA 611>>**: **<< Clear anodized; Medium bronze anodized; Dark bronze anodized; _____ anodized; Color as selected by Architect; Color as selected from manufacturers standard line; or _____>>**.

B. Plywood: Softwood plywood with **<< veneer; lumber; or particleboard>>** core, waterproof glue, 3/4 inch thick.

C. Heat-Strengthened and Fully Tempered Glass: **<<ASTM C1048>>**, Kind FT.

D. Fasteners: Provide screws, bolts, and other fasteners as recommended by manufacturer for substrates indicated, and in sizes and lengths required for secure attachment of display case product to substrate.
   1. For fastening to masonry substrates, provide stainless steel or galvanized steel fasteners.

PART 3 EXECUTION

3.01 EXAMINATION & PREPARATION

A. Examination: Verify that rough openings match field measurements and that rough openings and conditions are acceptable for product installation.

B. Verify that electrical conduit, wiring, and other work that will be concealed by display case is complete and ready for installation.

C. Provide blocking, grounds, and shims as required for display cases to be mounted securely, plumb and level, within rough openings.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Locate fastening devices to secure cases securely to sides of rough opening.
   1. Locate at manufacturer's required spacing, but not more than 16 inches o.c.
   2. Fasteners shall be concealed in the final installation.

C. Install recessed display cases plumb and level in wall openings.

D. Refer to drawings for display case mounting heights.

E. Provide mitered and wrapped hairline joints for all trims.

F. Coordinate with electrical installer to ensure lighting is properly connected and operational.

3.03 ADJUSTING AND CLEANING

A. Verify that all accessories are installed as detailed for each unit.

B. Restore and touch up damaged or worn areas of factory finishes.

C. At completion of work, clean glass surfaces, back panels and trim in accordance with manufacturer’s recommendations leaving units ready for use.

END OF SECTION 101200

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SECTION 101400
SIGNAGE

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines.

B. ADA Standards - 2010 ADA Standards for Accessible Design.

C. ICC A117.1 - Accessible and Usable Buildings and Facilities.

D. UL 879 - Electric Sign Components.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Allowance: Interior and exterior panel signage shall be covered by allowance; refer to Division 1 Section "Allowances."

B. Pre-Fabrication Meeting: The signage contractor shall meet with representatives of the Owner to develop a Signage Schedule, including signage style and layout, individual sign locations, including locations of code required signage and wayfinding signage, and final room naming and numbering. The Architect will provide the graphics contractor with reproducible floor plan drawings for use in determining sign locations.

1.03 SUBMITTALS

A. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.

B. Signage Schedule**<< (After Pre-Fabrication Meeting); or None - N/A>>**: Submit schedule with information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.

1. Submit for approval by **<<Owner>>** through **<<Architect>>** prior to fabrication.

C. Selection Samples: Where colors are not specified, submit color selection charts or chips for each type of signage.

D. Verification Samples: Submit samples, manufacturer's standard size, showing selected colors for each type of signage.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Package room and door signs in sequential order of installation, labeled by floor or building.

C. Store tape adhesive at normal room temperature.

1.05 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

B. Maintain this minimum temperature during and after installation of signs.

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PART 2 PRODUCTS

2.01 SIGNAGE APPLICATIONS

A. Accessibility Compliance: Signs are required to comply with **<<ADA Standards>>** and **<<ICC A117.1>><< and applicable building codes; _____; or None - N/A>>**, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.

1. Sign Type: **<< Flat; Curved; or _____>>** signs with **<< engraved; injection molded; applied character; etched metal; or _____>>** panel media as specified.
2. Provide "tactile" signage, with letters raised minimum **<< 1/32 inch>>** and Grade II braille.
3. Toilet room signage shall include pictograms and international symbol of accessibility.

C. Plaque: See Allowance for details.

2.02 PANEL SIGNAGE TYPES

A. ******Coordinate Signage with wall protection if using 4 foot high rigid wall protection wainscot. Refer to Division 10****** General: Interior and exterior panel signage shall be provided via lump-sum allowance; refer to Division 1 Section "Allowances."

B. Manufacturers:

1. **Adcorp.**
2. Allen Industries Architectural Signage.
3. APCO Graphics, Inc.
4. ASI-Modulex, Inc.
5. **Bayuk Graphic Systems, Inc.**
6. **Best Sign Systems, Inc.**
7. **Digital Color Graphics.**
8. Gemini Incorporated.
9. Innerface Sign Systems, Inc.
10. InPro Corporation.
11. Matthews International Corporation, Bronze Division.
12. **Mohawk Sign Systems.**
13. Nelson-Harkins Industries.
14. Seton Identification Products.
15. **Signs and Wonders.**
16. **The Supersine Company.**
17. Welch Sign Company.
18. Worth Higgins and Associates.

C. Photopolymer Panel Signage: Signage media **<< without; in aluminum; in matching plastic; or _____>>** frame.

1. Signage Material: 0.032-inch water wash photopolymer face layer over a 0.160-inch phenolic or 0.120-inch PETG base layer.
   a. Thickness: 0.080 inch.
2. Edges: Bevelled.
3. Corners: Round.

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4. Wall Mounting of One-Sided Signs: **<< Tape adhesive; Concealed screws; Concealed or exposed screws; or _____>>**. Finish perimeter with sealant.
   a. For signs mounted to glass, such as at door sidelights, provide a rear cover plate so the backside of sign will not be visible through the glass.
5. Tactile Signage: Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.

D. Color and Font: Unless otherwise indicated, panel signage, font, and color shall be **<< selected from manufacturer's full range; custom designed in collaboration with Architect; or _____>>**.

E. Code-Required Signage: In addition to the room signage, provide panel signage required by accessibility regulations and requirements of authorities having jurisdiction, including, but not limited to, the following:
1. Tactile exit signs, stairway identification signs, room maximum capacity signs, elevator signs, and accessible space signs.
2. Refer to Division 26 and Electrical Drawings for illuminated exit and area of refuge signs.

2.03 PLAQUES

A. Manufacturers:
1. Advance Corporation; Braille-Tac Division.
2. A.R.K. Ramos.
3. Gemini Incorporated.
4. Matthews International Corporation, Bronze Division.
5. Metal Arts; Division of L&H Manufacturing Co.
6. Mills Manufacturing Company.
7. Nelson-Harkins Industries.
8. The Southwell Company.
9. Worth Higgins and Associates.

B. Metal Plaques:
1. Metal: **<< Aluminum casting; Bronze casting; Brass casting; Bronze sheet, flat, etched; Copper sheet, flat, etched; Brass sheet, flat, etched; Stainless steel sheet, flat, etched; Aluminum sheet, flat, etched; Magnesium sheet, flat, etched; Zinc sheet, flat, etched; or _____>>**.
2. Size: For bid purposes assume one 18 inch wide by 12 inch high plaque, with raised text. Confirm final size and desired information, text, and typeface, with Owner.
3. Text and Typeface:
   a. Character Font: Helvetica.
4. Surface Finish: **<< Brushed, satin; Polished; As selected by Architect from manufacturer's full range; or _____>>**.
5. Painted Background Color: **<< Light oxide stain; Dark oxide stain; Dark green; Metallic gray; Black; Natural sandblast; Light bronze; Medium bronze; Dark bronze; As selected by Architect from manufacturer's standard background colors; or _____>>**.
6. Protective Coating: **<< Manufacturer's standard clear coating; None; or _____>>**.
7. Mounting: Stud mounted, with concealed studs.

2.04 DIMENSIONAL LETTERS

A. Manufacturers:

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1. A.R.K. Ramos.
2. ASI-Modulex, Inc.
3. Charleston Industries, Inc.
4. Gemini Incorporated.
5. Innerface Sign Systems, Inc.
6. Matthews International Corporation, Bronze Division.
7. Metal Arts; Division of L&H Manufacturing Co.
8. Mills Manufacturing Company.
9. Mohawk Sign Systems.
10. Superior Signs.
11. Worth Higgins and Associates.
12. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Metal Letters:

1. Metal: **<< Aluminum casting; Bronze casting; Aluminum sheet, flat; Bronze sheet, flat; Stainless steel sheet, flat; Stainless steel sheet, formed; Brass sheet, flat; Weathering steel sheet, flat; Aluminum sheet, fabricated reverse channel; Stainless steel sheet, fabricated reverse channel; or _____>>**.
2. Letter Thickness: Provide manufacturer's standard for height indicated, or as follows:
   a. 9 inches high or less: 3/4 inch thick.
   b. 10- to 14-inches high: 1 inch thick.
   c. 15- to 17-inches high: 1-1/4 inches thick.
   d. 18 inches high or more: 1-1/2 inches thick.
3. Letter Height: **<< _____ inches; As indicated on drawings; As indicated on signage schedule; or _____>>**.
4. Text and Typeface: As indicated; where not indicated, as selected by Architect from manufacturer's full range of fonts.
5. Finish: **<< Brushed, satin; Polished; As selected by Architect from manufacturer's full range; or Painted; color as selected by Architect from manufacturer's full range>>**.
6. Mounting: Fabricate dimensional lettering for the following mounting types:
   a. Projected Wall Mounted: Cast studs into the back of each letter for wall mounting at location indicated. Studs shall be sized to extend through cladding and fasten to structural substrate. Provide for a 1/2-inch gap between back of letter and face of cladding. Do not mount directly flush to wall surface.
   b. Flush Wall Mounted: Cast studs into back of each letter for mounting to wall. Mount flush to wall surface with no gap behind letters.
   c. Bottom Stud Mount: Provide characters with studs cast into bottom and with flattened base, and fasten directly to structural substrate below.
   d. Bottom Rail Mount: Provide characters with flattened base, and fasten to an aluminum C-channel rail with stainless steel screws. Rail shall have black enamel finish. Provide vertical post supports extending to structural substrate and fasten securely and seal penetrations watertight.

2.05 APPLIED VINYL CHARACTERS

A. Applied Vinyl Letters/Numbers: Provide die cut vinyl film characters of 3 mil minimum nominal thickness. Characters shall have manufacturer's standard adhesive backing suitable for outdoor or indoor installation. Refer to Drawings for locations.

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2.06 LED VIDEO DISPLAY (ELECTRONIC MESSAGE CENTER)

A. Manufacturers:
   1. Daktronics, Inc.
   2. LG Electronics.
   3. Stewart Signs.
   4. ThinkSign Inc.

B. System Type: Single-sided, outdoor/exterior; capable of both graphics and text.
   1. Provide products that are listed and labeled as complying with **<<UL 879>>**, where applicable.
   2. Size: 96 inch by 36 inch viewing area, unless otherwise indicated.
   3. Pixel Pitch: 10 mm.
   4. Brightness: 7,500 Nits.
   5. Mounting: Custom wall mount into recessed masonry rough opening. Coordinate total rough opening size required with masonry contractor.
   6. Electrical Characteristics: 120V, 60 Hz, single phase.
   7. Control Interface: Provide secure wireless/remote cellullar connection as standard with manufacturer, and with cloud-based software.
      a. Contractor shall provide training for school staff in access to and usage of software.

2.07 ACCESSORIES

A. Applied Vinyl Film (Characters): Provide nominal 3 mil thickness vinyl film; die cut into characters required. Film shall have pressure-sensitive adhesive backing, and shall be suitable for both interior and exterior application to glazing surfaces.

B. Concealed Screws: Stainless steel, or other non-corroding metal.

C. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install neatly, with horizontal edges level.

C. Locate signs and mount at heights indicated on drawings and in accordance with **<<ADA Standards>>** and **<<ICC A117.1>>**.
   1. Room Signs: Mount on latch side, with a clear space of 18 inches by 18 inches beyond the door swing arc, centered on the tactile characters. At double doors, mount to the right of right-hand leaf or on nearest adjacent wall. Mount at height that is compliant with ADA Standards.

D. Mounting, Dimensional Letters:
   1. Projected Wall Mounted: Cast studs into the back of each letter for wall mounting at location indicated. Studs shall be sized to extend through cladding and fasten to structural substrate. Provide for a 1/2-inch gap between back of letter and face of cladding. Do not mount directly flush to wall surface.

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2. Flush Wall Mounted: Cast studs into back of each letter for mounting to wall. Mount flush to wall surface with no gap behind letters.
3. Bottom Stud Mount: Provide characters with studs cast into bottom and with flattened base, and fasten directly to structural substrate below.
4. Bottom Rail Mount: Provide characters with flattened base, and fasten to an aluminum C-channel rail with stainless steel screws. Rail shall have black enamel finish. Provide vertical post supports extending to structural substrate and fasten securely and seal penetrations watertight.

E. Mounting, Plaques:
1. Mount plaques with manufacturer's standard concealed stud method; with anchors recommended specifically for wall/partition substrate structure indicated. Mount plaques flush to wall surface with no gap behind plaques.

F. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION 101400

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SECTION 102113.19
PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design.

B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

C. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

D. ASTM A743/A743M - Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.

E. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings.

F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

I. ICC (IBC) - International Building Code.

J. ICC A117.1 - Accessible and Usable Buildings and Facilities.

K. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings where required.

1.03 SUBMITTALS

A. Product Data: Provide data on panel construction, hardware, and accessories.
   1. Provide data for wall anchors for attachment of wall brackets.
   2. Provide data substantiating that door latch product complies with accessibility standards.
   3. Provide data indicating NFPA 286 testing and compliance.

B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of **<< wall; floor; and ceiling>>** supports, door swings.
   1. Include locations of plumbing fixtures and floor drains.
   2. Include accessible and ambulatory stalls, including stall and door clearances.

C. Selection Samples: Submit color charts indicating manufacturer's full range of colors. **<< Color charts shall indicate which colors are NFPA 286 compliant.; or None - N/A>>**

D. Verification Samples: Submit manufacturer's physical samples of each selected color.

E. Samples: **<< Two; or _____>>** sample blocks, **<< 6 by 6 inches; or _____ by _____ inches>>** in size, illustrating partition panel finish, color, and sheen.

F. Sustainable Design Documentation: Indicate postconsumer and preconsumer recycled content and cost for recycled content.

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G. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods. Describe cleaning materials detrimental to finish surfaces and hardware finish.

H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. See Section **<< 017419 - Construction Waste Management and Disposal>>** for packaging waste requirements.

B. Deliver, store, and handle materials and products in accordance with manufacturer's instructions and recommendations and industry standards.

C. Store products indoors in manufacturer's or fabricator's original containers and packaging, with labels clearly identifying product name and manufacturer. Protect products from damage.

D. Lay cartons flat; support to ensure flatness and prevent damage to prefinished surfaces.

1.05 FIELD CONDITIONS

A. Ambient Conditions: Maintain environmental conditions, such as temperature, humidity, and ventilation, within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.06 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Manufacturer Warranty: Provide **<< 10-year; 15-year; or _____>>** manufacturer warranty for material against breakage, corrosion, and delamination. Complete forms in **<<Owner>>**'s name and register with manufacturer.

1.07 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Provide **<< two; five; ten; or 15>>** year manufacturer warranty against defects in material and workmanship, excluding abuse.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Solid Plastic Toilet Compartments:
   1. ASI Accurate Partitions.
   2. ASI Global Partitions.
   3. Hadrian.
   4. General Partitions Mfg. Corp.
   5. Scranton Products.
   6. Substitutions: **<< Section 016000 - Product Requirements; or Not permitted>>**.

2.02 PERFORMANCE REQUIREMENTS

A. Accessibility: Comply with **<<ICC A117.1>>** and **<<ADA Standards>>**.

B. Fire-Test-Response Characteristics: Provide HDPE panels tested per **<<NFPA 286>>** and shown to meet the following criteria:

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1. During the 40 kW exposure, flames shall not spread to the ceiling.
2. During the 160 kW exposure:
   a. Flame shall not spread to the outer extremity of the sample on any wall or ceiling.
   b. Flashover, as defined in **<<NFPA 286>>**, shall not occur.
3. The peak rate of heat release throughout the **<<NFPA 286>>** test shall not exceed 800 kW.
4. The total smoke released throughout the **<<NFPA 286>>** test shall not exceed 1,000 m^2.

2.03 PLASTIC TOILET COMPARTMENTS

A. Solid Plastic Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded 100 percent post-consumer recycled content high density polyethylene (HDPE), tested in accordance with NFPA 286; floor-mounted headrail-braced.
   1. Color(s): As selected by Architect from manufacturer's full range of NFPA 286 compliant colors. ******Not all HDPE colors are Class A fire-rated, and it is not consistent across manufacturers. Confirm fire-rating when selecting colors.******
   2. Doors: All door widths shall be clear widths with door open at 90 degrees.
      a. Thickness: 1 inch.
      b. Door Width (Standard Stalls): 24 inch, in-swinging.
      c. Door Width (Ambulatory Stalls): 32 inch, out-swinging.
      d. Door Width (Accessible Stalls): 36 inch, out-swinging.
      e. Height: 55 inch.
   3. Panels:
      a. Thickness: 1 inch.
      b. Height: 55 inch.
   4. Pilasters:
      a. Thickness: 1 inch.
      b. Width: As required to fit space; minimum 3 inches.
   5. Urinal Partitions: Provide wall mounted type (no post/pilaster).
      a. Thickness: 1 inch.
      b. Height: 55 inches.
      c. Depth: 1'-10" minimum. Verify with depth of submitted urinal product; front of urinal partition shall extend a minimum of 6 inches beyond the outermost front lip of the urinal.

B. Fabrication
   1. Fabricate toilet compartment components to sizes indicated in shop drawings.
   2. Coordinate requirements and provide cutouts for through-partition toilet accessories.
   3. Provide high shoes and caps at pilasters and posts to conceal anchorage, supports, and leveling mechanisms.
   4. Provide manufacturer's standard corrosion-resistant supports, leveling mechanisms, anchors, and anchoring assemblies for pilasters and posts.
   5. Floor-Anchored, Overhead-Braced Units: Provide supports, leveling mechanisms, and anchors at pilasters to suit floor conditions.
   6. Urinal and Entrance Screen Posts: Provide anchoring assemblies with leveling adjustment at **<< tops; bottoms; and _____>>** of posts.

C. Materials
   1. Aluminum Castings: **<<ASTM B26/B26M>>**.

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2. Aluminum Extrusions: **<<ASTM B221>>** (**<<ASTM B221M>>**).
3. High-Density Polyethylene (HDPE):
   a. Composition: Formed from waterproof, nonabsorbent, HDPE resins.
   b. Properties: Mark-resistant, self-lubricating surface.
   c. Material Fire Ratings: **<<ICC (IBC)>>**, Class B.
4. Stainless Steel Sheet, Plate, and Bar: **<<ASTM A240/A240M>>** or **<<ASTM A666/A666M>>**, Type 304, stretcher-leveled standard of flatness.
5. Stainless Steel Castings: **<<ASTM A743/A743M>>**.

2.04 ACCESSORIES

A. Material for Hardware and Accessories: Provide stainless steel or anodized aluminum as indicated, with satin finish. Where not indicated, Contractor may provide either material at its option. Zamac is not acceptable.
   1. All hardware at out-swinging doors shall comply with accessibility regulations.

B. Heat-Sink Strip: Manfuacturer's standard aluminum strip applied to bottom edge of doors and panels.

C. Pilaster Shoes: **<< Stainless steel, satin finish; Plastic, to match compartments; Solid surface, to match compartments; or _____>>**, 4 inches high; concealing **<< floor; ceiling; wall; and _____>>** fastenings.
   1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.

D. Headrails: **<< Extruded aluminum; Steel clad with solid surface material; or _____>>**,**<< anti-grip profile; _____; or None - N/A>>**.
   1. Size: **<< Manufacturer's standard size; 1 by 1-1/2 inches; _____ by _____ inches; or _____>>**.

E. **<< Wall; Pilaster; and _____>>** Brackets: Natural anodized aluminum with minimum 0.125 inch wall thickness; continuous type.

F. Attachments, Screws, and Bolts: Stainless steel**<< , tamper proof type; or None - N/A>>**.
   1. For attaching panels and pilasters to brackets: Through-bolts and nuts**<< ; tamper proof; or None - N/A>>**.
   2. Wood Blocking and Supports: Refer to Division 06 section.

G. Hinges: Coordinate hinges with latch and keeper to provide emergency access.
   1. Continuous (Piano) Hinges (Heavy-Duty): 3-inch-wide, continuous, 0.062-inch (16 gauge) thick stainless steel piano hinge with 1/8-inch stainless steel pivot pin. Provide spring-loaded self-closing type with five (5) adjustable internal springs at accessible, barrier-free, and outswing doors, and provide gravity type with cam knuckles that can be adjusted to hold doors open at inswinging doors. Hinge length shall be a maximum of 1 inch less than door height. Provide pre-drilled hinge leaves for mounting and stainless steel through-bolts; holes at 12 inches o.c.

H. Door Hardware: Coordinate latch and keeper with hinges to provide emergency access.
   1. Door Latch (Heavy-Duty): **<< Slide type; Thumbturn type; or _____>><< with exterior emergency access feature; with _____; or None - N/A>>**, cast stainless steel with minimum 0.150-inch thickness slide bar, latch knob welded to slide bar.
   2. Door Strike and Keeper with Rubber Bumper (Heavy-Duty): Cast stainless steel, minimum 2.5-inch high with minimum 0.125-inch wall thickness, with integral rubber bumper. Mount on pilaster in alignment with door latch.

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3. Provide a door pull on both sides of door for accessible and ambulatory compartments, in compliance with the ADA Standards for Accessible Design.

I. Coat Hook with Rubber Bumper: One per compartment, mounted centered on inside face of door.

J. Rubber Door Bumper: Mount in upper corner on latch side of outswinging doors where door will impact wall in the open position.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and interfaces with other work.

B. Verify spacing of and between plumbing fixtures.

C. Verify location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's written instructions.

B. Install toilet partitions with minimum 12 inch toe space clearance from bottom of partition to top of finished floor surface. Do not exceed 12-1/2 inch clearance above finished floor.

C. Install urinal partitions with bottom of partition at a height not greater than 12 inches above finished floor surface, but not lower than 11-1/2 inches above finished floor.

D. Maintain 3/8-to-1/2-inch space between wall and panels and between wall and end pilasters.

E. Attach panel brackets securely to walls using anchor devices.

F. Attach panels and pilasters to brackets. Locate headrail joints at pilaster center lines.

3.03 TOLERANCES

A. Maximum Variation from True Position: 1/4 inch.

B. Maximum Variation from Plumb: 1/8 inch.

3.04 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding **<< 3/16 inch>>**.

B. Adjust hinges to position doors in partially open position when unlatched. Return outswinging doors to closed position.

C. Adjust adjacent components for consistency of line or plane.

END OF SECTION 102113.19

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SECTION 102123
CUBICLE CURTAINS AND TRACK

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.

1.02 SUBMITTALS

A. Product Data: Provide data for curtain fabric characteristics**<< and for curtain track; or None - N/A>>**.
   1. Fire Test Data: Provide data indicating fabric is identical to that which has passed**<<NFPA 701>>** and is inherently and permanently flame resistant.

B. Shop Drawings: Indicate a reflected ceiling plan view of curtain track, hangers and suspension points, attachment details, schedule of curtain sizes. Include above ceiling blocking.

C. Selection Samples: Manufacturer's pattern and color charts for curtain and mesh fabrics.

D. Verification Samples: Submit 12 by 12 inch sample patches of curtain and mesh cloth with representative top, bottom, and edge hem stitch detail, heading with reinforcement and carrier attachment to curtain header.

E. Maintenance Data: Include recommended cleaning methods and materials and stain removal methods.

F. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.
   1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
   2. Extra Curtains: Two of each type and size.
   3. Extra Carriers: Ten.

PART 2 PRODUCTS

2.01 TRACKS AND TRACK COMPONENTS

A. Tracks: Extruded aluminum sections; minimum 0.050-inch aluminum thickness; fabricated in one piece per track run, to greatest extent possible.
   1. Profile: Channel, nominal 1-1/4 inches wide by 3/4 inch high.
   2. Mounting: Surface.
   3. Structural Performance: Capable of supporting vertical test load of 50 lbs without visible deflection of track or damage to supports, safely supporting moving loads, and sufficiently rigid to resist visible deflection and without permanent set.
   4. Track **<< End Stop; Tees; Y's; Switches; and _____>>**: To fit track section.
   5. Track Bends: Minimum 12 inch radius; fabricated without deformation of track section or impeding movement of carriers.
   6. Finish on Exposed Surfaces: **<< Clear anodized; White enamel; or _____>>**.
   7. Products:
      a. Construction Specialties; Traditional 6062 Track + 1062N carrier with ball chain/hook.
      b. Inpro; Clickeze CE5000 track + CE5038 carrier with ball chain/hook.
      c. Imperial Fastener Co.; IFC-98 track + IFC-100 carrier with ball chain/hook.
      d. Salsbury Industries; 19100 series track + 19103 carrier with ball chain/hook.

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e. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Curtain Carriers: Nylon **<< rollers; slider; or _____>>** and 6 inch long beaded chain with aluminum hooks, size and type compatible with track; designed to eliminate bind when curtain is pulled; fitted to curtain to prevent accidental curtain removal.

C. Installation Accessories: Types required for specified mounting method and substrate conditions.

1. Provide stainless steel fasteners for exposed locations, and hot-dip galvanized fasteners for concealed locations.

2.02 CURTAINS

A. Cubicle Curtains:

1. Inherently flame resistant or flameproofed; capable of passing **<< NFPA 701; or _____>>** test.
   a. Fabric shall include identification markings from testing agency.
2. Material: Close weave polyester\ **<< polyester; cotton; nylon; recycled content and eco-polyester material; or _____>>**; anti-bacterial, stain resistant, self deodorizing, sanitized, and preshrunk.
3. Open Mesh Cloth: Open weave to permit air circulation; flameproof material, to be selected by Architect from manufacturer's full range.
4. Attachment of Curtain Fabric to Open Mesh Cloth: Manufacturer's standard sewn seam.
5. Products:
   a. INVISTA; Avora FR.
   b. Trevira; Trevira CS.
   c. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
6. Color/Pattern: To be selected by Architect from manufacturer's **<< full; or standard>>** range.

B. Curtain Fabrication:

1. Width of curtain to be **<< 10; 15; or ____>>** percent wider than track length.
2. Length of curtain to end **<< 10 inches; 12 inches; 15 inches; or ____ inches>>** above finished floor.
3. Pattern match fabric with vertical seams.
4. Include open mesh cloth at top 20 inches of curtain for room air circulation, attached to curtain as specified above.
5. Curtain Heading: Web reinforced band of open mesh cloth with metal grommet holes for carriers spaced 6 inches on center.
6. Seams and Hems: Manufacturer's standard fabrication method for securely sewn and finished seams and hems.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and supports above ceiling are ready to receive work of this Section.

B. Verify that field measurements are as indicated .

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3.02 INSTALLATION

A. Install curtain track to be secure, rigid, and true to ceiling line, per manufacturer's installation instructions.

B. Secure track to ceiling system.

1. Secure with mechanical fasteners to ceiling grids, not to exceed manufacturer's recommended spacing.

C. Install end caps and stop devices, and provide splices and connector accessories as required for layout indicated.

D. Install curtains on carriers ensuring smooth operation.

END OF SECTION 102123

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SECTION 102239
FOLDING PANEL PARTITIONS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM C1396/C1396M - Standard Specification for Gypsum Board.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

C. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

D. ASTM E413 - Classification for Rating Sound Insulation.

E. ASTM E557 - Standard Guide for Architectural Design and Installation Practices for Sound Isolation Between Spaces Separated by Operable Partitions.

F. ASTM F793/F793M - Standard Classification of Wall Coverings and Ceiling Coverings by Use Characteristics.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene at project site seven calendar days prior to scheduled beginning of construction activities of this section to review section requirements.

1. Require attendance by representatives of installer and other entities directly affect, or affected by, construction activities of this section.

1.03 SUBMITTALS

A. Product Data: Provide data on **<< partition materials; operation; hardware and accessories; electric operating components; track switching components; colors and finishes available; and _____>>**.

B. Design Data: Design calculations, bearing seal and signature of structural engineer licensed to practice in the State of Maryland, showing loads at points of attachment to the building structure.

C. Shop Drawings: Indicate **<< opening sizes; track layout; details of track and required supports; static and dynamic loads; location and details of pass door and frame; adjacent construction and finish trim; stacking depth; and _____>>**.

D. Samples for Selection: Submit manufacturer's color charts for selection of colors.

E. Samples for Verification: Submit physical samples of surface finish, manufacturer's standard size, illustrating **<< quality; colors selected; texture; weight; and _____>>**.

F. Certificates: Certify that partition system meets or exceeds specified **<< acoustic requirements; and _____>>**.

G. Designer's qualification statement.

H. Installer's qualification statement.

I. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods. Describe cleaning materials detrimental to finish surfaces and hardware finish.

J. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

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1.04 QUALITY ASSURANCE

A. Designer Qualifications: Perform design under direct supervision of Professional Engineer experienced in design of this type of work and licensed in the State of Maryland.

B. Installer Qualifications: Company specializing in performing work of the type specified, with personnel trained and approved by manufacturer for installation of specified products.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until installation.

1.06 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Provide **<< two; five; ten; or ____>>** year manufacturer warranty against defects in material and workmanship, excluding abuse.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Folding Panel Partitions - Horizontal Opening:

1. Kwik-Wall Company**<< ; 2000 Series Operable Walls; ; 3000 Series Operable Walls; ; 3030 - Paired Panels; or None - N/A>>**.
2. Moderco, Inc**<< ; 800 Series Model 841; ; 800 Series Model 842; ; Signature 8800; ; 700 series Model 741; ; 700 series Model 742; ; 700 series Model 743E; ; ____; or None - N/A>>**.
3. Modernfold, a DORMA Group Company**<< ; Acousti-Seal 942; or None - N/A>>**.

2.02 FOLDING PANEL PARTITIONS - HORIZONTAL OPENING

A. Folding Panel Partitions: **<< Center; Side; or _____>>** opening; **<< paired; individual; or continuous hinged>>** panels; **<< side; center; or _____>>** stacking; **<< manually operated; or motor operated>>**.

B. Panel Construction:

1. Frame: **<< 14 gauge, 0.0747 inch; 16 gauge, 0.0598 inch; 18 gauge, 0.0478 inch; ____ gauge, ___ inch; or Manufacturer's standard>>** thick formed sheet steel frame top, bottom, jambs, and intermediates; with corner support and cross-bracing reinforcement; welded construction with acoustical insulation fill.
2. Substrate: **<< Gypsum board; Plywood; Particle board; Medium-density fiberboard; or _____>>**.
3. Panel Substrate Facing: **<< Steel; or Aluminum>>** sheet, **<< 14 gauge, 0.0747 inch; 16 gauge, 0.0598 inch; 18 gauge, 0.0478 inch; 20 gauge, 0.0359 inch; 22 gauge, 0.0299 inch; ____ gauge, ___ inch; or manufacturer's standard>>** thickness for performance requirements indicated.
   a. Provide all-welded, all-steel construction of panel, with facing sheet welded to specified framing. Riveted connections will not be accepted. Horizontal or vertical spliced frame members or facings will not be accepted.
4. Hinges: Manufacturer's standard full leaf butt hinges; with steel mounting bracket welded to frame.
5. Panel Properties:
   a. Thickness with Finish: **<< 3 inches; 4 inches; or ____ inches>>**.

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b. Width: Manufacturer's standard panel widths.
c. Weight: **<< 8 lb/sq ft; 10 lb/sq ft; 12 lb/sq ft; or 9.5 lb/sq ft>>**, maximum.

C. Panel Finishes:
1. Facing: **<< Vinyl coated fabric; Non-woven PVC-free coated fabric; Acoustical carpet; Plastic laminate; Wood veneer; Markerboard; Tackboard; Paint; or _____>>**.
2. Trim/Edges: Provide manufacturer's trimless vertical edges/astragals, with a minimal grooved appearance between panel joints.

D. Panel Seals:
1. Panel to Panel Seals: Grooved and gasketed astragals, with continuous flexible ribbed vinyl seal fitted to panel edge construction; color to match panel finish.
2. Acoustic Seals: Flexible acoustic seals at jambs, meeting mullions, ceilings, retractable floor seals, and above track to structure acoustic seal.
a. Top Seal: Continuous contact fixed resilient seal or sweeps.
b. Bottom Seal: Automatically retracts and extends due to movement of partition. Retraction operating range of 1-1/2 or 2 inches.

E. Suspension System:
1. Track: **<< Formed steel; Extruded aluminum; or _____>>**; **<< 1-1/4 by 1-1/4 inch; 1-5/8 by 1-5/8 inch; or ____ by ____ inch>>** size, thickness and profile designed to support loads, steel sub-channel and track connectors.
2. Carriers: Steel, b**<< Nylon; Steel, ball bearing; or _____>>** wheels on trolley carrier at top of every panel, sized to carry imposed loads, with threaded pendant bolt for vertical adjustment.

F. Performance:
1. Acoustic Performance:
a. Sound Transmission Class (STC): **<< 38 to 42; 43 to 47; 48 to 52; 53 to 57; or 52, minimum>>**; calculated in accordance with **<<ASTM E413>>**, based on tests conducted in accordance with **<<ASTM E90>>**, on panel size of 100 sq ft.
2. Surface Burning Characteristics of Panel Finish: Flame spread/smoke developed index of 25/50, maximum, when tested in accordance with **<<ASTM E84>>**.
3. Installed partition system track capable of supporting imposed loads, with maximum deflection of 1/360 of span.

G. Operation:
1. Electric Operator: 12 inches per second traveling speed; adjustable friction clutch brake actuated by solenoid controlled motor starter; enclosed limit switch; enclosed magnetic reversing starter.
2. Control Station: **<< One; Two; or _____>>** standard keyed, three button **<< OPEN-STOP-CLOSE; constant pressure; momentary contact; or _____>>** type; 24 volt circuit; **<< surface; recess; or _____>>** mounted.
a. Key switch prepared for mortise lock cylinder.
b. Key switches alike.
3. Safety Features:
a. Limit Switches: Automatic type, at both extremes of travel, to prevent over-travel.
b. Emergency Release: Mechanism to disengage motor drive system and permit manual operation.

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c. Pocket Door Interlock: Mechanism to prevent operation of panels unless storage pocket doors are fully open.

4. Electrical Requirements:

H. Accessories:

1. Pocket Enclosures: Door, frame, and trim to match adjacent **<< walls; panels; or _____>>**; non-acoustical.
2. Acoustic Sealant: As recommended by partition manufacturer.

2.03 MATERIALS

A. Standard Gypsum Board: **<<ASTM C1396/C1396M>>**,, maximum permissible length; ends square cut, **<< square; beveled; or ____>>** edges.

B. Vinyl Coated Fabric: **<< ASTM F793 Category IV; ASTM F793 Category V; ASTM F793 Category VI; or _____>><< , polyvinyl fluoride (PVC) finish for washability and improved flame retardance; , _____; or None - N/A>><< ; _____ color; or ; color as selected by Architect from manufacturer's standard range>>**.

C. Acoustic Insulation: Manufacturer's standard type and thickness as required for acoustic performance indicated.

1. Type: **<< Manufacturers standard; As required for acoustic performance indicated; ASTM C665 preformed mineral fiber, friction fit; or _____>>**.
2. Thickness: **<< As required for acoustic performance indicated; 2-1/2 inch; 3-1/2 inch; or ___ inch>>**.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that overhead support beam and supporting structure is properly sized and installed in accordance with manufacturer's requirements.

C. Verify track supports are laterally braced and will permit track to be level within 1/4 inch of required position and parallel to the floor surface.

D. Verify floor flatness of 1/8 inch in 10 feet, non-cumulative.

E. Verify wall plumbness of 1/8 inch in 10 feet, non-cumulative.

3.02 INSTALLATION

A. Install partition in accordance with manufacturer's instructions and ASTM E557.

B. Install electric operator, wiring, and controls. Locate control station(s) as indicated.

C. Fit and align partition assembly and pocket doors level and plumb.

D. Lubricate moving components.

E. Install acoustic sealant to achieve required acoustic performance.

3.03 ADJUSTING

A. Adjust partition assembly to provide smooth operation from stacked to full open position. Do not over-compress acoustic seals.

B. Visually inspect partition in full extended position for light leaks to identify a potential acoustical leak.

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C. Adjust partition assembly to achieve lightproof seal.

3.04 CLEANING

A. Clean finish surfaces and partition accessories.

B. Condition markerboard surfaces in accordance with manufacturer's instructions.

3.05 CLOSEOUT ACTIVITIES

A. Demonstrate operation and maintenance of partition to Owner's personnel and identify potential operational problems.

END OF SECTION 102239

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SECTION 102600
WALL AND DOOR PROTECTION

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design.

B. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.

C. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.

D. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

F. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies.

G. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.

H. FDA Food Code - Chapter 6 - Physical Facilities.

I. ICC A117.1 - Accessible and Usable Buildings and Facilities.

J. ISO 846 - Plastics - Evaluation of the Action of Microorganisms.

K. ISO 2812-1 - Paints and Varnishes -- Determination of Resistance to Liquids -- Part 1: Immersion in Liquids Other than Water.

L. SCAQMD 1168 - Adhesive and Sealant Applications.

1.02 SUBMITTALS

A. Product Data: Indicate **<< physical dimensions; features; wall mounting brackets with mounted measurements; anchorage details; rough-in measurements; and _____>>**.

B. Shop Drawings: Include plans, elevation, sections, and attachment details.**<< Show design and spacing of supports for protective corridor handrails, required to withstand structural loads.; or None - N/A>>**

C. Selection Samples: Provide manufacturer's color charts for each product and material requiring color selection.

D. Verification Samples: Submit physical samples, manufacturer's standard size, for each selected color.

E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in **<<Owner>>**'s name and registered with manufacturer.

F. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project:

1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
2. Extra Stock Materials: One package minimum 96 inches long unit of each kind of covers for protective handrails.
3. Extra Stock Materials: Five sheets minimum of each type of protective wall covering.

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1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.

B. Protect work from moisture damage.

C. Protect work from UV light damage.

D. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations for each type of item.

E. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

1.04 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Manufacturer Warranty: Provide 5-year manufacturer warranty for metal crash rails. Complete forms in **<<Owner>>**'s name and register with manufacturer.

1. Failures include, but are not limited to, the following:
    a. Structural failures or internal connection failures.
    b. Deterioration of materials beyond that expected of normal use, as intended by manufacturer.

PART 2 PRODUCTS

2.01 PERFORMANCE CRITERIA

A. Impact Strength: Unless otherwise noted, provide protection products and assemblies that have been successfully tested for compliance with applicable provisions of **<<ASTM D256>>** and/or **<<ASTM F476>>**.

B. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with **<<CAL (CDPH SM)>>** AND shall meet the chemical content requirements of **<<SCAQMD 1168>>**.

2.02 PRODUCT TYPES

A. Protective Corridor Handrails: Factory- or shop-fabricated, with preformed end caps and internal and external corners:

1. See Section **<< 055213 - Pipe and Tube Railings>>** for metal railings not intended to protect walls.
2. Comply with accessibility requirements of **<<ICC A117.1>>** and **<<ADA Standards>>**.
3. Products (flat bar):
    a. Construction Specialties; HRB-4C.
    b. InPro; G2-800 Series.
    c. Pawling Corp; BR-530P.
4. Products (flat bar with round grip):
    a. Construction Specialties; HRB-10C.
    b. InPro; 1200 Ser
    c. Pawling Corp; BR-400PS.
5. Performance of Installed Assembly:

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a. Support vertical live load of **<< 100 lb/lineal ft; or ____ lb/lineal ft>>** with deflection not to exceed **<< 1/50; or ____>>** of span between supports.
b. Resist lateral force of **<< 250 lbs; 75 lbs; or ____ lbs>>** at any point without damage or permanent set.
c. Ligature-resistant.

6. Material: Polyethylene terephthalate (PET or PETG); PVC-free, color **<< as selected from manufacturer's full range of colors; as indicated on drawings; as scheduled; or ____>>**.
7. Surface Burning Characteristics: Provide assemblies with flame spread index of **<< 25 or less; or _____>>** and smoke developed index of **<< 450 or less; or _____>>**, when tested in accordance with **<<ASTM E84>>**.
8. Mounting: Surface.
9. Projection From Wall to Outside of Rail: As indicated on Drawings.
10. Clear Space From Wall: As indicated on Drawings.
11. Length: Factory fabricated into longest possible lenghts; flush splicing.

B. Rigid Sheet Wall Protection: ******If using rigid sheet wall protection, indicate 4 foot high waincscot terminating in a handrail or chairrail on drawings. Indicate 6 inch squares for room signs. Refer to Division 10, "Signage."******

1. Products:
   a. Construction Specialties; Acrovyn Rigid Sheet.
   b. InPro; Palladium G2 Rigid Sheet.
   c. Pawling Corp; Pro-Tek NXT Wall Covering.
2. Material: Polyethylene terephthalate (PET or PETG); PVC and PBTs-free.
3. Thickness: **<< 0.028 inch; 0.040 inch; 0.060 inch; 0.075 inch; 0.080 inch; or _____ inch>>**.
4. Surface Burning Characteristics: Provide assemblies with flame spread index of **<< 25 or less; or _____>>** and smoke developed index of **<< 450 or less; or _____>>**, when tested in accordance with **<<ASTM E84>>**.
5. Color: To be selected by Architect from manufacturer's **<< full; or standard>>** range.
6. Texture: **<< Suede; or _____>>**.
7. Accessories: Provide manufacturer's standard **<< color-matched; contrasting; or _____>>** trim and moldings.
   a. Inside Corner Trim: **<< Standard angle; adjustable angle; and _____>>**
   b. Outside Corner Trim: **<< Standard angle; adjustable angle; and _____>>**.
8. Adhesive: Type recommended by panel manufacturer; low-VOC compliant.

C. ~~Impact Resistant Wall Covering with Custom Digital Image:~~

1. ~~Basis-of-Design: Construction Specialties; Acrovyn High Impact Wall Covering.~~
2. ~~Material: Polyethylene terephthalate (PET or PETG); PVC and PBTs-free.~~
3. ~~Thickness: **<< 0.028 inch; 0.040 inch; 0.060 inch; 0.075 inch; 0.080 inch; or _____ inch>>**.~~
4. ~~Surface Burning Characteristics: Provide assemblies with flame spread index of **<< 25 or less; or _____>>** and smoke developed index of **<< 450 or less; or _____>>**, when tested in accordance with **<<ASTM E84>>**.~~
5. Pattern: **<< None; Simulated wood; Simulated metal; Decorative pattern; or Custom digital graphic>>**.

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a. Include $500 **<< allowance; or lump sum>>** for digital image copyright acquisition and formatting unless digital image is already property of the **<< Owner>>** or wallcovering manufacturer.
b. Digital image licenser shall provide a digital file formatted in accordance with wall protection manufacturer's digital requirements.
c. Coordinate image selection and orientation with **<< Architect>>** after bidding.

6. ~~Texture: **<< Suede; or _____>>**.~~
7. ~~Accessories: Provide manufacturer's standard **<< color-matched; contrasting; or _____>>** trim and moldings.~~
   a. ~~Inside Corner Trim: **<< Standard angle; adjustable angle; and _____>>**~~
   b. ~~Outside Corner Trim: **<< Standard angle; adjustable angle; and _____>>**.~~
8. ~~Adhesive: Type recommended by panel manufacturer; low-VOC compliant.~~

D. Fiberglass Reinforced Panels (FRP): ******MCPS prefers FRP or wall tile at janitor sinks. Extend 24 to 30 inches above sink top.******
   1. Products:
      a. Crane Composites, Inc; Glasbord.
      b. Marlite, Inc; Standard FRP.
      c. Nudo Products, Inc; FiberLite FRP - Wall Panels.
      d. Panolam Surface Systems; FRP.
      e. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
   2. Wall Panels**<< at _____; _____; or None - N/A>>**:
      a. Panel Size: 4 by 10 feet, nominal.
      b. Panel Thickness: 0.09 inch, minimum.
      c. Surface Design: **<< Pebble; Smooth; or _____>>**.
      d. Color: **<< White; As selected by Architect from manufacturer's full range of colors; or _____>>**.
      e. Attachment Method: **<< Adhesive only, sealant joints, no trim; Adhesive only, with trim and sealant in joints; Mechanical fasteners concealed by trim, with sealant in joints; or _____>>**.
   3. Material: Fiberglass reinforced plastic (FRP), complying with **<<ASTM D5319>>**.
      a. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with **<<ASTM E84>>**.
      b. Mold Resistance: Score of 10, when tested in accordance with **<<ASTM D3273>>**.
      c. Impact Strength: Greater than **<< 6 ft lb force per inch; or ___ ft lb force per inch>>**, when tested in accordance with **<<ASTM D256>>**.
      d. Surface Characteristics and Cleanability: Provide products that are smooth, durable, and easily cleanable, in compliance with **<<FDA Food Code>>**, Chapter 6 - Physical Facilities.
      e. Chemical Cleanability: Excellent chemical resistance to common cleaners and detergents when tested in accordance with **<<ISO 2812-1>>**.
      f. Biological Resistance: Rating of 0, when tested in accordance with **<<ISO 846>>**.
   4. Accessories: Provide manufacturer's standard **<< vinyl; or aluminum>>** trim.
   5. Adhesive: Type recommended by panel manufacturer; low-VOC compliant.
   6. Sealant: Mildew-resistant silicone; refer to Division 7 Section "Joint Sealants"; color coordinated with panel color.

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E. Fiber Reinforced Laminate:
   1. Products:
      a. Formica; HardStop.
      b. Panolam Surface Systems; FRL Wall Protection Panels
   2. Material: Fiber Reinforced Laminate (FRL): Thermofused melamine overlay, decorative paper and fire-rated phenolic paper with fiber reinforcing inner layers.
   3. Thickness: **<< 0.075 inch; or _____ inch>>**.
   4. Panel Size: **<< 3 feet by 8 feet; 3 feet by 10 feet; 4 feet by 8 feet; 4 feet by 10 feet; 5 feet by 8 feet; 5 feet by 10 feet; or _____ feet by _____ feet>>**.
   5. Surface Burning Characteristics: Provide assemblies with flame spread index of **<< 25 or less; or _____>>** and smoke developed index of **<< 55 or less; or _____>>**, when tested in accordance with **<<ASTM E84>>**.
   6. Color and Pattern: To be selected by Architect from manufactuter's **<< full; or standard>>** range.
   7. Texture: **<< As selected from manufacturer's standard textures; As indicated on drawings; As scheduled; or ____>>**.
   8. Accessories: Provide manufacturer's standard **<< PVC; aluminum; or _____>> << color-matched; contrasting; or _____>>** trim and moldings.
      a. Outside Corner Trim: **<< Flat; Round; or _____>>**.
      b. Division Bar: **<< Flat; Round; or _____>>**.
   9. Mounting: Adhesive.

F. Adhesives and Primers: As recommended by manufacturer.

G. Mounting Brackets and Attachment Hardware: Appropriate to component and substrate.

2.03 FABRICATION

A. Fabricate components with tight joints, corners and seams.

2.04 SOURCE QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Provide wall ~~and door~~ protection systems of each type from a single source and manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.

B. Verify that field measurements are as **<< indicated on drawings; instructed by the manufacturer; or _____>>**.

C. Verify that substrate surfaces for adhered items are clean and smooth.
   1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer. Follow adhesive manufacturer's recommendations for remedial measures at locations and/or application conditions where adhesion test's results are unsatisfactory.

D. Start of installation constitutes acceptance of project conditions.

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3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.

B. Position top of corridor hand rail **<< 36 inches; or _____ inches>>** from finished floor.

C. Terminate rails **<< 1 inch; or _____ inch>>** short of **<< door openings; intersecting walls; and _____>>**.

D. Rigid Sheet Wall Protection:

1. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.
2. Establish a fixed level line slightly above finished floor, but not exceeding 1 inch, to allow for floor slab variations.
3. Full-Height Installation: Establish a plumb line located at edge of starting point of first sheet to ensure following sheets will be installed plumb.
4. Wainscot Installation: Establish a level line at the specified height for entire length of run. Install by aligning top of edge of covering with this line.
5. Adhesive Installation: Apply adhesive using trowel to an area of wall surface that can be completed within cure time of the adhesive. Use a roller to ensure maximum contact with adhesive.
6. Install trim pieces as required for a complete installation. Allow tolerance for thermal movement. Place trim on panel before fastening edges, as required by manufacturer's installation instructions.
7. At joints indicated to be caulked, allow for a minimum **<< 1/16 inch>>** wide gap between edges of sheets. Gaps are required to be of consistent width throughout the project. Remove excess sealant after paneling is installed and prior to curing.
8. At inside and outside corners cut covering sheets to facilitate installation of trim pieces or corner guards.

3.03 TOLERANCES

A. Maximum Variation From Required Height: **<< 1/4 inch; or ____ inch>>**.

B. Maximum Variation From Level or Plane For Visible Length: **<< 1/4 inch; or ____ inch>>**.

3.04 CLEANING

A. See Section **<< 017419 - Construction Waste Management and Disposal>>**, for additional requirements.

B. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION 102600

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SECTION 102800
TOILET AND BATH ACCESSORIES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design.

B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

D. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

E. ASTM C1036 - Standard Specification for Flat Glass.

F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.

G. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror.

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

I. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of **<< internal wall reinforcement; concealed ceiling supports; reinforcement of toilet partitions; and ____>>** to receive anchor attachments.

1.03 SUBMITTALS

A. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

B. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.

C. Maintenance Data: For each type of accessory, to include in maintenance manual per Section **<< 017800 - Closeout Submittals>>**. Include list of replacement parts and service recommendations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Commercial Toilet, Shower, and Bath Accessories:
   1. American Specialties, Inc.
   2. Bobrick Washroom Equipment.
   3. Bradley Corporation.

B. Under-Lavatory Pipe Supply Covers:
   1. Plumberex Specialty Products, Inc.
   2. Truebro; IPS Corporation.

C. Electric Hand/Hair Dryers:

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1. Dyson.
2. Excel Dryer.
3. World Dryer Corporation.

D. Provide products of each category type by single manufacturer.

2.02 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.

B. Keys: Provide **<< 6 master/universal>>** keys, minimum, to **<<Owner>><< ; master key lockable accessories; ; _____ lockable accessories; ; _____; or None - N/A>>**.

C. Stainless Steel Sheet: **<<ASTM A666/A666M>><< , Type 304; , Type ____; None - N/A; or ____>>**.

D. Stainless Steel Tubing: **<<ASTM A269/A269M>>**, Grade TP304 or TP316.

E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, **<<ASTM A653/A653M>>**, with **<< G60/Z180; G90/Z275; or _____>>** coating.

F. Mirror Glass: Annealed float glass, **<<ASTM C1036>>** Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with **<<ASTM C1503>>**.

G. Fasteners, Screws, and Bolts: Hot dip galvanized**<< ; tamper-proof; ; ____; or None - N/A>><< ; security type; ; ____; or None - N/A>>**.

1. Provide mechanical attachment of all accessories. Use of adhesive or double-side tape is not acceptable.

2.03 FINISHES

A. Stainless Steel: **<< Satin; Bright polished; or _____>>** finish**<< , unless otherwise noted; , ____; or None - N/A>>**.

B. Baked Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats **<< epoxy; electrostatic; or ____>>** baked enamel.

2.04 TOILET ACCESSORIES SCHEDULE, GENERAL

A. General: The following products make reference to the designations indicated on the Toilet Accessories Schedule, Toilet Assemblies, and toilet room plans on the drawings; herein designated as "TA-x".

2.05 COMMERCIAL TOILET<< AND BATH; OR NONE - N/A>> ACCESSORIES

A. Grab Bars [*designation?*]: Stainless steel, peened surface.

1. Standard Duty Grab Bars:
   a. Push/Pull Point Load: 250 pound-force, minimum.
   b. Dimensions: 1-1/2 inch outside diameter, minimum 0.05 inch wall thickness, concealed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
   c. Finish: Satin.
   d. Length and Configuration: As indicated on drawings.
   e. Products:
      1) American Specialties, Inc.; 3800 Series.
      2) Bobrick Washroom Equipment, Inc.; B-6806 Series.
      3) Bradley Corporation; 812 Series.

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B. Toilet Paper Dispenser [*designation?*]: Roll-in-reserve type, designed to allow automatic activation of reserve roll when needed, or manual activation by pressing release bar, surface-mounted, stainless steel unit with pivot hinge, and tumbler lock. ******MCPS prefers 2 rolls covered.******
   1. Products:
      a. American Specialties, Inc.; Model 0030.
      b. Bobrick Washroom Equipment, Inc.; Model B-2888.
      c. Bradley Corporation; Model 5402.

C. Sanitary Napkin Disposal Unit [*designation?*]: Stainless steel, surface-mounted, self-closing door, with full-length stainless steel piano-type hinge, removable receptacle.
   1. Products:
      a. American Specialties, Inc; Model 0852.
      b. Bobrick Washroom Equipment, Inc.; Model B-254.
      c. Bradley Corporation; Model 4722-15.

D. Soap Dispenser [*designation?*]: Owner furnished for installation by Contractor.

E. Mirrors [*designation?*]: Stainless steel framed, 1/4 inch thick **<< annealed float glass; ASTM C1036; tempered safety glass; ASTM C1048; acrylic plastic sheet; polycarbonate plastic sheet; abrasion-resistant coated acrylic plastic sheet; abrasion-resistant coated polycarbonate plastic sheet; or ____>>** with galvanized steel back.
   1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with **<<ASTM C1503>>**.
   2. Size: As indicated on Drawings. ******MCPS prefers 18x24 mirrors in Pre-K and K restrooms. MCPS prefers 18x36 in single use restrooms. MCPS prefers 24x72 mirrors in group and Pre-K restrooms.******
   3. Frame: 0.05 inch channel shapes, with mitered and welded and ground corners, and tamperproof hanging system, bright-polished finish.
   4. Products:
      a. American Specialties, Inc; 0620-L Series.
      b. Bobrick Washroom Equipment, Inc.; Model B-165 Series.
      c. Bradley Corporation; Model 720.

F. Corner Grab Bar Assembly [*designation?*]: Stainless steel, surface.
   1. Stainless-Steel Nominal Thickness: 0.05 inch.
   2. Finish: Satin.
   3. Mounting: Concealed with manufacturer's standard flanges and anchors.
   4. Outside Diameter: 1-1/2 inches unless otherwise indicated.
   5. Configuration: Single "L" shaped shower grab bar.
      a. Length (Control Wall): 32 to 34 inches from wall to centerline of return.
      b. Length (Back Wall): Nominal 24 inches from wall to centerline of return. Limit leg length so as not to interfere with folding shower seat.
   6. Products:
      a. American Specialties, Inc.; Model 3274P.
      b. Bobrick Washroom Equipment, Inc.; *Model B-68616.99*.
      c. Bradley Corporation; 8122-0591833.

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G. Folding Shower Seat [*designation?*]: Wall-mounted surface; welded tubular seat frame, structural support members, hinges, and mechanical fasteners of Type 304 stainless steel, **<< L-shaped; and rectangular>>** seat.
   1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, of manufacturer's standard color.
   2. Size: ADA Standards compliant.
   3. Products (L-Shaped - 33" to 34.5" wide, reversible):
      a. American Specialties, Inc.; Model 8206.
      b. Bobrick Washroom Equipment, Inc.; Model B-5181.
      c. Bradley Corporation; Model 9565.

H. Shower Rod & Curtain [*designation?*]: Stainless steel tube, 1 inch outside diameter, 0.04 inch wall thickness, satin-finished, with 1-3/8 inch outside diameter, minimum 0.04 inch thick satin-finished *bright-polished chrome-plated plastic* flanges, for concealed mounting.
   1. Products:
      a. American Specialties, Inc; Model 1214.
      b. Bobrick Washroom Equipment, Inc.; Model B-207.
      c. Bradley Corporation; Model 9538.

I. Shower Curtain [*designation?*]: Provide shower curtain with each shower curtain rod.
   1. Material: Opaque vinyl, 0.008 inch thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
   2. Size: Provide curtain width 6 inches wider than shower opening dimension for 36 inch showers, and 12 inches wider than shower opening dimension for 48 inch and larger showers. Provide curtain height sized to 2 inches less than curtain rod mounting height.
   3. Grommets: Stainless steel; pierced through top hem on 6 inch centers.
   4. Color: White.
   5. Products:
      a. American Specialties, Inc; Model 1200-V.
      b. Bobrick Washroom Equipment, Inc; Model 204-2.
      c. Bradley Corporation; Model 9535.

J. Shower Curtain Hooks [*designation?*]: Chrome-plated or stainless steel spring wire designed for snap closure.
   1. Products:
      a. American Specialties, Inc; Model 1200-SHU.
      b. Bobrick Washroom Equipment, Inc; Model 201-1.
      c. Bradley Corporation; Model 9536.

K. Paper Towel Dispenser [*designation?*]: Folded paper type, stainless steel, surface-mounted, with viewing slots on sides as refill indicator and tumbler lock. ******MCPS prefers paper towel dispensers at classroom sinks and single use restrooms.******
   1. Capacity: 400 C-fold or 525 multifold, minimum.
   2. Products (Surface-Mounted):
      a. American Specialties, Inc; Model 210.
      b. Bobrick Washroom Equipment, Inc.; Model B-262.
      c. Bradley Corporation; Model 250-15.

L. Waste Receptacle [*designation?*]: **<< Wall-mounted; Recessed; or ____>>**, **<< stainless steel; or _____>>**, seamless lower door for access to container, **<< with tumbler lock,;**

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None - N/A; or ____>> reinforced panel full height of door,**<< push-in self-closing top door,; ____; or None - N/A>>** continuously welded bottom pan and seamless exposed flanges.

1. Liner: **<< Removable; Reusable; or ____>>**, heavy-duty vinyl liner, attached at a minimum of **<< four; three; or ___>>** points with stainless steel grommets and hooks.
2. Minimum capacity: **<< 4 gallons; 12 gallons; or ____ gallons>>**.
3. Products:
   a. American Specialties, Inc; Model 0826.
   b. Bobrick Washroom Equipment, Inc; Model B-277.
   c. Bradley Corporation; Model 3565.

M. Combination Towel Dispenser/Waste Receptacle [*designation?*]: Recessed **<< flush with wall; with projecting waste receptacle; or ____>>**, **<< stainless steel; or _____>>**; seamless wall flanges, continuous piano hinges**<< , tumbler locks on upper and lower doors; None - N/A; or , ____>>**.

1. Waste receptacle liner: Provide with manufacturer's reusable, molded plastic liner accessory with stainless steel support strap. Bobrick "LinerMate" or equivalent.
2. Towel dispenser capacity: **<< 400 C-fold; 700 multifold; or 800 multi-fold; 600 C-fold>>**.
3. Waste receptacle capacity: **<< 4 gallons; 12 gallons; or ___ gallons>>**.
4. Products:
   a. American Specialties, Inc; Model 0469.
   b. Bobrick Washroom Equipment, Inc; Model B-3944.
   c. Bradley Corporation; Model 234.

N. Coat Hook [*designation?*]: Heavy-duty stainless steel, double-prong, rectangular-shaped, vertical bracket and backplate for concealed attachment, bright polished finish. Provide one centered on interior face of door of all single-user toilet rooms and one adjacent to each shower, unless otherwise indicated on Drawings; verify final mounting locations with Architect in field. ******MCPS prefers in single use restrooms, kitchen, principal, and gym restrooms.******

1. Products:
   a. American Specialties, Inc.; Model 7832.
   b. Bobrick Washroom Equipment, Inc.; Model B-682.
   c. Bradley Corporation; Model 9134.

2.06 UNDER-LAVATORY PIPE AND SUPPLY COVERS

A. Under-Lavatory Pipe and Supply Covers:

1. Insulate exposed drainage piping, including hot, cold, and tempered water supplies under lavatories or sinks to comply with **<<ADA Standards>>**.
2. Exterior Surfaces: Smooth non-absorbent, non-abrasive surfaces.
3. Construction: **<< 1/8 inch>>** flexible PVC.
   a. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with **<<ASTM E84>>**.
   b. Microbial and Fungal Resistance: Comply with **<<ASTM G21>>**.
4. Color: **<< White; Gray; or _____>>**.
5. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces.
6. Products:
   a. Plumberex Specialty Products, Inc; Plumberex Trap Gear.

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b. Truebro; IPS Corporation; Lav Guard 2.

2.07 ELECTRIC HAND DRYERS

A. Electric Hand Dryers [*designation?*]: Traditional fan-in-case type, with downward fixed nozzle.
   1. Operation: Automatic, sensor-operated on and off.
   2. Mounting: Surface-mounted.
   3. Cover: **<< Plastic; Stainless steel with brushed finish; Epoxy painted steel or die-cast zinc alloy; Chrome plated steel or die-cast zinc alloy; Aluminum with natural anodized satin finish; Cast iron with white porcelain enamel finish; or _____>>**.
      a. Color: White.
      b. Tamper-resistant screw attachment of cover to mounting plate.
      c. Screen or shield to prevent access to motor/heater.
   4. Air Velocity: 13,000 linear feet per minute, minimum, at full power.
   5. Heater: 500 W, minimum, at full power.
   6. Fan/Heater Control: Nichrome wire heating element with automatic resetting thermal cutoff.
   7. Total Wattage: 950 W, maximum.
   8. Runtime: Field adjustable or automatic, up to 60 seconds with vandal lockout feature.
   9. Air sanitizing and deodorizing without use of chemicals.
   10. Supply Voltage: **<< As indicated on drawings; 120 V, single phase, 60 Hz, nominal; 240 V, single phase, 60 Hz, nominal; or _____>>**.
   11. Warranty: 3 years.
   12. Electric Hand Dryer Products:
      a. Bradley Corporation; Aerix +.
      b. Excel Dryer Inc; ThinAir Hand Dryer.
      c. World Dryer Corporation; SLIMdri.

2.08 UTILITY ROOM ACCESSORIES

A. Combination Utility Shelf/Mop and Broom Holder [*designation?*]: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
   1. Drying rod: Stainless steel, **<< 1/4 inch>>**1/4 inch diameter.
   2. Hooks: **<< Two; Three; Five; or ____>>**, 0.06 inch stainless steel rag hooks at shelf front.
   3. Mop/broom holders: **<< Three; Four; or ___>>** spring-loaded rubber cam holders at shelf front.
   4. Length: 36 inches.
   5. Products:
      a. American Specialties, Inc; Model 1315-3.
      b. Bobrick Washroom Equipment, Inc.; Model B-224 x 36.
      c. Bradley Corporation; Model 9983.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

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C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.

D. Refer to Divisoin 6 Section "Rough Carpentry" and Division 9 Section "Cold-Formed Steel Framing - Non-Structural" for installation of **<< blocking; reinforcing plates; concealed anchors; and _____>>** in **<< walls; ceilings; and _____>>**.

3.02 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated on Drawings.

3.03 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION 102800

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SECTION 104400
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.

1.02 SUBMITTALS

A. Product Data: Provide **<< extinguisher operational features; extinguisher ratings and classifications; color and finish; anchorage details; installation instructions; and trim and door panel styles>>**.

B. Shop Drawings: Indicate **<< locations of cabinets; cabinet physical dimensions; rough-in measurements for recessed cabinets; locations of individual fire extinquishers; mounting measurements for wall bracket; installation procedures; accessories required for complete installation; and _____>>**.

C. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.03 FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

B. Coordinate rough opening sizes to ensure cabinet locations meet ADA mounting requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguishers and Cabinets:
1. Activar Construction Products Group, Inc. - JL Industries.
2. Amerex Corporation.
3. Ansul, a Tyco Business.
4. Babcock-Davis.
5. Badger Fire Protection.
6. Buckeye Fire Equipment Company.
7. Fire-End & Croker Corporation.
8. Kidde, a unit of United Technologies Corp.
9. Modern Metal Products; Div of Technico.
10. Larsen's Manufacturing Co.
11. MOON American.
12. Nystrom, Inc.
13. Oval Brand Fire Products.
14. Potter-Roemer.
15. Pyro-Chem, a Tyco Business.
16. Strike First Corporation of America.

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2.02 FIRE EXTINGUISHERS

A. Fire Extinguishers: Furnished by Owner after Date of Substantial Completion. ******MCPS coordinates fire extinguishers with the Fire Marshal's office. Specifiers must refer to current Memorandum of Understanding, provided by MCPS, to coordinate. Fire extinguishers are provided by MCPS after construction.******

2.03 FIRE EXTINGUISHER CABINETS

A. Cabinet Construction, General: ******MCPS prefers fire extinguisher cabinets furnished and installed by Contractor.******
   1. Formed **<< cold-rolled; or ASTM A240 or ASTM A666, Type 304 stainless>>** steel sheet; minimum 0.036 inch thick base metal.
   2. Size to accommodate extinguisher(s) and accessories indicated.
   3. Provide cabinet enclosures with right angle inside corners and seams, and with formed perimeter trim and door stiles.

B. Fire Rated Cabinet Construction: Provide manufacturer's fire rated model of style/finish below. Match style and finish of non-rated cabinets.
   1. Fire Rating: Listed and labeled in accordance with **<<ASTM E814>>** requirements to match fire resistance rating of walls where being installed.
   2. Steel; double wall or outer and inner boxes with manufacturer's standard fire barrier material.

C. Cabinet Configuration: Recessed type. ******MCPS preferred.******
   1. Trim Type: Flat square edge trim; 3/8-inch or 1/2-inch nominal return to wall surface.
   2. Available Products: One of the following, or comparable product by manufacturer from list above:
      a. J.L. Industries/Activar; Ambassador 1015.
      b. Larsen's Manufacturing Co.; Model 2409-R2.
      c. Potter-Roemer; Model 1704.

D. Cabinet Configuration: Semi-recessed type.
   1. Trim Type: One piece trim and door frame, returned to wall surface. Rolled edge trim; 2-1/2- to 3-inch depth as standard with manufacturer.
   2. Available Products (Non-Rated): One of the following, or comparable product by manufacturer from list above:
      a. J.L. Industries/Activar; Ambassador C1017.
      b. Larsen's Manufacturing Co.; Model 2409-6R.
      c. Potter-Roemer; Alta Model 7023.
   3. Available Products (Fire-Rated): One of the following, or comparable product by manufacturer from list above:
      a. J.L. Industries/Activar; Ambassador Fire-FX2 C1017.
      b. Larsen's Manufacturing Co.; Model FS 2409-6R.
      c. Potter-Roemer; Alta Model FRC7023.

E. Cabinet Configuration: Surface-mounted type.
   1. Trim Type: Manufacturer's standard rolled edge.
   2. Available Products: One of the following, or comparable product by manufacturer from list above:
      a. J.L. Industries/Activar; Ambassador 1013.
      b. Larsen's Manufacturing Co.; Model 2409-SM.

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c. Potter-Roemer; Model 1754.

F. Doors: Minimum 0.036 inch metal thickness, reinforced for flatness and rigidity **<< with nylon catch; with roller type catch; with lock and breakable window access; or _____>>**. Hinge doors for 180 degree opening with continuous piano hinge.

1. Door Glazing Style: **<< Full glazed panel; or Vertical duo>>**, configuration as standard with manufacturer.
2. Door Glazing: Tempered glass, clear, 1/8 inch thick, and set in resilient channel glazing gasket.
   a. For fire extinguishers in gymnasium, provide 1/8-inch thick impact resistant clear acrylic plastic, set in resilient channel glazing gasket.

G. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.

H. Operating Hardware: Manufacturer's standard for cabinet type; continuous door hinge allowing 180 degree opening, with ADA-compliant door latch either surface mounted or flush inset into door panel, with cam or friction latch operation.

1. Provide cylinder door locks, with all fire extinguisher cabinets keyed alike.

I. Fabrication: Weld, fill, and grind components smooth.

J. Finish of Cabinet Exterior Trim and Door: **<< Primed for field paint finish; Polished chrome; Satin chrome; No.4 - Brushed stainless steel; Red enamel; Red baked enamel; Baked enamel, _____ color; Baked enamel, color as selected; Anodized to _____ color; Anodized to color as selected; or _____>>**.

K. Finish of Cabinet Interior: White colored enamel.

2.04 ACCESSORIES

A. Extinguisher Brackets: Formed steel, **<< chrome-plated; galvanized and enamel finished; or _____>>** or baked-enamel finish.

B. Extinguisher Theft Alarm: Battery operated alarm, 10 second delay for disarming, activated by opening cabinet door.

C. Lettering: “FIRE EXTINGUISHER” decal, or vinyl self-adhering, pre-spaced lettering in accordance with authorities having jurisdiction (AHJ).

1. Apply vertically to door of fire extinguisher cabinets, and apply to wall surface at bracket mounted extinguishers.

2.05 EMERGENCY KEY ACCESS BOX

A. Commercial Door Key Access Box: Provide fire department emergency key access box manufactured by The Knox Company; as required by local Fire Marshal. Provide Knox Box recessed mount 4400 Series, nominal 7 inches by 7 inches by 5 inches deep, with tamper switch and recessed mounting kit. Provide manufacturer's standard polyester powder coat finish in black color. No substitutions will be considered. Coordinate recessed installation with substrate construction, electrical connections as required for proper operation, and with requirements of local Fire Marshal. Contact Knox Company: www.knoxbox.com

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

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3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cabinets plumb and level in wall openings, no greater than 48 inches from finished floor to top of handle.

C. Install mounting brackets at 44 inches above finish floor.

D. Secure rigidly in place.

E. Place extinguishers and accessories in cabinets and on wall brackets as applicable.

F. Install cabinet and extinguisher signage.

G. Adjust cabinet doors after installation to ensure smooth operation.

3.03 PROTECTION AND CLEANING

A. Protect fire extinguishers, fire extinguisher cabinets, and accessories from damage until Substantial Completion.

B. Provide touchup to damaged finishes; replace items that cannot be satisfactorily repaired or refinished.

END OF SECTION 104400

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SECTION 105113
METAL LOCKERS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

C. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable.

D. ICC A117.1 - Accessible and Usable Buildings and Facilities.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Where indicated, coordinate with Section **<< 033000 - Cast-in-Place Concrete; or _____>>** to provide 4-inch high concrete bases with embedded anchors or grounds as required for locker attachment.

1.03 SUBMITTALS

A. Product Data: Manufacturer's published data on locker construction, sizes, and accessories.

B. Shop Drawings: Indicate locker plan layout, **<< numbering plan; combination lock code; key codes; and _____>>**.

C. Samples: Submit manufacturer's color charts illustrating full range of available colors.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect locker finish and adjacent surfaces from damage.

1.05 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Manufacturer Warranty: Provide **<< five-year; or 2 year>>** manufacturer warranty for materials and workmanship. Complete forms in **<<Owner>>**'s name and register with manufacturer.

1. Warranty shall cover failures including material and finish failure and faulty operation of latches, hinges, or other hardware.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Lockers:

1. Art Metal Products**<< ; Standard KD; or None - N/A>>**.
2. List Industries, Inc**<< ; Classic Line of Superior KD; or None - N/A>>**.
3. Lockers MFG**<< ; KnockDown Lockers; ; KnockDown Heavy Duty Lockers; ; Open Front Lockers; ; All Welded Lockers; ; ____; or None - N/A>>**.
4. Lyon Workspace Products**<< ; Standard Lockers; or None - N/A>>**.
5. Penco Products, Inc**<< ; Vanguard; or None - N/A>>**.

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6. Republic Storage Systems Co**<< ; Standard; or None - N/A>>**.
7. Tennsco Storage**<< ; Steel Lockers; ; _____; or None - N/A>>**.

2.02 LOCKER APPLICATIONS

A. **<< Student Lockers; Wardrobe Lockers; or _____>>**: Metal lockers, **<< recessed mounted; wall mounted with matching closed base; wall mounted for base indicated on drawings; free-standing with matching closed base; free-standing for base indicated on drawings; or mounted to wall and concrete base>>**.

1. Width: 15 inches.
2. Depth: 15 inches..
3. Height: 60 inches.
4. Configuration: **<< Single tier; Two tier; Three tier; Four tier; Five tier; Six tier; Z-tier (2 lockers each with a short and long compartment); or _____>>**.
5. Fittings (Single Tier): Provide shelf, double-prong ceiling hook mounted to underside of shelf, and two single-prong wall hooks, one on each side wall. ******MCPS prefers single tier for HS, MS, and staff lockers.******
6. Fittings (Two-Tier): Provide one double-prong ceiling hook and two single-prong wall hooks, one on each side wall. ******MCPS prefers two-tier for ES student lockers.******
7. Ventilation: None. ~~Louvers at top and bottom of door panel~~. ******MCPS prefers no ventilation in student and staff lockers.******
8. Locking: **<< Padlock hasps, for padlocks provided by Owner; Built-in key locks with spring bolt action; Built-in combination locks; Built-in digital keypad locks; or _____>>**. ******MCPS prefers "padlock hasps, for padlocks provided by Owner" for staff lockers. MCPS prefers "built-in combination locks" for HS and MS student lockers. No locks for ES student lockers.******
9. Provide sloped top.

B. **<< Athletic Lockers; Open-Front Athletic Lockers; or _____>>**: Metal lockers, **<< recessed mounted; wall mounted with matching closed base; wall mounted for base indicated on drawings; free-standing with matching closed base; free-standing for base indicated on drawings; or _____>>**.

1. Width: **<< 18 inches; 21 inches; 24 inches; 27 inches; 30 inches; 33 inches; 36 inches; or _____ inch>>**.
2. Depth: **<< 18 inches; 21 inches; 24 inches; or ____ inches>>**.
3. Height: 72 inches.
4. Configuration: **<< Single tier; Two tier; or _____>>**. ******MCPS prefers two-tier for HS athletic lockers. MCPS prefers 3-tier for MS athletic lockers.******
5. Fittings: Size and configuration as indicated on drawings.
6. Ventilation: Perforated side panels**<< and doors; or None - N/A>>**. ******MCPS prefers ventilation in athletic lockers.******
7. Locking: **<< Padlock hasps, for padlocks provided by Owner; Built-in key locks with spring bolt action; Built-in combination locks; Built-in digital keypad locks; Radio-frequency identification (RFID) locks; or _____>>**. ******MCPS prefers built-in combination locks in athletic lockers.******
8. Provide sloped top.

2.03 METAL LOCKERS

A. Accessibility: Design units as 'accessible' to comply with **<<ICC A117.1>>** and **<<ADA Standards>>**.

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1. Quantity: Provide not less than one ADA-compliant locker for every 20 total; for each locker type (single-tier and two-tier). Locate ADA lockers at end of locker run with clear access space.
2. Locate bottom shelf no lower than 15 inches above floor.
3. Locate hooks, coat rods, and shelves no higher than 48 inches above floor.
4. Provide ADA-compliant recessed handle and latch, no higher than 48 inches above floor.
5. Provide 3" x 3" aluminum plate logo with the international symbol of accessibility on each ADA-compliant locker.

B. Locker Case Construction:
1. Standard-Duty, Knockdown Construction: Made of formed sheet steel; metal edges finished smooth without burrs; **<< baked enamel; powder coat; or _____>>** finished inside and out.
a. Locker Body Components: Formed and flanged from steel sheet of the following type and minimum thicknesses:
1) **<< Unperforated; Perforated; or _____>>** Steel Sheet: Commercial Steel (CS), Type B, supplied for exposed applications and complying with **<<ASTM A1008/A1008M>>** and the following:
(a) Provide uncoated (cold-rolled) steel sheet, except provide zinc-coated steel sheet for locker bottoms.
b. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
1) Door Frame: 16 gauge, 0.0598 inch, minimum.
c. Where ends or sides are exposed, provide flush panel closures.
d. Provide filler strips where indicated, securely attached to lockers.

C. Lockers: Factory assembled, made of formed sheet steel, **<< ASTM A653/A653M SS Grade 33/230, with G60/Z180 coating; ASTM A653/A653M SS Grade 50/340, with G90/Z275 coating; ASTM A653/A653M SS Grade ___ , with ___ coating; Cold-rolled mild steel, uncoated; or _____ >>**, stretcher leveled; metal edges finished smooth without burrs; baked enamel finished inside and out.
1. Where ends or sides are exposed, provide flush panel closures.
2. Provide filler strips where indicated, securely attached to lockers.
3. Color: To be selected by **<<Architect>>**. Manufacturer's standard neutral color is acceptable for locker interiors.

D. Locker Body: Formed and flanged; with steel stiffener ribs; electric spot welded.
1. Tops, Sides, and Shelves: **<< 24 gauge, 0.0239 inch; ____ gauge, ___ inch; or 16 gauge, 0.0598 inch>>** minimum.
2. Backs: 18 gauge, 0.0478 inch minimum.
3. Reinforced Bottoms: 16 gauge, 0.0598 inch minimum with channel edge; welded to frame panels, with manufacturer's standard stiffeners.

E. Doors: Channel edge; welded construction, manufacturer's standard stiffeners, grind and finish edges smooth.
1. Door Thickness: **<< 16 gauge, 0.0598 inch; 14 gauge, 0.0747 inch; or ____ gauge, ___ inch>>**, minimum.
2. Form recess for operating handle and locking device.

F. Latches and Door Handles:**<< Manufacturer's standard; _____; or None - N/A>>**.
1. Latching: Manufacturer's standard for locking arrangement selected.

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a. Multi-Point Lift Handle Gravity Latch: Pocket-mounted, provide three-point latching for locker doors.******MCPS prefers three-point latch, no locks for ES lockers.******

1) Handle Pocket, Recess: Stainless steel flush-mounted cup recessed into face of door.

2) Handle: Steel finger lift mechanism with exposed portion encased in molded plastic trigger.

(a) Padlock Eye: Integral with lift trigger, sized for use with **<< 9/32 inch; or _____ inch>>** diameter padlock shackles.

3) Latching Mechanism: Spring activated nylon slide latch enclosed in steel latch channel allows closing of door while padlock or built-in lock is in position.

4) Provide resilient silencers secured to door stops for silent operation.

b. Single-Point Latch: ******MCPS prefers single-point latch for HS, MS, and staff lockers.******

1) Stationary latch welded securely to locker frame.

2) Latch extends no more than **<< 1-1/4 inch; or _____ inch>>** into locker opening, penetrating through cup.

3) Flush-mounted, recessed stainless steel cup in a formed door with **<< 18 gauge, 0.0478 inch; or ____ gauge, ___ inch>>** vertical back panel stiffener.

4) Handle: Steel finger lift mechanism with exposed portion encased in molded plastic trigger.

(a) Padlock Eye: Integral with lift trigger, sized for use with **<< 9/32 inch; or _____ inch>>** diameter padlock shackles.

5) Lock Hole Filler Plate: Manufacturer's standard. Provide for lockers intended to be unsecured or secured with padlocks.

G. Hinges: Heavy duty, **<< 7-knuckle; 5-knuckle; or 5- or 7-knuckle>>** type; two for doors under **<< 42 inches>>** high; three for doors over **<< 42 inches>>** high.

H. Sloped Top: **<< 20 gauge, 0.0359 inch; ____ gauge, ___ inch; or 18 gauge, 0.0478 inch>>** minimum, with closed ends.

I. Filler Panels, End Closures and Trim: **<< 20 gauge, 0.0359 inch; ____ gauge, ___ inch; or 18 gauge, 0.0478 inch>>**, minimum.

J. Number Plates: Provide **<< oval; rectangular; or _____>>** shaped **<< aluminum; plastic; or _____>>** plates. Form **<< numbers; or _____>>** of **<< block; or _____>>** font style**<< with ADA designation; _____; or None - N/A>>**, in contrasting color.

K. Built-In Combination Locks:

1. Single-Dial Numerical Combination Lock: Three-number dialing lock, key-controlled, capable of minimum five combination changes with key.
2. Latch: **<< Deadbolt; Spring latch; Cam latch; or _____>>**.
3. Lock Finish: **<< Manufacturer's standard finish; Satin nickel; Matte black; Matte white; Satin gold; Brass; Chrome; or _____>>**.

L. Built-In Lock Boxes: Same material as locker, manufacturer's standard size, with **<< padlock hasps, for padlocks provided by Owner; built-in key locks with spring bolt action; built-in combination locks; built-in digital keypad locks; or _____>>**.

2.04 LOCKER BENCHES

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A. Locker Benches: Stationary type; bench top of **<< laminated birch; laminated maple; laminated _____; or _____>>**; **<< painted steel; satin stainless steel; or _____>>** pedestals.
   1. Standard Benchtop Dimensions: 9-1/2 inches deep by 1-1/4 inches thick; lengths indicated on Drawings. Where not indicated, provide 8 foot long benches.
   2. Height: 17-1/2 inches to top of bench; at all benches.
   3. Accessibility: Where accessible benches are indicated, comply with **<<ICC A117.1>>** and **<<ADA Standards>>**.
      a. Accessible Bench Dimensions: 42 inches wide by 20 inches deep, minimum.
      b. Where accessible bench is not indicated to be installed against a wall, provide unit with a backrest extending at minimum 18 inches above the bench top. Each backrest shall be mounted to bench with at least two mounting brackets.
   4. Pedestals: Tubular steel, with mounting flanges welded to each end; fixed to floor.
      a. Pedestal Finish: Powder coat; match locker exterior finish color.
      b. Fasteners: Provide with manufacturer's standard concealed fasteners for securing benchtop to pedestals, and provide concrete expansion/wedge anchors for anchorage to floor slab. Provide all anchors with heads color-matched to pedestals.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared bases are in correct position and configuration.

B. Verify bases and grounds are properly sized and located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Place and secure on prepared base.

C. Install lockers plumb and square.

D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds.

E. Bolt or rivet adjoining locker units together to provide rigid installation.

F. Install **<< end panels; filler panels; sloped tops; miscellaneous panels; and _____>>**.

G. Install fittings if not factory installed.

H. Replace components that do not operate smoothly.

3.03 CLEANING

A. Clean locker interiors and exterior surfaces.

END OF SECTION 105113

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SECTION 107300
PROTECTIVE COVERS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AAMA 611 - Specification for Anodized Architectural Aluminum.

B. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).

C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

F. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

G. AWS D1.2/D1.2M - Structural Welding Code - Aluminum.

1.02 SUBMITTALS

A. Metal Product Data: Product data sheets, including material descriptions and finishes, and preparation instructions and recommendations.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, footings, anchorage, size and type of fasteners, **<< graphic images; patterns; accessories; locations; and _____>>**.

1. Shop drawings shall be project specific; manufacturer's standard details are not acceptable.
2. For protective covers indicated to attach to the building, include detail showing project-specific wall attachment detail that will transfer structural loads to the primary structural element of the exterior wall.

C. Selection Samples: Manufacturer's color charts for metal components.

D. Verification Samples: Manufacturer's standard size physical samples, representing actual material and finish of exposed metal, for each color selected by Architect.

E. Design Data: Submit comprehensive structural analysis of design for the specified loads. Stamp and sign calculations by professional engineer.

F. Designer's qualification statement.

G. Specimen warranty.

1.03 QUALITY ASSURANCE

A. Designer Qualifications: Perform design under direct supervision of **<< Professional Engineer; Professional Structural Engineer; Professional Civil Engineer; or _____>>** experienced in design of this type of work and licensed in **<<the State in which the Project is located>>**.

1.04 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

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B. Manufacturer's Warranty: Provide standard 1-year warranty covering all material deterioration, structural failure, and installation defect.

C. Finish Warranty: Provide **<< 5; 10; 20; or _____>>**-year manufacturer warranty against excessive degradation of factory-applied finishes. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design (Building Mounted): Mapes Architectural Products; Super Lumideck - Hanger Rod**<< Flat Soffit; or None - N/A>>**.

B. Basis-of-Design (Column Supported): Mapes Architectural Products; Post Supported Walkway Canopy.

C. Acceptable Comparable Manufacturers:
1. Architectural Fabrication, Inc.
2. Dittmer Architectural Aluminum.
3. Mitchell Metals.
4. Perfection Architectural Systems, Inc.
5. Superior Mason Products, LLC.
6. Tennessee Valley Metals.
7. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.02 PROTECTIVE COVERS - GENERAL

A. Design Criteria: Design and fabricate to resist gravity, wind, snow, ponding water, weather exposure, seismic, and other structural loads without failure, damage, or permanent deflection in accordance with **<<ASCE 7>>**, applicable building code, and as indicated on Drawings.
1. Structural Design:
   a. Post-Supported: Coordinate foundations and footing design with Division 3 Section "Cast-in-Place Concrete" and with Structural Drawings.
   b. Building-Mounted: Provide engineered wall anchorage system capable of transferring structural loads to the structural CMU wythe or structural cold-formed steel framing (CFSF-S) of the exterior wall assembly. Do not support protective covers directly from brick veneer or other non-structural exterior claddings.
2. Thermal Movement: Design protective covers to accommodate thermal movement caused by ambient temperature range of 120 degrees F and surface temperature range of 180 degrees F **<< 180 degrees F; or ____ degrees F>>** without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects on assembly components.

B. Configuration: Column layout, dimensions, clearances**<< , fascia profile; or None - N/A>>**, and design as indicated on drawings.
1. Drainage Concept (Post Supported): Water collected in decking conducted into perimeter **<< gutters; drain beams; or _____>>** and discharged through **<< columns; downspouts; or _____>>**. Design drainage system to **<< discharge water at grade level with internal diverter plates and cutouts in column sidewalls; or connect to underground subdrainage system. Coordinate with subdrainage installer for connection sizing and outlet elevation/invert>>** Discharge water either at grade level with diverter plates and column cutouts, or coordinate with subdrainage installer for connection into underground subdrainage system, as indicated on Drawings.

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2. Drainage Concept (Building-Mounted): Water collected in decking shall run to rear of protective cover into aluminum fascia/channel. Provide 2-inch diameter drain hole at one end of protective cover, with 3-inch by 3-inch downspout fabricated of smooth extruded aluminum. Downspout shall be fastened to wall with straps at minimum 60 inch on center. Downspouts shall drain on grade with splash block or into underground drainage, as indicated. Downspout and wall straps shall be finished to match protective cover.

C. Provide a complete system ready for erection at project site.

D. Shop fabricate to the greatest extent possible; disassemble if necessary for shipping.

2.03 PROTECTIVE COVERS - ASSEMBLY

A. Description: **<< Flat top; Sloped top; Gabled top; Arched top; or _____>>** metal framework with metal covering supported by **<< metal columns; or hanger-rod assembly>>**, as indicated.

B. Column Anchorage: Column embedded in concrete footing. Provide column sleeves or Styrofoam blockouts for presetting into concrete formwork.

C. Framework: **<< Aluminum; Steel; or _____>>**.

D. Covering Materials:

1. Manufacturer's standard interlocking **<< extruded; roll-formed; or _____>>** aluminum decking modules.

2.04 COMPONENTS

A. Components for Post-Supported Protective Covers:

1. Columns: **<< Extruded; Roll-Formed; or _____>>** aluminum; minimum wall thickness of 0.125 inch.
   a. Type: **<< Fluted; Cloverleaf; Box tube; or _____>>** column.
   b. Cross-Section: **<< 3 inches by 3 inches; 4 inches by 4 inches; 6 inches by 6 inches; _____ inches by _____ inches; or As indicated on drawings>>** (per basis-of-design), unless otherwise indicated, or unless larger column size is required due to structural engineering analysis.
   c. Grout Key: Provide two 1-1/2 inch diameter holes on opposite sides in column base.
2. Beams: **<< Extruded; Roll-Formed; or _____>>** aluminum; minimum wall thickness 0.125-inch.
   a. Style: **<< U-shaped drain beams; C-shaped beams; I-shaped beams; Closed; or _____>>**.
   b. Beam Depth: **<< 6 inches; 7 inches; 10 inches; _____ inches; or As indicaed on drawings>>** (per basis-of-design), unless otherwise indicated, or unless larger size is required due to structural engineering analysis.
   c. Beam Width: Match nominal dimension of column width as required to allow for manufacturer's standard attachment method.
3. **<< Extruded; Roll-Formed; or _____>>** Aluminum Decking: Self-flashing, interlocking sections; minimum 0.078-inch thick.
   a. Deck Profile: Manufacturer's standard deck section for **<< corrugated; or flat>>** soffit profile; size deck depth for structural spacing indicated.
4. Fascia: **<< Extruded; Roll-Formed; or _____>>** aluminum; height per manufacturer's standard profile; minimum 0.070-inch thickness.
5. Wall Attachment for Cantilever Type Post-Supported Canopies: Provide threaded rod anchors, extending fully through exterior wall. Provide integral eyebolt, "U" bracket, or

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manufacturer's standard clevis assembly at rod attachment anchors for hanger rod attachment. At all through anchors, provide galvanized steel compression sleeves, sized to wall cavity and cladding depth, and additional construction as needed to prevent transferring structural loads onto veneer/cladding. All loads shall transfer to structural "backup" wall.

a. The structural system above is per the Basis-of-Design product indicated. Manufacturer may submit an alternate pre-engineered structural system, provided the system complies with other requirements of this section and is capable of supporting loads from the primary wall structure.

B. Components for Building-Mounted Protective Covers:

1. Beams: **<< Extruded; Roll-Formed; or _____>>** aluminum.
   a. Style: **<< U-shaped drain beams; C-shaped beams; I-shaped beams; Closed; or _____>>**; 3-1/4" x 3-1/4" x 1/4" nominal.
2. **<< Extruded; Roll-Formed; or _____>>** Decking: Self-flashing, interlocking sections, minimum 0.078-inch thick.
   a. Deck Profile: Manufacturer's standard deck section for **<< corrugated; or flat>>** soffit profile; size deck depth for depth of protective cover as indicated.
3. Fascia: **<< Extruded; Roll-Formed; or _____>>** aluminum; height per manufacturer's standard profile; minimum 0.125-inch thickness.
4. Hanger Rod Assembly: Manufacturer's standard 1-inch diameter hanger rod assembly, fabricated of schedule 40 galvanized steel. Provide aluminum clip angle bolted to aluminum I-beams for attachment of hanger rod assembly to canopy, with neoprene washers or other material standard to manufacturer for separation of dissimilar metals.
   a. Wall Attachment: Provide threaded rod anchors, extending fully through exterior wall. Provide integral eyebolt, "U" bracket, or manufacturer's standard clevis assembly at rod attachment anchors for hanger rod attachment. At all through anchors, provide galvanized steel compression sleeves, sized to wall cavity and cladding depth, and additional construction as needed to prevent transferring structural loads onto veneer/cladding. All loads shall transfer to structural "backup" wall.
      1) The structural system above is per the Basis-of-Design product indicated. Manufacturer may submit an alternate pre-engineered structural system, provided the system complies with other requirements of this section and is capable of supporting loads from the primary wall structure.

C. Exposed Framing Fasteners: Flush countersunk **<< galvanized; plated; stainless; or _____>>** steel screws or bolts; consistent with design of system and acceptable to manufacturer.

1. Decking Fasteners: Stainless steel with neoprene washers.
2. Finish exposed fasteners to match metal framing.

D. Flashings: Metal and finish matching system framing components, with thickness as recommended by manufacturer for conditions encountered.

E. Reinforcement Materials and Bracing: Where **<< light fixtures; dimensional letter signage; or other items>>** are indicated to be mounted to the protective cover, provide additional reinforcing or bracing elements to ensure a secure attachment to the protective cover without failure of decking or structural elements. Coordinate with submitted manufacturer(s) of items to be mounted to protective cover for loading requirements and attachment methods.

2.05 MATERIALS

A. Aluminum:

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1. Aluminum Extrusions: Alloy and temper 6063-T5, 6063-T6, or 6061-T6 members complying with **<<ASTM B221>>** (**<<ASTM B221M>>**), with minimum thickness 1/8 inch for structural members and 1/16 inch for nonstructural members.

B. Concrete for Footings: Refer to Division 3 Section "Cast-in-Place Concrete."

C. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Grout: Comply with **<<ASTM C1107/C1107M>>**.

D. Bituminous Coating: ASTM D 1187 asphaltic coating or comparable protective coating to prevent corrosion between materials. Building felt is not acceptable.

2.06 FABRICATION - METAL COMPONENTS

A. Fit and shop assemble components in largest practical sizes, for delivery to site.

B. Fabricate components with joints tightly fitted and secured.

C. Provide notches, cut outs, and internal deflectors in members as noted to act as internal water drainage system.

D. Weld aluminum members in accordance with **<<AWS D1.2/D1.2M>>**.

E. Exposed Fastenings: Unobtrusively located; consistent with design of component, except where specifically noted otherwise.

F. Supply components required for anchorage of framing. Fabricate anchors and related components of same material and finish as framing, except where specifically noted otherwise.

G. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

H. Accurately form components to suit each other and to building structure.

2.07 FINISHES

A. Class I Natural Anodized Finish: **<<AAMA 611>>**AA-M12C22A41, clear anodic coating not less than 0.7 mils thick.

B. High Performance Organic Coatings: **<<AAMA 2604>>**, multiple coats, thermally cured fluoropolymer system.

C. Finish Color: To be selected by **<<Architect>>** from manufacturer's full range.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and site area for conditions that might prevent satisfactory installation.

B. Verify that foundation, electrical utilities, and placed anchors are in correct position.

C. Verify that bearing surfaces are ready to receive this work.

D. Do not proceed with installation until conditions are satisfactory.

3.02 PREPARATION

A. Supply items required to be cast into concrete with setting templates for installation of work in other sections.

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B. Concrete Foundations/Footings: Coordinate with and provide column sleeves or Styrofoam blockouts to the concrete installer to ensure foundations comply with manufacturer's requirements.

3.03 INSTALLATION - FRAMING

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects.

C. Post Supported Canopies: Anchor columns in concrete foundations with column sleeves or preset Styrofoam blockout locations. Insert columns into foundation space and fill remaining annular space between concrete and columns with non-shrink cementitious grout. Wipe off surplus anchoring material, provide 1/8-inch build up at column and slope smoothly away from column. Seal anchoring material when required by grout manufacturer's installation instructions.

D. Building Mounted Canopies: Provide threaded anchor assemblies required for connecting framing to structure. Anchor framing to primary structural wall elements. Where primary structure of exterior wall is cold-formed steel framing (CFSF-S metal studs), provide additional fire-retardant treated wood blocking between metal stud members to accommodate hanger rod spacing.

E. Protective Coating: Provide a protective coating to separate aluminum surfaces from masonry, concrete or cementitious materials, and dissimilar metals.

3.04 INSTALLATION - METAL COVERING

A. Install in accordance with manufacturer's instructions.

B. Fasten metal decking to metal support members, aligned level and plumb.

C. Install **<< fascia panels; trim; flashing; and _____>>**.

D. Separate dissimilar metals using concealed bituminous paint.

E. Touch-up damaged finish coating using material provided by manufacturer to match original coating.

3.05 TOLERANCES

A. Maximum Variation from Plumb, Level, or Line: **<< 1/8 inch per 10 feet; or ___ inch per 10 feet>>**, or **<< 3/8 inch; or ___ inch>>** total in overall dimension.

B. Alignment of Two Adjoining Members Abutting in Plane: Within **<< 1/16 inches; or ____ inches>>**.

3.06 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

B. Test for watertightness, water management, and lack of ponding of completed protective covers and components, including **<< decking; gutters; drain beams; columns; and _____>>**.

3.07 CLEANING

A. See Section **<< 017000 - Execution and Closeout Requirements>>** for additional requirements.

B. Clean all exposed surfaces after installation.

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3.08 PROTECTION

A. Touch-up, repair, or replace damaged components before Date of Substantial Completion.

B. Protect protective covers after installation to prevent damage due to other work until Date of Substantial Completion.

END OF SECTION 107300

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SECTION 107500
FLAGPOLES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

C. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.

D. NAAMM FP 1001 - Guide Specifications for Design Loads of Metal Flagpoles.

1.02 SUBMITTALS

A. Product Data: Provide data on pole, accessories, and configurations.

B. Shop Drawings: Indicate detailed dimensions, **<< base; or attachment>>** details, anchor requirements, and imposed loads.

C. Sustainable Design Submittals: Refer to Division 01 Section "Sustainable Design Requirements."

D. Designer's Qualification Statement.

1.03 QUALITY ASSURANCE

A. Designer Qualifications: Design flagpole assemblies, including foundations, under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State of Maryland.

B. Products Requiring Electrical Connection: Listed and classified by **<< Underwriters Laboratories Inc.,; or testing firm acceptable to the authority having jurisdiction>>** as suitable for the purpose specified and indicated.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.

B. Protect flagpole and accessories from damage or moisture.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Flagpoles:
   1. American Flagpole & Flag Co.
   2. Baartol Co., Inc.
   3. Concord American Flagpole.
   4. Eagle Mountain Flag and Flagpole.
   5. Eder Flag Manufacturing Co., Inc.
   6. Morgan-Francis Flagpoles & Accessories.
   7. Pole-Tech Co, Inc.

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2.02 FLAGPOLES

A. Flagpoles: Designed in accordance with NAAMM FP 1001.
   1. Material: Aluminum.
   2. Design: Cone tapered.
   3. Mounting: **<< Ground mounted type; Shoe base; Vertical wall mounted type; Wall mounted type, 30 degree inclusive angle outrigger; Wall mounted type, 45 degree inclusive angle outrigger; Wall mounted type, 60 degree inclusive angle outrigger; Roof set type, fixed type; Roof set type, tiltable type; Roof set type, counter balanced type; Roof set type, geared type; or _____>>**.
   4. Quantity and Nominal Heights: As indicated on Drawings; heights shall be measured from **<< nominal ground elevation.; top of base.; or center of wall mounting.>>**
   5. Halyard: **<< Interior; or External>>** type.
      a. Provide one halyard at each flagpole.
      b. Snap Hooks: Provide four snap hooks per halyard; fabricated of brass.

B. Performance Requirements:
   1. Wind Pressure Loading on Flagpole with Flag: Resistant without permanent deformation in accordance with **<<NAAMM FP 1001>><< ; the factor of safety used is 2.5; ; the factor of safety used is 1.95; ; the factor of safety used is _____; or None - N/A>>**.

2.03 POLE MATERIALS

A. Aluminum: **<< ASTM B241/B241M; or ASTM B221 ASTM B221M>><< , 6063 alloy; or _____>><< , T6 temper; or _____>>**; minimum wall thickness of 3/16 inch.

2.04 ACCESSORIES

A. Finial Ball: **<< Stainless steel; Aluminum; Copper; or _____>>**, 5 inch diameter.

B. Truck Assembly: Cast aluminum; revolving, stainless steel ball bearings mounted on aluminum spin, non-fouling.

C. Cleats: 9 inch size, cast aluminum with stainless steel fastenings, one per halyard.

D. Halyard: 5/16-inch diameter polypropyhlene, braided, white.

E. Connecting Sleeve For Multiple Section Poles: Same material as pole, precision fit for field assembly of pole, concealed fasteners.

2.05 MOUNTING COMPONENTS

A. Foundation Tube Sleeve: **<<AASHTO M 36>>**, corrugated 16 gauge, 0.0598 inch steel, galvanized, depth as indicated on Drawings.

B. Pole Base Attachment: Flush; steel base with spun aluminum base cover.

C. Lightning Ground Cable: Copper No. **<< 6; or ____>>** AWG, soft drawn.

2.06 FINISHING

A. Metal Surfaces in Contact With Concrete: Protect with bituminous/asphaltic coating.

B. Concealed Steel Surfaces: Galvanized to **<<ASTM A123/A123M>>** requirements.

C. Aluminum: Mechanical finish; medium satin directionally textured (AA-M32).

D. Stainless Steel: No. 4 satin finish.

E. Bronze: Dark bronze, lacquered finish.

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F. Finial: Gold anodized finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that **<< concrete foundation is; wall supports are; or roof supports are>>** ready to receive work and dimensions are as **<< indicated on shop drawings.; or instructed by the manufacturer.>>**

B. Verify that electric power is available and of the correct characteristics.

3.02 PREPARATION

A. Coat metal sleeve surfaces below grade and surfaces in contact with dissimilar materials with asphaltic paint.

3.03 INSTALLATION

A. Install flagpole and fittings in accordance with manufacturer's instructions.

B. Electrically ground flagpole installation with ground spike and plate.

C. Fill base around foundation tube sleeve with concrete specified in Division 03 concrete spec.

D. Install foundation plate and centering wedges for flagpoles base set in concrete base and fasten.

E. Fill foundation tube sleeve with sand and compact.

F. Seal around top of foundation tube sleeve with two inches of elastomeric sealant.

G. Locate electric control box where indicated.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1 inch.

3.05 ADJUSTING

A. Adjust operating devices so that halyard functions smoothly.

END OF SECTION 107500

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SECTION 111313
LOADING DOCK BUMPERS

PART 1 GENERAL

1.01 SUBMITTALS

A. Product Data: Submit data on unit dimensions, method of anchorage, and details of construction.

B. Shop Drawings: Include plans, sections and details indicating dock bumper locations, sizes, mounting heights, and anchorage methods and details.

PART 2 PRODUCTS

2.01 COMPONENTS

A. Loading Dock Bumpers (Laminated): Fabric reinforced rubber pads, ozone resistant, laminated and compressed in position using two galvanized steel rods with threaded ends, washers, and nuts between manufacturer's standard 1/4- or 3/8-inch thick galvanized steel angle end plates.
   1. Projection From Wall: **<< 4-1/2 inches; 6 inches; or ____ inches>>**, minimum.
   2. Vertical Height: 10 inches, minimum.
   3. Width: **<< 12 inches; 14 inches; 15 inches; 24 inches; or ____ inches>>**, minimum.
   4. Profile: **<< Rectangular; Semi-circular; T shape; L shape; or _____>>**, with chamfered corners.
   5. Finish steel angles and anchor components with manufacturer's standard black enamel / powder coat painted finish.
   6. Manufacturers:
      a. Blue Giant Equipment Corporation.
      b. Chalfant Dock Equipment.
      c. Durable Corp.
      d. Ideal Warehouse Innovations, Inc.
      e. Rite-Hite.
      f. Rotary Products, Inc.
      g. Vestil Manufacturing Corp.

B. Attachment Hardware: 3/4 inches diameter galvanized bolts with **<< expansion shields; "L" shaped anchor rods for casting into concrete; or _____>>**, or threaded studs welded to L-shaped anchor galvanized steel plate / angle that is cast-in to concrete wall; finish exposed anchors to match exposed steel finish of angle end plates.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that anchor placement is acceptable.

3.02 INSTALLATION

A. Install dock bumpers in accordance with manufacturer's instructions.

B. Set plumb and level.

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C. Laminated Bumpers: Secure angled end frames to concrete loading dock wall with expansion anchors or threaded studs welded to embedded anchor plates / angles.

END OF SECTION 111313

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SECTION 113013
RESIDENTIAL APPLIANCES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design.

B. ICC A117.1 - Accessible and Usable Buildings and Facilities.

C. UL (DIR) - Online Certifications Directory.

1.02 SUBMITTALS

A. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with a service center within 50 miles of Project site capable of maintenance and emergency repairs.

B. Electric Appliances: Listed and labeled by **<<UL (DIR)>>** and complying with NEMA Standards (National Electrical Manufacturers Association).

C. Accessibility: Where ADA-compliant appliances are indicated, provide appliances that comply with reach ranges and operable parts requirements in compliance with **<<ICC A117.1>>** and **<<ADA Standards>>**.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers:
1. BOSCH Home Appliances.
2. Fisher and Paykel.
3. Frigidaire Home Products.
4. GE Appliances.
5. Jenn-Air.
6. Maytag.
7. Whirlpool Corp.

2.02 KITCHEN APPLIANCES

A. Refrigerator: Free-standing, **<< side-by-side; top-mounted freezer; or bottom-mounted freezer>>**, and **<< frost-free; cycle-defrost; manual defrost; or _____>>**.
1. Basis-of-Design Product: GE Appliances; Model GTE22JTNRWW. ******If the unit does not have a top-mounted freezer or frost-free defrost, indicate a new model number.******
2. Capacity: Total minimum storage of **<< 18 cubic ft; 20 cubic ft; 22 cubic ft; 24 cubic ft; 30 cubic ft; or 21 cubic ft>>**; minimum **<< 15; 20; 25; or ____>>** percent freezer capacity.
   a. Provide ADA-compliant model; at least 50 percent of freezer shall be located within 54 inches of floor.

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3. Energy Usage: Provide ENERGY STAR qualified product.
4. Features: Include **<< glass shelves; automatic icemaker; light in freezer compartment; in-door water and ice dispenser; and ____>>**. Do not provide water dispenser. ******If using a different basis of design model number, update these features.******
5. Electrical Requirements: 120V; 60 Hz; 15 Amp.
6. Exterior Finish: White.

B. Refrigerator - Undercounter: Free-standing, **<< single-door; or double-door>>**, and **<< manual defrost; or cycle-defrost>>**.
1. Basis-of-Design Product: GE Appliances; Model GME04GLKLB. ******If the unit does not have a single-door or manual defrost, indicate a new model number.******
2. Overall Height: 33.875 inch. ******Most undercounter refrigerators are too high to fit under a 34 inch high countertop and require a 36 inch high countertop. Coordinate unit height with casework.******
3. Capacity: Total minimum storage of 4 cubic feet.
   a. Provide ADA-compliant model.
4. Energy Usage: Provide ENERGY STAR qualified product.
5. Features: Include **<< glass shelves; two front leveling legs; in-the-door can rack; light in freezer compartment; and ice tray>>**. ******If using a different basis of design model number, update these features.******
6. Electrical Requirements: 120V; 60 Hz; 15 Amp.
7. Exterior Finish: Stainless steel.

C. Range: Electric, free-standing, with glass-ceramic cooktop and integral backsplash.
1. Basis-of-Design Product: GE Appliances; Model JB480DYWW. ******If the unit does not have the features indicated, indicate a new model number.******
2. Stainless Steel Backsplash: 30 inches wide.
   a. Provide Broan-NuTone, LLC; "Model SP3004" or comparable stainless steel backsplash submitted as a properly formatted substitution request.
3. Size: 30 inches wide.
4. Oven: **<< Self-cleaning; Continuous cleaning; Manual cleaning; or _____>><< with electronic ignition; or None - N/A>>**.
   a. Oven Capacity: 5.0 cubic ft.
5. **<< Elements; Burners; or _____>>**: **<< Four (4); Six (6); or ____>>**; two 2000W 8-inch and two 1500W 6-inch.
6. Controls: **<< Solid state electronic; Push-to-turn knobs with electronic clock and timer; Push-to-turn knobs with analog clock and timer; Push-to-turn knobs with analog timer; or ____>>**.
   a. Provide ADA compliant model with controls located at the front of the unit.
   b. Range Knob Lockouts: Provide RangeSafe; Classic Range Knob Lockout or GE; OEM Range Lock-Out Knob, or comparable range lockout devices for range knobs as a properly formatted substitution request.
7. Features: Include **<< automatic meat thermometer; storage drawer; oven door window; broiler pan and grid; oven light; and ____>>**. ******If using a different basis of design model number, update these features.******
8. Electrical Requirements: 208/240V; 60 Hz; 40 Amp.
9. Exterior Finish: White.

D. Cooking Exhaust: Range hood.

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1. Basis-of-Design Product: GE Appliances; Model JVX5305DJWW. ******If the unit does not have the features indicated, indicate a new model number.******
2. Size: 30 inches wide.
3. Fan: **<< Single-; Two-; Three-; Variable-; or ____ ->>**speed, **<< 500 cfm; 300 cfm; 250 cfm; 180 cfm; 150 cfm; or 270 cfm>>**. ******Keep fan volume under 400 cfm. Fans 400 cfm and above must have an air-handler to comply with code. Confirm with applicable d******
4. Energy Usage: Provide ENERGY STAR qualified product.
5. Exhaust: Recirculating.
6. Features: Include **<< cooktop light; night light; backdraft damper; removable grease filter; retractable visor; and removable, washable filter>>**. ******If using a different basis of design model number, update these features.******
7. ADA Controls: Provide wall mounted controls adjacent to range to comply with accessibility requirements. Coordinate with Division 26 electrical contractor to provide wiring to the control location and for cover plate with finish matching other cover plates in the space.
8. Electrical Requirements: 120V; 60 Hz; 1 Amp.
9. Exterior Finish: White, color to match range.
10. Range Fire Suppression: Provide electronically-operated, hood mounted, automatic fire suppression system. Basis-of-Design is Guardian G600B. ******Confirm with applicable code official if fire suppression is required.******

E. Microwave: Countertop.
1. Basis-of-Design Product: GE Appliances; Model PCWK22U1WWW. ******If the unit does not have the features indicated, indicate a new model number.******
2. Capacity: 2 cubic feet.
3. Power: **<< 700; 850; 1000; or ____>>** watts.
4. Features: Include **<< turntable; cooktop light; night light; 2-speed exhaust fan; built-in trim kit; undercabinet mounting kit; and _____>>**. ******This unit can be modified to mount inside a cabinet or over a range. It is specified here as a countertop microwave.******
5. Electrical Requirements: 120V; 60 Hz.
6. Exterior Finish: White.

F. Dishwasher: Undercounter. Provide ADA compliant product, no more than 32-1/4 inch high, to fit under 34 inch counter.
1. Basis-of-Design Product: GE Appliances; Model GDT226SGLWW. ******If the unit does not have the features indicated, indicate a new model number.******
2. Width: 24 inches.
3. Controls: **<< Solid state electronic; Manual timer; or ____>>**, top mounted in door.
4. Energy Usage: Provide ENERGY STAR qualified product.
5. Wash Levels: **<< Three (3); Two (2); or ____>>**; auto, heavy, and light.
6. Features: Include rinse aid dispenser, temporary temperature boost option, child lock, delay start, and sanitize option.
7. Electrical Requirements: 120V; 60 Hz; 8.9 Amp.
8. Exterior Finish: White.

2.03 LAUNDRY APPLIANCES

A. Clothes Washer: Front-loading; ADA-compliant.

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1. Basis-of-Design Product: GE Appliances; Model GFW550SSNWW.
2. Interior Size: 4.8 cubic ft.
3. Overall Unit Size: 28 inches wide by 32 inches deep by 40 inches high, nominal.
4. Controls: **<< Solid state electronic; Rotary; or ____>>** with rotary cycle selector; front-mounted.
5. Energy Usage: Provide ENERGY STAR qualified product.
6. Cycles: Include multiple cycles for normal, delicates, quick wash, whites. Include with at least 5 spin speed options and 5 water temperature options.
7. Additional Features: Include adaptive, automatic temperature, water level, and spin controls. Include dispensers for bleach, fabric softener, and sanitizer, self-cleaning lint filter, and delay wash option.
8. Electrical Requirements: 120V; 60 Hz; 20 Amp.
9. Exterior Finish: Painted steel, color white.

B. Clothes Dryer: Electric, stationary; ADA-compliant.
1. Basis-of-Design Product: GE Appliances; Model GFD65ESSNWW.
2. Interior Size: 7.8 cubic ft.
3. Overall Unit Size: 28 inches wide by 32 inches deep by 40 inches high, nominal.
4. Controls: **<< Solid state electronic; Rotary; or ____>>** with rotary cycle selector, with **<< electronic moisture-sensing dry control; temperature-sensing dry control; timer dry control; or ____>>**.
5. Energy Usage: Provide ENERGY STAR qualified product.
6. Cycles: Include multiple cycles for normal, delicates, quick dry, and timed dry. Include with at least 5 heat selections.
7. Additional Features: Include automatic moisture sensor to adjust control, front-mounted lint filter, and delay dry option.
8. Ventilation: Provide ductwork sized to match outlet, in length required to vertically extend through roof. Provide gooseneck exhaust vent at roof. Coordinate with Division 7 roofing contractor for roof penetration.
9. Electrical Requirements: 208/240V; 60 Hz; 24 Amp.
10. Exterior Fih: Painted steel, color white.

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2.04 ICE MAKER

A. Ice Maker: Free-standing, air-cooled ice maker with **<< cube; nugget; dice; or _____>>**-type ice machine mounted to top of stainless steel storage bin, with adjustable leveling feet.
1. Manufacturers:
   a. Avantco.
   b. Hoshizaki.
   c. Manitowoc.
   d. Scotsman.
2. Width: **<< _____>>**.
3. Ice Maker Size: **<< _____>>**.
4. Storage Bin Size: **<< _____>>**.
5. Ice Making Capacity: **<< _____>>**.
6. Bin Storage Capacity: **<< _____>>**.
7. Electrical Requirements: 115 V; **<< _____>>**.

B. Ice Maker: Free-standing, undercounter, air-cooled ice maker with **<< cube; nugget; dice; or _____>>**-type ice machine and built-in storage bin, with **<< drain pump and; or None - N/A>>** adjustable leveling feet.
   1. Manufacturers:
      a. Avantco.
      b. Hoshizaki.
      c. Manitowoc.
      d. Scotsman.
   2. Width: **<< _____>>**.
   3. Overall Unit Dimensions: **<< 15 inches wide by 22.5 inches deep by 31.5 inches high>>**.
   4. Ice Making Capacity: **<< 50 pounds in 24 hours>>**.
   5. Storage Capacity: **<< 25 pounds>>**.
   6. Electrical Requirements: 115 V; **<< 60 Hz>>**.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify utility rough-ins are provided and correctly located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Anchor built-in equipment in place.

3.03 ADJUSTING

A. Adjust equipment to provide efficient operation.

3.04 CLEANING

A. Remove packing materials from equipment and properly discard.

B. Wash and clean equipment.

END OF SECTION 113013

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SECTION 114000
FOODSERVICE EQUIPMENT – ELEMENTARY SCHOOLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Furnish all labor, materials, services, equipment and appliances required to provide and deliver all foodservice equipment hereinafter specified into the building, uncrate, assemble, hang, set-in-place, level, and completely install, exclusive of final utility connections. Demonstration and training shall be performed by manufacturer's representative knowledgeable in all aspects of this equipment.

B. Related Work Specified Elsewhere:

1. All plumbing, electrical and ventilating work required in conjunction with commercial foodservice equipment including rough-in to points indicated on mechanical drawings, and final connections from rough-in points, electrical service to points of connection and final connections shall be by Divisions 22, 23 and 26.
2. Refrigeration work will be done by the Kitchen Equipment Contractor except for electrical and plumbing connections to and between compressors, blower coils, controls, etc. These final connections shall be by Divisions 22 and 26.
3. All traps, steam traps, grease traps, line strainers, tail pieces, valves, mixing valves, backflow preventors, stops, shut-offs, and fittings necessary for equipment specified will be furnished and installed under mechanical contract by Division 22 unless specifically called for otherwise under each item.
4. All line and disconnect switches, safety cut-offs and fittings, convenience boxes or other electrical controls, fittings and connections will be furnished and installed under electrical contract by Division 26, unless specifically indicated otherwise in the item specifications. Starting switches for certain specified pieces of foodservice equipment are to be provided by Kitchen Equipment Contractor. Those starting switches, if furnished loose as standard by Foodservice Manufacturers (other than fabricated items), shall be mounted and wired complete under Division 26.
5. Any sleeves or conduit required for refrigeration, syrup tubing, or carbonation tubing will be furnished and installed under Division 22.
6. Unless specifically called for in the Item Specifications, ventilating fans and all duct work between same and ceiling rough-in openings, and from same to discharge opening in building will be furnished and installed by Division 22.

1.2 DEFINITIONS

A. All references to the terms "Kitchen Equipment Contractor", or "K.E.C." in the specifications and/or on the drawings shall be defined to mean the Kitchen Equipment Contractor.

B. All references to the term "Owner" in the specifications and/or on the drawings shall be defined to mean the Owner or Owner's designated representative and the Foodservice Equipment Consultant.

C. All references to the term "Consultant" or "Foodservice Equipment Consultant" in the specifications and/or on the drawings shall be defined to mean **NYIKOS GARCIA FOODSERVICE DESIGN, INC.** its employees, and authorized representatives and is referred to throughout the contract documents as if singular in number and masculine in gender.

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D. The phrase "The K.E.C. shall" or "by the K.E.C.", as applicable, is understood to be included as a part of each sentence, paragraph or article of these specifications unless otherwise indicated or specified.

1.3 QUALITY ASSURANCE

A. Qualification of Suppliers:

1. Commercial foodservice equipment suppliers shall submit satisfactory evidence of compliance with the following qualifications and conditions to be approved.

a. Successful completion of jobs of comparable scope.
b. Have manufacturer's authorization to distribute and install specified factory items of equipment.
c. Maintain a permanent staff experienced in the installation of foodservice equipment and preparation of professional style rough-in drawings and brochures.
d. Maintain or have access to fabrication shop meeting N.S.F. requirements. If other than foodservice equipment suppliers own fabrication shop, obtain Consultant approval of fabrication shop desired to be used.
e. Maintain or have access to a readily available stock of repair and replacement parts, together with authorized service personnel.

B. Qualification of Fabricators:

1. Fabricators shall be an N.S.F. approved organization with trained personnel and facilities to properly design, detail and fabricate equipment in accordance with the specifications and standard details contained herein.
2. Custom fabricated equipment shall bear the National Sanitation Foundation seal of approval and listed as such under N.S.F. Standards No. 2 and No. 33.
3. Only one (1) fabricator shall be used for this project, and all equipment will be fabricated at the same shop. Where units cannot be fully shop-fabricated, complete fabrication at project site.
4. Acceptable fabricators are:

a. Pro Stainless, Inc.; Keyser, WV
b. Commercial Stainless, Inc.; Bloomsburg, PA
c. Aero Manufacturing; Clifton, NJSouthern Equipment Fabricators, Inc.; Columbia, SC
d. Titan Stainless; Pageland, SC
e. Other fabricators, as approved by Consultant.

C. Qualification of Manufacturers:

1. Manufacturers shall be regularly engaged in the production of items furnished and shall have demonstrated the capability to furnish similar equipment that performs the functions specified or indicated herein.

D. Standard Products:

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1. Materials, products, and equipment furnished under this contract shall be the standard items of manufacturers regularly engaged in the production of such materials, products, and equipment and shall be of the manufacturer's latest design that complies with the specifications which have been produced and used successfully on other projects and in similar applications.
2. Discrepancies within contract documents should immediately be brought to the attention of the Consultant in writing for clarification prior to fabrication or ordering of standard items.

1.4 PLANS & SPECIFICATIONS

A. Specifications and drawings have been prepared to form the basis for procurement, erection, start-up and adjustment of all equipment in this contract. Plans and specifications shall be considered as mutually explanatory and work required by one, but not the other, shall be performed as though required by both. Items required by one, but not by the other shall be provided as though required by both. Work shall be accomplished as called for in specifications and shown on drawings, so that all items of equipment shall be completely functional for purpose for which they were designed. When there is any discrepancy between drawings and specifications, drawings shall govern. Bidders should seek clarification of any discrepancies from the Consultant prior to bidding.

1.5 SUBMITTALS

A. General Requirements:

1. Assemble and submit all shop drawings, rough-in drawings, brochures, color samples, etc. as a complete package. There will be no review of partial submittals.
2. Any and all costs, to all trades and parties involved, arising from delay of project due to non-submittal of the complete package by the K.E.C. within a reasonable time period shall be borne solely by the K.E.C.
3. Identify each submittal by project name, date, contractor, submittal name, and any other necessary information to distinguish it from other submittals.

B. Shop Drawings:

1. Submit shop drawings electronically in PDF format, drawn on sheets equal in size to Contract Documents of equipment specified for custom fabrication including all accessories attached to each item.
2. Drawings shall be detailed and fully dimensioned to a minimum scale of 3/4"=1'-0" for plan and elevation views, and 1-1/2"=1'-0" for sections, based on the floor plan(s) and following item specifications. Drawings will be checked for thoroughness, accuracy, completeness, neatness, and returned for corrections, if necessary.

C. Rough-in Drawings:

1. Submit rough-in drawings electronically in PDF format, drawn on sheets equal in size to Contract Documents of detailed arrangement plans professionally prepared from architects dimensioned plans (not traced from Contract Documents) at a minimum scale of 1/4"=1'-0".
2. Equipment Layout Plan showing arrangement of all items specified and identified on schedule of equipment listing item number, description, quantity, manufacturer, model number, and remarks.

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3. Ventilation Plan showing dimensioned locations of all duct openings for ventilators and dishmachines identifying size, c.f.m. required (exhaust and supply), static pressures, and connection heights.
4. Plumbing/Electrical Plans showing dimensioned locations, sizes, elevations and capacities of all utility services required for each item of equipment in relation to finished walls, columns, and heights above finished floor.
5. Special Conditions Plan showing exact dimensions and details of all masonry bases, floor depressions, critical partition locations/heights, wall openings, reinforcing for wall and/or ceiling mounted equipment, and conduit locations for soda and compressed gas lines.

D. Equipment Brochures:

1. Submit electronic files in PDF format of manufacturer's illustrations and technical data for approval prior to procurement. All items of Standard Manufacture shall be submitted, including items purchased to be built into fabricated equipment. Each illustration shall be marked to accurately describe the item to be furnished as specified. Include all deviations from standard information (i.e., voltage, phase, load, etc.).
2. Include a separate information sheet ahead of each illustration sheet showing all service connection sizes, electrical requirements, loads, consumptions, and all accessories specified.
3. Manufacturer's suggested schematic drawings for connection of mechanical and electrical services for such items as booster heaters, disposers, or any other item of equipment that may require the same.

E. Miscellaneous Shop Drawings:

1. Submit electronic files in PDF format of manufactured equipment specified requiring clarification and approval such as, walk-in cooler/freezer drawings, ventilator drawings, utility raceway drawings, and refrigeration system drawings.

F. Operation and Maintenance Manuals:

1. Submit electronic files in PDF format for all mechanically operated equipment of standard manufacture. Include operating and cleaning/maintenance instructions, parts listing, recommended parts inventory listing and purchase source, copy of warranties, and similar applicable information.
2. Brochure covers shall bear the job name, date, and name of contractor.
3. Submit start-up report for food service equipment such as walk-in cooler/freezer, refrigeration system, utility raceway, ventilator and cooking equipment.

G. Manufacturer's List:

1. The K.E.C. shall submit in writing a list of all manufacturer's representatives of the food service equipment such as convection ovens, ranges, etc., and their authorized service agencies' addresses and telephone numbers; to be presented after submission of manufacture data.

H. Samples:

1. Samples of materials, products, and fabrication methods, shall be submitted for approval upon request at no additional cost, before proceeding with work.

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I. Re-submission Requirements:

1. Shop Drawings:

a. Revise initial drawings as required and resubmit in accordance with submittal procedures.
b. Indicate on drawings all changes which have been made in addition to those requested by Consultant.

2. Product Data and Samples:

a. Submit new data and samples as required for initial submittal.
b. Make all re-submittals within fourteen (14) working days from date of Consultants previous action.

J. Approvals:

1. After approval of the submittals listed above, furnish as many prints and copies as are required for the various trades, the Owner, the Architect, and the Consultant.
2. The approval of the shop drawings will be general and shall not relieve the K.E.C. of responsibility for proper fitting, finishing, quantities, and erection of work in strict accordance with the contract requirements, nor does it relieve him of the responsibility of furnishing material and workmanship not indicated on approved shop drawings but required for the completion of his work.
3. Approval by the Consultant and/or Owner of the manufacturer's data submitted by the K.E.C. does not waive the responsibility of K.E.C. to furnish each item of equipment in complete compliance with the specifications and drawings. Discrepancies between Contract Documents and furnished equipment shall be corrected even after approval and installation of this equipment at no additional cost to the Owner.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery:

1. Equipment shall be delivered to the job site only after the building is weather-safe and vandal-safe.

B. Storage:

1. Store equipment in an area convenient to the point of installation in such a way that it is protected from the weather and job hazards.

C. Protection:

1. Wrapping and protective coatings shall remain on all items until ready for use and in the case of stainless steel items, until installation is complete and the job is ready for cleaning.

D. Damage:

1. All responsibility shall rest with the K.E.C. for any damage or loss incurred prior to final acceptance. Such items as may be lost or damaged shall immediately be replaced or repaired to a new condition to the complete satisfaction of and at no additional cost to the Owner.

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1.7 JURISDICTION TRADE AGREEMENTS AND RESTRICTIONS

A. Include the work specified, shown or reasonably infer able as part of foodservice equipment. Portions of this work may be subcontracted to those qualified to do such work, as may be necessary because of jurisdictional trade agreements and restrictions.

1.8 REGULATIONS AND CODES

A. Except as otherwise indicated, each item of equipment shall comply with the latest current edition of the following standards as applicable to the manufacture, fabrication, and installation of the work in this section.

1. N.S.F. Standards: Comply with National Sanitation Foundation Standards and criteria, and provide N.S.F. "Seal of Approval" on each manufactured item and major items of custom-fabricated work.
2. U.L. Standards: For electrical components and assemblies, provide either U.L. labeled products or, where no labeling service is available, provide a complete index of the components used as selected from the U.L. "Recognized Component Index".
3. A.N.S.I. Standards: For gas-burning equipment, comply with A.N.S.I. Z21-Series standards. Comply with A.N.S.I. B57.1 for compressed gas cylinder connections and with applicable standards of the Compressed Gas Association for water connection air gaps and vacuum breakers.
4. A.G.A.: All gas-fired equipment shall be A.G.A. Approved, equipped to operate on the type gas available at the job site and shall contain 100% automatic safety shut-off devices.
5. N.F.P.A. Standards: Comply with N.F.P.A. Bulletin 96 for exhaust systems and with N.F.P.A. Bulletins 17 & 96, and U.L. 300 for fire extinguishing systems.
6. A.S.M.E. Code: Comply with A.S.M.E. boiler code requirements for steam generating and steam heated equipment. Provide A.S.M.E. inspection, stamps, and certification of registration with National Board.
7. National Electric Code: Comply with N.E.C. Volume 5 for electrical wiring and devices included with foodservice equipment.
8. Code of Maryland Regulation, COMAR 10.15.03 for Food Service Facilities.
9. All authorities having jurisdiction over this type of equipment and/or installation.
10. Where specifications and/or drawings require mechanical, electrical or refrigeration work to be performed, such work shall be done in strict conformance to other portions of the Base Building Specification which sets forth standards for this type of work.
11. Where there exists two standards or codes for one type of work, the stricter method shall govern.

1.9 WARRANTIES

A. Warrantee in writing all equipment and fabrication against defects and workmanship for a period of two (2) years from date of acceptance.

1. Each piece of mechanical equipment shall be listed, together with the authorized service and repair agency whom the Owner will call should malfunctions occur within the two-year (2) guarantee period.

B. Refrigeration system compressors shall be warranted for five (5) years by the manufacturer. Free refrigeration preventive service, including parts and labor, shall be furnished for two (2) years from date of acceptance, unless otherwise specified.

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1.10 JOB CONDITIONS

A. Visit the site to field check actual wall dimensions and roughing-in and shall be responsible for fabricating and installing the equipment in accordance with the available space and utility services as they exist on the job site.

B. Check all door openings, passageways, elevators, etc., to be sure that the equipment can be conveyed to its proper location within the building and if necessary, check the possibility of holding wall erection, placement of doorjambs, windows, etc. for the purpose of moving the equipment to its proper location with the Contractor. Any removal and rebuilding of walls, partitions, doorjambs, etc. necessary to place the equipment, or if caused by incorrect information on the Contractor's drawings, shall be done at the expense of the K.E.C., at no additional cost to the Owner.

C. Notify the Consultant and Owner before fabrication of equipment of any discrepancies between plans and specifications and actual conditions on the job.

D. Before finished floors, walls, and/or ceilings are in place, physically check the location of all "rough-ins" at the job site. Report discrepancies in writing.

E. Any changes required after fabrication has been started to ensure equipment accurately fitting the space as it exists and conforming to actual field dimensions on the job shall be made at no additional cost to the Owner.

F. If special hoisting equipment and operators are required, include such cost as part of the bid for this work.

1.11 CHANGES IN THE WORK

A. The Owner reserves the right to require reasonable modification to be made in the routing of work and relocation of equipment. This specifically refers to conditions where interference occurs or where more desirable accessibility can be obtained or whose materials cannot be installed because of structural or mechanical conditions encountered. Such changes shall be made at no additional cost to the Owner.

1.12 PATENTS

A. Hold harmless and save the Owner and its officers, consultants, servants and employees from liability of any nature or kind, including costs and expenses for or on account of any copyrighted, patented, or un-patented invention, process, trademark, design, device, material, article, or appliance manufactured or used in the performance of the contract, including its use by the Owner, unless otherwise specifically stipulated in the Contract Documents.

B. If the Contractor has information that the process or article specified is an infringement of a patent, he shall be responsible for such loss unless he promptly gives such information to the Owner in writing. The contract price shall include all royalties or costs arising from the use of any or all of the above which are, in any way, involved in the contract.

1.13 CONTRACTOR'S WARRANTY

A. The Contractor represents and warrants:

1. That he is financially solvent and that he is experienced in and competent to perform the types of work or to furnish the plans, materials, supplies or equipment, to be so performed or furnished by him.
2. That he is familiar with all Federal, State, municipal, and department laws, ordinances, orders, and regulations, which may, in any way, affect the work of those employed therein, including, but not limited to, any special acts relating to the work or to the project of which it is a part.

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3. That such temporary and permanent work required by the contract as is to be done by him can be satisfactorily constructed and used for the purpose for which it is intended and that such construction will not injure any person or damage any property.
4. That he has carefully examined the plans, specifications, addenda, if any, and the site of the work and that, from his own investigations, he has satisfied himself as to the nature and location of the work, the character, quality, and quantity of materials likely to be encountered, the character of equipment and other facilities needed for the performance of the work, the general and local conditions, and all other materials which may, in any way, affect the work or its performance.
5. That he has satisfied himself as to the existing openings and accesses to the foodservice area through which his equipment shall be required to pass and that he is responsible for his equipment being delivered in as many sections as necessary to conform to the available space dictated by these existing limitations.

1.14 SUBSTITUTIONS

A. Bids submitted shall be for the specific manufacturer and model, size, capacity, and accessories, as specified or shown on the drawings.
B. The K.E.C. may quote upon brands and models of equipment other than those specified as a substitute, but must also bid the primary item. In the event that it is desired to request approval of substitute material, product, article, process, or item of equipment in lieu of that which is specified, submit a written request at the time of submitting bid on separate sheet attached to, but not part of, the base bid, setting forth the proposed substitution in detail, including an itemized analysis of the addition or deduction in the amount of the contract, if any, which will result if the substitution is approved. Each such request shall include a complete description of the proposed substitute, the name of the material or equipment for which it is to be substituted, drawings, cuts, performance and test data and any other data or information necessary for a complete evaluation. If approved, bidders will be notified in the form of addendum.
C. The Contractor shall be held responsible for additional costs to himself or any other prime contractor for changes required to install materials, devices, equipment, etc., which the Contractor has substituted for that specified.
D. The Owner reserves the right to award a contract or contracts based upon the inclusion or exclusion of one or more of the alternate estimates. The description of all workmanship and materials under the various headings of the specifications shall have the same meaning and force when applied to similar workmanship and materials in the alternate. If the descriptions are not specific, the workmanship shall be the best quality and the materials the best commercial grade.
E. Whenever any product is specified in the Contract Documents by reference to the name, trade name, make, or catalog number of any manufacturer or supplier, the intent is not to limit competition but to establish a standard of quality which is necessary for the project. Products of other manufacturers meeting the established criteria will be considered. However, please take note that the plumbing, electrical, steam, heating, ventilating, and air-conditioning drawings prepared by the consulting engineers, have been engineered based on the first product named under each item number designation. Therefore, any other product which is submitted for approval in lieu of the primary item specified, shall conform to the rough-in requirements established for the first product named, as well as physical size and building construction requirements.

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F. Any equipment listed, which is not in accordance with the provisions of these specifications, will be rejected. If the Contractor fails to submit for approval within the specified time the list of equipment as required herein, the Consultant shall then have the right to make the final equipment selection. The selection made by the Consultant shall strictly conform to these specifications and will be final and binding, and the items shall be furnished and installed by the Contractor without change in the contract price at the time of completion.

G. It shall be the responsibility of the K.E.C. to prove that substitutions are equal to specified items. **NYIKOS GARCIA FOODSERVICE DESIGN, INC.** as the Owner's representative, shall be the determining authority as to the acceptability or equality of the substitutions. No substitutions shall be approved after bids are received.

1.15 DESIGN/MODEL CHANGE, DISCONTINUED ITEMS

A. All equipment specified shall be of latest design. Any improvements made in design and construction of prefabricated items before equipment is actually delivered to the project site, shall be incorporated in equipment, at no additional cost, provided such incorporation does not delay delivery date of equipment.

B. In the event of an item being discontinued after specified and prior to delivery to project site, the K.E.C. shall responsible for notifying the Consultant in writing of the discontinued item and request an alternate of equal performance, including all accessories, at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

A. The equipment and its component parts shall be new and unused. All items of standard manufactured equipment shall be current models at the time of delivery. All parts subject to wear, breakage, or distortion shall be accessible for adjustment, replacement, and repair.

B. Means shall be provided to ensure adequate lubrication for all moving parts. All oil holes, grease fittings, and filler caps shall be accessible without the use of tools.

C. The design of the equipment shall be such as to provide for safe and convenient operation. Covers or other safety devices shall be provided for all items of equipment presenting safety hazards. Such guards or safety devices shall not present substantial interference to the operation of the equipment. All guards shall provide easy access to the guarded parts.

D. Trim shall not be an acceptable substitute for accuracy and neatness. When trim is required and accepted by the Consultant and the Owner in lieu of rejection of items of equipment, it shall be the K.E.C.'s responsibility to provide same at no additional cost.

E. Unless otherwise specified herein, no material lighter than #20 gauge shall be incorporated into the work. All gauges for sheet iron and sheet steel shall be U.S. Standard Gauges, and finished equipment gauge thickness shall not vary more than 5% plus or minus from the thickness indicated below.

GAUGE	THICKNESS	GAUGE	THICKNESS
#10	0.1406	#16	0.0625
#12	0.1094	#18	0.0500
#14	0.0781	#20	0.0375

F. Materials or work described in words which have a well known and acceptable trade meaning shall be held to refer to such accepted meanings.

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2.2 MATERIALS

A. Refrigeration Systems:

1. Self-contained:

a. Whether the units be top-mounted or cabinet-mounted, they shall be started by the K.E.C. and shall be tested for maintenance of temperature.
b. All units shall be furnished with condensate evaporators.

2. Remote: Provide and install complete refrigeration system(s), charged, started, and operating properly, according to the Item Specifications and the following.

a. Single stage compressors with air-cooled condensers operating within the recommended range of suction discharge pressure of economical operation and within the required capacity.
b. All units shall be new and factory assembled, to operate with the refrigerant specified. Refrigerant R-448A shall be used for all medium and low temperature applications. Due to the unsettled nature of refrigerants, no refrigerant shall be used with a phase-out date of less than ten (10) years from the date of installation.
c. Compressors shall be accessible scroll type, Copeland or approved equal, and shall be equipped with high-low pressure control, liquid line drier, sight glass, suction and discharge vibration eliminator, and head pressure control.
d. The system shall have a factory mounted and pre-wired control panel complete with main fused disconnect, compressor circuit breakers, contactors, and time clocks wired for single point power connection.
e. The supporting frame shall be constructed of structural steel, fully welded, and protected against rust and corrosion with one (1) coat primer, and two (2) coats paint, unless otherwise specified.
f. Systems specified for outdoor installation shall be fully protected in a weather-proofed housing with louvered front panel and hinged top, constructed to resist rust and corrosion, and furnished with low ambient controls. Crankcase heater shall be provided with every compressor.

3. Where specifications call for pre-piped lines (i.e., from a fixture to a valve compartment, etc.), provide such work in strict conformance with other sections of the specifications which set forth standards for this type of work or in conformity with the requirements of the Board of Fire Underwriters or ASHRAE Standards, whichever is greater.

4. Each refrigeration item specification is written to provide minimum specifications and scope of work. All refrigeration equipment shall be designed and installed to maintain the following general temperatures unless otherwise specified.

TYPE	REFRIGERATORS	FREEZERS
a. Walk-In	+35° F./1.7° C.	-10° F./-23.3° C.
b. Reach-In	+35° F./1.7° C.	-10° F./-23.3° C.
c. Undercounter	+35° F./1.7° C.	-10° F./-23.3° C.
d. Fabricated	+35° F./1.7° C.	-10° F./-23.3° C.
e. Cold Pans	+0° F./-17.8° C.	
f. Work Rooms	+50° F./10° C.	

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5. Provide (including payment if subcontracted) all electrical and refrigeration components needed by the completed system and complete (or have completed by the respective trades) all connections of and to said components.
6. An evaporator coil defrost system shall be provided and installed by the K.E.C. on all refrigeration systems designed to operate at an evaporator coil temperature of less than +35° F. Evaporator coil units provided without electric defrost feature shall be installed with a solenoid valve in the liquid line, controlled by the time clock so as to shut off the flow of refrigerant and allow the compressor to pump down and shut off by activation of the pressure control switch.
7. Verify the requirements of and provide any or all additional refrigeration specialty(s) or component(s) required or recommended by the manufacturer for proper operation under the specific operating conditions and location of each system specified.
8. Verify and provide manufacturer's certification that the equipment selection hereinafter specified for each refrigeration system is properly sized and shall meet the operating requirements set forth for each system regarding maintaining specified operating temperature, hours of compressor running time, and system pressures and velocities as recommended by the equipment manufacturer(s).
9. All refrigeration systems shall be installed and wired in strict conformance with the manufacturer's instructions and recommendations.

B. Motors and Heating Elements:

1. Motors up to and including 1/2 HP shall be wired for 120 volt, single phase service. Motors larger than 1/2 HP shall be wired for 208 volt, single or three phase service as indicated. Motors shall be of the drip-proof, splash-proof, or totally enclosed type, having a continuous duty cycle and ball bearings, except small timing motors which may have sleeve bearings. All motors shall have windings impregnated to resist moisture. Motors located where subject to deposits of dust, lint, or other similar matter shall be of the totally enclosed type. Motors shall have ample power to operate the machines for which designated under full load operating conditions without exceeding their nameplate ratings. Insulation shall be N.E.M.A. Class B or better.
2. Heating elements having a connected load up to and including 1,000 watts shall be wired for 120 or 208 volt, single phase service, or as indicated on the drawings.
    a. Any heating element larger than 1,000 watts or any combination of elements in one fixture totaling more than 1,000 watts shall be wired for 208 volt single or three phase service, as indicated on the drawings.
    b. Fixtures having multiple heating elements may be wired for three phase service with the load balanced as equally as possible within the fixture.

C. Switches and Controls:

1. Provide recognized commercial grade signals, "on-off" pushbuttons or switches, and other speed and temperature controls as required for operation of each item, complete with pilot lights and permanent graphics, conspicuously labeled, to assist the user of each item.
2. Mount switches and controls directly adjacent the piece of equipment for which it involves, on operator's side of counter body apron, out of view to the public.

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3. Provide on or for each motor-driven appliance or electrical heating or control unit, a suitable control switch or starter of the proper type and rating and in accordance with Underwriter's Code wherever such equipment is not built in. All other line switches, safety cut-outs, control panels, fuse boxes, other control fittings and connections, when not an integral part of the unit or furnished loose by the manufacturer will be furnished and installed by the Electrical Contractor, unless otherwise specified. All electrical controls, switches, or devices provided loose for field installation as a part of the item specified shall be installed in the field by the Contractor unless otherwise specified.
4. Appliances shall be furnished complete with motors, driving mechanisms, starters, and controllers, including master switches, timers, cut-outs, reversing mechanisms, and other electrical equipment if and as applicable.

D. Cover Plates:

1. All controls mounted on vertical surfaces of fixtures shall be set into recessed die stamped stainless steel cups, or mounted onto removable cover plates in such a fashion as to not protrude or interfere with the operation of each item.
2. Cover plates shall be furnished and installed for all electrical outlets, receptacles, switches and controls furnished by the K.E.C., and shall match the material and finish of the equipment to which they will be fastened.

E. Wiring and Conduit:

1. Wiring shall be properly protected in N.E.M.A. and U.L. approved metal enclosures. Only rigid steel conduit shall be used, zinc coated where unexposed and chrome plated where exposed. All wiring shall be run concealed wherever possible.
2. All equipment furnished under this contract shall be so wired, wound, or constructed so as to conform with the electrical characteristics at the job site.
3. Wiring and connection diagrams shall be furnished with electrically operated machines and for all electrically wired fabricated equipment.
4. Furnish all foodservice equipment completely wired internally using wire and conduit suitable for a wet location. Where an Electrician's services are required, the work shall be done in the K.E.C.'s factory or at his expense at the job site at no additional cost to the Owner. Provide all electrical outlets and receptacles required to be mounted on or in fabricated equipment and interconnect to a master circuit breaker panel with all wires neatly tagged showing item number, voltage characteristics, and load information. Final connection shall be made by the Electrical Contractor.

F. Cords, Plugs, and Receptacles:

1. The Electrical Contractor shall provide three- or four-wire, grounding-type receptacles for all wall and floor mounted outlets to be used for plug-in equipment with characteristics as noted on the drawings. Provide "Hubbell" three-wire or four-wire grounding-type connectors and neoprene cords installed on each item of plug-in equipment, as indicated on drawings and item specifications.
2. K.E.C. shall coordinate with the Electrical Contractor so that the receptacles provided will match the specific plugs provided as part of the plug-in equipment. Any changes in cords and plugs required in the field due to lack of coordination between the Electrical Contractor and the K.E.C. shall be the latter's responsibility.

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3. Reduce the length of all cords furnished with the specified equipment to a suitable or appropriate length so they do not interfere with other equipment or operations.
4. Pedestal receptacles that are part of fabricated equipment exposed to view, shall be similar to T&S Model No. B-1508DD single face, single gang or Model No. B-1528DD single face, double gang.

G. Water Inlets:

1. Water inlets shall be located above the positive water level wherever possible to prevent siphoning of liquids into the water supply system. Wherever conditions shall require a submerged inlet, a suitable type of check valve (except in jurisdictions where check valves are prohibited) and vacuum breaker shall be placed on the fixture to form a part of same to prevent siphoning. Where exposed to view, piping and fittings shall be chrome-plated.

H. Drain Lines:

1. Plumbing Contractor shall provide and install indirect waste lines from equipment which will discharge into floor drains or safe wastes in accordance with Plumbing Rough-In Plans. chrome-plated where exposed. Extend to a point at least 1" (or as required by local codes) above the rim of the floor drain, cut bottom on 45° angle and secure in position.
2. All horizontal piping lines shall be run at the highest possible elevation and not less than 6" above finished floor, through equipment where possible.
3. No exposed piping in or around fixtures or in other conspicuous places shall show tool marks of more than one thread at the fitting.
4. All steam operating valves on or in fabricated and purchased foodservice equipment shall be provided with composition hand wheels, which shall remain reasonably cool in service.
5. Provide suitable pressure regulating valves for all equipment with such components that might reasonably be expected to be affected over a period of time by adverse pressure conditions.

I. Faucets, Valves and Fittings:

1. All sinks shall be fitted with chromium plated, swing spout faucets of same manufacturer throughout as follows, or otherwise specified in Item Specifications.

a. Prep and Utility Sinks:

1) Splash-Mounted:

a.) T&S Brass and Bronze Works, Inc., Model B-231.
b.) Fisher Manufacturing Company, Model 3253.

2) Deck-Mounted:

a.) T&S Brass and Bronze Works, Inc., Model B-221.
b.) Fisher Manufacturing Company, Model 3313.

b. Pot Sinks:

1) Splash-Mounted:

a.) T&S Brass and Bronze Works, Inc., Model B-290.
b.) Fisher Manufacturing Company, Model 5214.

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2. Pre-Rinse Assemblies:
   a. Splash-Mounted:
      1) T&S Brass and Bronze Works, Inc., Model B-133 with B-109 wall bracket.
      2) Fisher Manufacturing Company, Model 2210 with 2902-12 wall bracket.
   b. Deck-Mounted:
      1) T&S Brass and Bronze Works, Inc., Model B-143 with B-510 mixing valve and B-109 wall bracket.
      2) Fisher Manufacturing Company, Model 2810 with 2805-CV mixing valve and 2902-12 wall bracket.
3. Vacuum Breakers:
   a. General Use:
      1) Fisher Manufacturing Company, Model 3990-8000.
   b. Disposers:
      1) Splash-Mounted:
         a.) T&S Brass and Bronze Works, Inc., Model B-455.
         b.) Fisher Manufacturing Company, Model 3990.
      2.) Deck-Mounted:
         a.) T&S Brass and Bronze Works, Inc., Model B-456.
         b.) Fisher Manufacturing Company, Model 3991.
4. Trough Inlets:
   a. Fisher Manufacturing Company, Model No. 2905.
5. Other specialty faucets, pre-rinse assemblies, vacuum breakers, and trough inlets, as specified under Item Specifications.
6. All sink compartments shall be fitted with 2" NPT male, chrome-plated, brass rotary waste valves complete with overflow assemblies and stainless steel strainers.
   a. Prep and General Utility Sinks:
      1) Fisher Manufacturing Company, Model No. 6100.
   b. Pot Sinks:
      1) Fisher Manufacturing Company, Model No. 6102.
7. Refer to Division 22 for all other fittings.

J. Metals Alloys:
1. Stainless steel sheets shall conform to ASTM 240, Type 302, Condition A, 18-8, of U.S. Standard Gauges as previously indicated under paragraph 2.1.E.
   a. All exposed surfaces shall have a No. 4 finish. A No. 2B finish shall be acceptable on surfaces of equipment not exposed to view.
   b. All sheets shall be uniform throughout in color, finish, and appearance.
   c. Rolled shapes shall be of cold rolled type conforming to ASTM A36.

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2. Stainless steel tubing and pipe shall be Type 304, 18-8, having a No. 4 finish, and shall conform to either ASTM A213 if seamless or ASTM A249 if welded.
3. Where galvanized metal is specified, it shall be copper-bearing galvanized iron, cold-rolled, stretcher leveled, bonderized, re-rolled to insure a smooth surface, and used in the largest possible sizes with as few joints as necessary.
4. Galvanizing shall be applied to rolled shapes in conformance with ASTM A123, and to sheets in conformance with ASTM A526, coating designation G-90.

K. Castings:

1. Castings shall consist of corrosion resisting metal (white metal) containing not less than 30% nickel. All castings shall be rough ground, polished, and buffed to bright lustre and free from pit marks, runs, checks, burrs, and other imperfections. In lieu of corrosion resisting metal castings, die-stamped or cast 18-8 stainless steel will be acceptable.

L. Hardware and Casters:

1. All hardware shall be of heavy-duty type, satin finished chromium plated brass, cast or forged or highlighted stainless steel of uniform design. All hardware shall be a well-known brand, and shall be identified by the manufacturer's name and model number for easy replacement of broken or worn parts.
2. Casters on custom-built equipment shall be heavy-duty type, ball bearing, solid or disc wheel, with grease-proof rubber, neoprene, or polyurethane tire. Wheel shall be 5" diameter, minimum width of tread 1-3/16", minimum capacity per caster 250 pounds, unless otherwise noted.
    a. Solid material are to be provided with stainless steel rotating wheel guard.
    b. All casters shall have sealed wheel and swivel bearings, polished plated finish and be N.S.F. approved.
    c. All equipment specified with casters shall have a minimum of two (2) with brakes installed on opposite corners, unless otherwise noted.

M. Locks:

1. When specified, doors and drawers of all custom fabricated or manufactured equipment shall be provided with cylinder locks, disc tumbler type with stainless steel faceplate as manufactured by Standard-Keil Mfg. Co., or approved equal.
    a. Provide two (2) sets of keys for each lock.
    b. All locks shall be keyed alike, except at cashiers stations or unless otherwise specified.

N. Thermometers:

1. All fabricated refrigerated compartments shall be fitted with exterior mounted, adjustable, dial or digital thermometers with flush bezels, and shall be calibrated after installation.

O. Sealants:

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1. Sealant, wherever required, shall conform to ASTM C 920; Type S Grade NS, Class 25, Use Nt, with characteristics that when fully cured and washed meets requirements of Food and Drug Administration Regulation 21 CFR 177.2600 and N.S.F. RTV-732 for use in areas where it comes in contact with food.
2. Dow-Corning #780 or General Electric "Silastic", or approved equal, in either clear or approved color to match surrounding surfaces and applied in accordance with sealant manufacturers recommendations for a smooth, sealed finish.

P. Plastic Laminate:

1. Plastic laminate surfaces shall be laminated with thermosetting decorative sheets of the color, pattern, and style as selected by the Architect.

a. Horizontal surfaces shall be laminated with sheets conforming to Federal Specification L-P-508F, Style D, Type I (general purpose), Grade HP, Class 1, 1/16" thick, satin finish, with rough sanded backs.
b. Vertical surfaces shall be laminated with sheets conforming to Federal Specification L-P-598F, Style D, Type II, (vertical Surface), Grade HP, Class 1, non-forming, satin finish, 1/32" thick or heavier.
c. Curved surfaces shall be laminated from sheets conforming to Federal Specification L-P-508F, Style D, Type III (post-forming), Grade HP, Class 1, satin finish.
d. Balance sheets for backs in concealed locations shall be either reject material of the same type and thickness as the general purpose grade facing or may be .020" thick laminate backing sheets conforming to Federal Specification L-P-00508E, Style ND, Type V (backing sheet), Grade HP.

2. Adhesives:

a. For application of plastic laminate to wood substrates of horizontal surfaces shall be a phenolic, resorcinol, or melamine adhesive conforming to Federal Specification MMM-A-181C, producing a waterproof bond.
b. For applying plastic laminate to vertical surfaces shall be either a waterproof type or a water-resistant type such as a modified urea-formaldehyde resin liquid glue conforming to Federal Specification MMM-A-188C.
c. Contact adhesive will not be acceptable.

2.3 FABRICATION AND MANUFACTURE

A. Materials and Workmanship:

1. Unless otherwise specified or shown on drawings, all materials shall be new, of best quality, perfect, and without flaws. Material shall be delivered and maintained on the job in an undamaged condition.
2. Fabrication shall be equal to the standards of manufacture used by all first class equipment manufacturers, performed by qualified, efficient, and skilled mechanics of the trades involved.
3. All items of standard equipment shall be the latest model at time of delivery.
4. All fabricated work shall be the product of one manufacturer of uniform design and finish.

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5. Each fabricated item of equipment shall include all necessary reinforcing, bracing, and welding with the proper number and spacing of uprights and cross members for strength.
6. Wherever standard sheet sizes will permit, the tops of all tables, shelves, exterior panels of cabinet type fixtures, and all doors and drainboards shall be constructed of a single sheet of metal.
7. Except where required to be removable, all flat surfaces shall be secured to vertical and horizontal bracing members by welding or other approved means to eliminate all buckle, warp, rattle, and wobble. All equipment not braced in a rigid manner and which is subject to rattle and wobble shall be unacceptable, and the K.E.C. shall add additional bracing in an approved manner to achieve acceptance.

B. Sanitary Construction:

1. All fabricated equipment shall be constructed in strict compliance with the standards of the National Sanitation Foundation as outlined in their Bulletin on Food Service Equipment entitled "Standard No. 2" dated October 1952, and in compliance with the local and State Public Health Regulations in which the installation will occur.
2. All fabricated equipment shall bear the N.S.F. "Seal of Approval".

C. Construction Methods:

1. Welding:

a. All welding shall be the heliarc method with welding rod of the same composition as the sheets or parts welded. Welds shall be complete, strong, and ductile with excess metal ground off and joints finished smooth to match adjoining surfaces; free of mechanical imperfections such as gas holes, pits, cracks, etc., and shall be continuously welded so that the fixtures shall appear as one-piece construction. Butt welds made by spot solder and finished by grinding shall not be acceptable.
b. Spot welds shall have a maximum spacing of 3". Tack welds shall be of at least 1/4" length, and spaced no greater than 4" from center to center. Weld spacing at the ends of the channel battens shall not exceed 2" centers.
c. In no case shall soldering be considered as a replacement for welding, nor shall any soldering operation be done where dependence is placed on stability and strength of the joint.
d. Fixtures shall be shop fabricated of one piece and shipped to the job completely assembled wherever possible. Equipment too large to transport or enter the building in one piece shall be constructed so that the field joints can be welded at the job site.
e. All exposed joints shall be ground flush with adjoining material and finished to harmonize therewith. Whenever material has been sunk or depressed by welding operation, depression shall be suitably hammered and peened flush with the adjoining surface and ground to eliminate low spots. In all cases the grain of rough grinding shall be removed by successive fine polishing operations.
f. All unexposed welded joints on undershelves of tables or counters of stainless steel shall be suitably coated at the factory with an approved metallic-based paint.

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g. After galvanized steel members have been welded, all welds and areas where galvanizing has been damaged shall have a zinc dust coating applied in conformance with Military Specification Number MIL-P-26915.

2. Joints:

a. Butt joints and contact joints, wherever they occur, shall be close fitting and shall not require a filler. Wherever break bends occur, they shall be free of undue extrudence and shall not be flaky, scaly, or cracked in appearance; where such breaks do mar the uniform surface appearance of the material, all such marks shall be removed by suitable grinding, polishing, and finishing. Wherever sheared edges occur, they shall be free of burrs, fins, and irregular projections and shall be finished to obviate all danger of laceration when the hand is drawn over them. In no case shall overlapping materials be acceptable where miters or bullnosed edges occur.

b. Field welded joints shall be ground smooth without dips and irregularities and finished to match original finish.

3. Bolt, Screw and Rivet Construction:

a. All exposed surfaces shall be free from bolt and screw heads. When bolts are required, they shall be of the concealed type and be of similar composition as the metal to which they are applied.

b. Where bolt or screw threads on the interior of fixtures are visible or may come into contact with hands or wiping cloths, they shall be capped with a stainless steel or chrome acorn nut and stainless steel lock washer.

c. If rivets are used to fasten rear paneling to the body of the fixture, such rivets shall be stainless steel. In no case shall iron rivets be used.

4. Sound Deadening:

a. Schnee Butyl-Sealant 1/2" wide rope continuously between all frame members and underside of stainless steel table tops, overshelves and undershelves.

Tighten stud bolts for maximum compression of sealant.

5. Hi-Liting:

a. All horizontal edges of stainless steel tops, splashes, tops of raised rolled rims, and edges of all exposed doors, handles and shelf edges shall be hi-lited, in uniform design by grinding with abrasive not coarser than #240 grit, then polishing with compound to a uniform mirror finish.

6. Polishing:

a. The grain of polishing shall run in the same direction on all horizontal and on all vertical surfaces of each item of fabricated equipment except in the case where the finish of the horizontal sections of each shall terminate in a mitered edge.

b. Where sinks and adjacent drainboards are equipped with backsplash, the grain of the polishing shall be consistent in direction throughout the length of the backsplash and sink compartment

7. Finishes:

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a. Paint and coatings shall be of an N.S.F. approved type suitable for use in conjunction with foodservice equipment. Such paint or coating shall be durable, non-toxic, non-dusting, non-flaking and mildew resistant, shall comply with all governing regulations, and shall be applied in accordance with the manufacturers recommendations.
b. All exterior, galvanized parts, exposed members of framework, and wrought steel pipe where specified to be painted shall be cleaned, primed with rust inhibiting primer, de-greased, and finished with two (2) coats of glossy enamel grey hammertone paint, unless otherwise noted.
c. Where baked enamel finishes are specified, they shall be oven baked on the fixtures for a minimum of 1-1/2 hours at a minimum temperature of 300º Fahrenheit.
d. Fabricated equipment shall be spray coated with plastic suitable for protecting the equipment during transport and installation. The coating shall be easily removable after the equipment installation is complete at the job site, and final clean-up has begun.

D. Construction:

1. Legs:

a. All tubular stands for open base tables, sinks, or dishtables shall have legs constructed of 1-5/8" O.D. stainless steel tubing, with 1-1/4" O.D., #16 gauge stainless steel crossbracing running between legs at a point 10" above finished floor.
b. All joints between legs and crossbracing shall be welded and ground smooth, full 360°F.
c. The top end of legs shall be closely fitted into fully-enclosed stainless steel conical gussets no less than 3" high, similar to Klein #481-58 or #483-58, or approved equal.
d. Gussets shall be fully welded to framing reinforcing members, so that, set screw is not visible from front.
e. Legs without crossrails will not be accepted.
f. Legs shall be spaced at not more than 5'-6" on centers, unless otherwise specified.

2. Feet:

a. All tubular legs will be swedged for appearance and close fit to United Show Case #BF-158, or approved equal, fully enclosed, stainless steel bullet-shaped foot.

1) The foot shall be threaded into a collar and completely welded inside the tubular leg to permit a maximum adjustment of 2" without any thread exposure.
2) Threads shall be National Course Series Class 2 fit or better, machined to prevent end play when foot is at maximum adjustment.
3) The bullet-shaped foot shall have slightly rounded bottom to protect the floor, and a minimum bearing surface of 3/4" diameter of stainless steel-to-floor contact.
4) Bottom of tubular leg shall be finished off smoothly to provide a sanitary fitting and prevent the accumulation of grease or other debris.

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b. Cabinet type fixtures shall be mounted on 8" high die-stamped, sanitary, two-piece stainless steel legs no less than 2-3/4" in diameter at the top, Component Hardware #A72-0811, or approved equal.

1) The bottom fully enclosed, stainless steel, bullet-shaped foot threads up into the inside of the upper member, with a male threaded 5/8" bushing to permit maximum adjustment of 2" without thread exposure.
2) The upper section shall be stamped in a neat design with a flared inverted shoulder and fully welded to a base plate designed for anchoring to the channel underbracing.

3. Table Tops:

a. Tables shall be constructed of stainless steel, and of a thickness not less than #14 gauge with 1-3/4" by 120º rolled edges, or as otherwise specified and detailed.
b. All corners shall be bull-nosed and of the same radius as rolled edges.
c. Joints where required shall be butt-welded and ground smooth to present a uniform one-piece appearance.
d. All tops shall be reinforced on the underside with a fully welded framework of 1-1/2"x1-1/2"x1/8" galvanized steel angles with the framing extending around the top perimeter and crossbraced on 24" maximum centers.
e. 1"x4"x1" galvanized or stainless steel, fully welded, cross channel, closed end members placed at each pair of legs with one (1) channel running lengthwise will also be acceptable.
f. All tops shall be reinforced so that there will be no noticeable deflection.
g. Metal tops where adjacent to walls or other items of equipment, shall be constructed with integral, coved, back and/or endsplashes as required and specified in accordance with the standard details contained herein. Close all ends of splashes.

4. Enclosed Bases:

a. All enclosed bases or cabinet bodies shall be of seamless #18 gauge stainless steel construction, enclosed on the ends and sides as required and called for under each item.
b. Ends of body shall terminate at front or operator's side in a 2" wide mullion, vertical, and completely enclosed. All intermediate mullions shall be completely enclosed.
c. The bases shall be reinforced at the top with a framework of 1-1/2"x1-1/2"x1/8" galvanized angles, with all corners mitered and welded solid.
d. Underside of top shall be reinforced with channels and gussets where necessary. Additional angles and cross members shall be provided to reinforce shelves and support tops under heavy tabletop equipment.
e. Where sinks or other drop-in equipment occur, provide additional reinforcing extending crosswise, both sides of opening.
f. In the case of fixtures fitting against or between walls, the bodies shall be set in 1" or 2" from the wall line, with the tops continuing to the wall line with integral, coved splashes as specified. Extend vertical face of body to the wall line only. This will permit adjustment to wall irregularities. Vertical trim strips will not be accepted.

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g. Bodies shall be fitted with counter style stainless steel legs as hereinbefore specified.

5. Drawers:

a. Drawers, where specified, shall have removable pan inserts of #18 gauge stainless steel, and shall be approximately 20"x20"x5" deep unless otherwise specified.

1) Perimeter top edge shall be flanged out 1/2".
2) All interior horizontal corners shall be rounded on a 1" radius, and all interior vertical corners shall be rounded on a 2" radius.

b. Fronts shall be double pan #16 gauge stainless steel construction, 1" thick, insulated with a semi-rigid, fiberglass board, unfaced, having a three-pound density.

1) The top of the drawer face shall be formed as an integral pull by breaking the front pan back on a 45° angle 1", then straight up 1", back to front 1", and then down at the front 3/4".
2) Drawer front shall have all edges and corners ground smooth with a radius edge pull.
3) Provide hard rubber button bumpers attached to rear of drawer face at each corner.

c. The drawer shall have an all welded frame of 1"x1", #16 gauge stainless steel angles sized to fit the removable pan insert.
d. Drawers shall operate on #14 gauge full-extension slides with stainless steel roller bearings with hardened and ground raceways, Component Hardware, S52 Series, or approved equal. Slides shall be pitched approximately 3/8" per foot to permit self closing action.
e. Drawers shall be adequately and neatly fitted to the guides to permit easy operation without rattle or binding.
f. Slides and frame shall be reinforced to support a dead weight of 150 pounds when drawer is fully extended.
g. Adjustable stops shall be provided for each drawer at the fully-opened position, and be readily liftable by hand for easy removal of drawer.
h. All drawers not mounted inside a cabinet body shall be completely enclosed in an #18 gauge stainless steel box-type enclosure and suspended from angle framing under the fixture top. The housing bottom shall be flanged and welded to an #18 gauge stainless steel reinforcing channel extending across the open end.

6. Sliding Doors:

a. Sliding doors shall be of the double pan type, with the exterior pan constructed of #18 gauge stainless steel with all four sides channeled and corners welded. The interior pan shall be similarly constructed of #20 gauge stainless steel, set into the exterior pan, and welded in place.
b. All doors shall be insulated with semi-rigid fiberglass board, un-faced, having a three-pound density. Styrofoam shall not be acceptable.
c. Doors 18" wide or greater, shall have internally welded 4" wide reinforcing channels to prevent warpage.
d. Each door shall be fitted with a positive flush-type stainless steel pull, Standard-Kiel #1262-1014-1283 recessed handle, or approved equal.

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e. In the back of each door install a 1"x1", #16 gauge stainless steel angle stop welded in a suitable location to prevent the doors from overpassing the flush pulls.
f. Doors in the closed position shall overlap each other by no more than 2".
g. Each door shall be fitted with two (2), 1-3/8" ball bearing sheaves fastened to 1"x1/8" stainless steel bar stock welded to the top corners of each door for suspending on an overhead #16 gauge stainless steel channel track. The hangers shall be tapped for 1/4"-20 thumb screw vertical locks which prevent the doors from jumping the track in operation while permitting easy removal for cleaning without tools.
h. Insure that the bottom of the doors are positively and continuously guided to assure proper alignment and passing regardless of the position of each door.
i. Provide hard rubber bumpers for doors to close against to insure quiet operation.

7. Hinged Doors:

a. Hinged doors shall be of the same materials and construction as sliding doors previously specified.
b. Hinges shall be heavy duty, stainless steel, removable type, and fastened by tapping into 1/4"x3/4" stainless steel bar stock inside the door pan and behind the door jamb.
c. The door face shall be flush with the cabinet body when fully closed.
d. Size widths of doors equally when installed in pairs, or in series with other pairs, with no door being greater than 36" in width.
e. Doors shall be held closed by permanent magnetic closure devices of an approved type and of sufficient strength to hold the doors shut. Install two (2) per door (minimum), mounted to the door jamb, top and bottom, with opposing chrome-plated steel plates securely fastened to the inner panel of the doors.

8. Undershelves:

a. All open base tables shall be provided with full-length undershelves of #16 gauge stainless steel fully welded to legs with all joints ground smooth and polished.
b. Front edge shall turn down 1-1/2" and under 1/2".
c. Turn up rear and ends 2", with integral coved radius, when specified.
d. If required by width, provide 1-1/2"x1-1/2"x1/8" galvanized angle bracing mounted to underside, full length.

9. Interior Shelves:

a. All interior shelves within cabinet bodies, enclosed bases and overhead cabinets, shall be of #16 gauge stainless steel.
b. Removable shelves shall be constructed in equal sections, and rest in 1-1/2"x1-1/2"x1/8" stainless steel angle frame. Cove all horizontal corners in accordance with N.S.F. requirements.
c. Stationary shelves shall have 2" turn-up on back and ends, and continuously welded to cabinet body, polished and ground smooth to form a one-piece interior free of any crevices.

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d. Front edge shall turn down 1-1/2" and under 1/2", and finished with "z" bar forming completely enclosed edge for maximum strength and sanitation.
e. Provide 1-1/2"x1-1/2"x1/8" angle bracing mounted to underside, full length.

10. Elevated Shelves:

a. Shelves over equipment not adjacent to a wall shall be mounted on 1" diameter #16 gauge stainless steel tubular standards neatly fitted with stainless steel base flanges, unless otherwise specified.
b. The top of the tubular standards shall be completely welded to #14 gauge stainless steel support channels, full width of overshelf.
c. Inside the tubular standard, and welded to same, provide 1/2" diameter steel tension rod extended through countertop and securely anchored to lower framework reinforcing with nuts and lock washers in such a manner as to assure a stable, sway-free structure.
d. If required by width, provide 1-1/2"x1-1/2"x1/8" stainless steel angle bracing mounted to underside, full length.
e. Cantilevered shelves, when called for, shall be #16 gauge stainless steel supported on #14 gauge stainless steel brackets welded to 1-5/8" O.D. stainless steel tubular standards extending through the backsplash, and fully welded to the table framework. Provide Klein #481-SH welded sleeves where standards penetrate backsplash.

11. Wall Shelves:

a. Open wall shelves shall be constructed of #16 gauge stainless steel with back and ends turned up 2", positioned 2" out from face of wall, with all corners welded, and supported on #14 gauge stainless steel brackets.
b. Brackets shall be flanged inward beneath the shelf and at the wall 1-1/2" with intersecting flanges completely welded, and attached to shelf with studs welded to the underside and bolted with stainless steel lock washers and chrome-plated cap nuts.
c. Each bracket shall be fastened to the wall with a minimum of two (2) 1/4"-20 stainless steel bolts anchored securely by means of toggles or expansion shields.

12. Sinks:

a. All sinks shall be the size and shape as shown on drawings, and constructed of #14 gauge stainless steel with backs, bottoms and fronts formed of one continuous sheet and the ends welded in place.
b. Sinks shall have all corners, both vertical and horizontal, coved on a 3/4" radius electrically welded, ground smooth and polished. Solder in filleted corners will not be acceptable.
c. Multiple compartment sinks shall be divided with double wall, #14 gauge stainless steel partitions with a 1/2" radius on top and all corners rounded as other corners, continuously welded, ground smooth and polished.
d. The bottom of each compartment shall be creased to a die stamped recess, tapered and shaped to receive a lever type waste without the use of solder, rivets, or welding.

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e. Provide #14 gauge stainless steel waste lever angle bracket mounted to underside of compartment at front.
f. The front and exposed ends of sinks shall be fabricated with a 1-1/2", 180 degree rolled edge. The back and ends adjacent to walls or other fixtures shall be turned up with integral coved edge 12" high and returned 2-1/2" at the top on a 45º angle. Cap ends of all exposed splashes.
g. Unless otherwise specified, two (2) faucet holes on 8" centers shall be provided, located over the centerline of partitions between compartments, 2-1/2" down from splash break.
h. Gussets for legs shall be fully welded all around to #12 gauge stainless steel triangular plates fully welded to underside of sink.
i. Sinks fabricated into working surfaces shall be constructed of the same material and in like manner to sinks specified above, except rolled edge and backsplash shall be omitted and the bowl shall be completely welded integral and flush with the working surface. Where basket type wastes are called for, they shall be fitted with removable seats.
j. Where sink bowls are exposed, the exterior shall also be polished to a #4 finish.

13. Sink Drainboards:

a. Drainboards shall be constructed of the same material as the sinks and shall be welded integral to same.
b. The front portion of drainboards shall continue the 1-1/2", 180º rolled edge of sink bowls on a continuous and level horizontal plane.
c. The surface of the drainboard shall pitch from 2-1/2" at the end furthest from the sink, to 3" at the bowl; or 1/8" per foot. In addition, the bottom surface shall be dished toward the center for complete drainage.
d. The backsplash of the drainboard shall match the rear of the sink contour and shall be welded integral thereto, running parallel to the floor.
e. Drainboards shall be reinforced on the underside with a framework of 1"x4"x1" stainless steel channel underbracing placed at each pair of legs, with exposed ends capped, and one (1) channel running lengthwise.
f. Where disposer cones are fabricated into drainboards, additional 1"x4"x1" stainless steel channels shall be welded into the top framing, spanning the drainboard from front-to-back on both sides of the cone and located not more than 3" to either side.
g. Disposer control panels or switches shall be supported beneath drainboards, when specified, by means of a #12 gauge stainless steel mounting bracket.

14. Dishtable Tops:

a. Dishtables shall be constructed of #14 gauge stainless steel with all corners, both vertical and horizontal, coved on a 3/4" radius electrically welded, ground smooth and polished. Solder in filleted corners will not be acceptable.
b. Fronts and exposed ends shall be fabricated with a 3" high, 1-1/2", 180° rolled edge with rounded corners. The back and ends adjacent to walls or other fixtures shall be turned up with integral coved edge 12" high and returned 2-1/2" at the top on a 45º angle. Cap ends of all exposed splashes.

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c. All tops shall slope 1/8" per foot (minimum).
d. Dishtables shall be reinforced on the underside with a framework of 1"x4"x1" stainless steel channel underbracing placed at each pair of legs, with exposed ends capped, and one (1) channel running lengthwise fully welded between front-to-back channels.
e. Where tops fit into dishmachines, they shall turn down and into, forming a sealed watertight fit, and attached according to dishmachine manufacturers instructions.
f. On each side of dishmachine, tables shall be provided with integral splash shields as part of the backsplash.
g. Silicon filling of gaps caused by poor fit will not be acceptable.
h. On corner-type door machines, provide #14 gauge stainless steel wall-mounted, splash panel to protect adjacent wall, full width of door opening.

15. Cafeteria Style Counters:

a. All counters shall be constructed as previously specified under Enclosed Bases.
b. Provide top and bottom framing for each counter food pan, cold pan, coffee urn, ice cream unit, ice bin, dish dispenser, etc., whether a drop-in unit or a cutout for a portable unit.
c. Where plate shelves occur, frame horizontally 8-1/2" back from counter edge or as design dictates, and at bottom of shelf at counteredge.
d. The countertop shall be constructed of #14 gauge stainless steel, as previously specified, with all joints welded, ground and polished.
e. Fronts and exposed ends shall be stainless steel, plastic laminate or other material as noted in the Item Specifications.
f. All display glass shelving shall be 1/4" polished plate glass and fully trimmed with #18 gauge stainless steel formed channels. Top shelves shall be the same width as the shelf below. Shelves shall be supported on 5/8" square, #16 gauge stainless steel perimeter tubing fully welded to 1-1/4" square, #16 gauge stainless steel tubing uprights.
g. Provide appropriate adjustable glass sneeze or breath guards trimmed in stainless steel along front, entire length, mounted in Klein 4465-A brackets.
h. Protector shelf over hot food wells shall be #16 gauge stainless steel supported on 1-1/4" square, #16 gauge stainless steel tubing uprights, with 1/4" polished plate glass front and end panels trimmed in #18 gauge stainless steel channels. When specified for self-service, mount bottom edge of front panel 8" above countertop.
i. All display and protector shelves shall be furnished with full-length LED lights wired to on/off switch in counter apron, with lamps and protective shields. Conceal all wiring in tubular uprights.
j. Refer to Item Specification for changes, as required.
k. Counter shall be internally wired complete by the K.E.C., and in such a way as to meet the requirements of the Electrical Code of the job location.

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2.4 EQUIPMENT

A. All items listed on the Contract Documents under the heading "Equipment Schedule" shall be furnished in strict accordance with the foregoing specifications and with the following detailed Itemized Specifications.
B. Manufacturer's names and model numbers are shown establishing quality, size, and finish required, representing the Owner's and Consultant's requirements and basis for bid. Equipment is listed hereinafter with same item numbers as shown on Contract Documents.

PART 3 - EXECUTION

3.1 INSPECTION

A. Before beginning the installation of foodservice equipment, the spaces and existing conditions shall be examined by the K.E.C. and any deficiencies, discrepancies, or unsatisfactory conditions for proper installation of foodservice equipment shall be reported to the Architect in writing.
    1. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner satisfactory to the installer.
    2. Beginning installation shall constitute acceptance of the area.
B. Prior to concrete pouring, the K.E.C. shall notify the Architect once drainage, water inlets and electrical conduits are laid in ground for the Consultant to schedule and conduct underslab inspection.
C. Pre-installation meetings must take place prior to any kitchen equipment installation.
D. Once all walk-in box compartments are constructed and all ventilators have been installed, notify the Architect for the Consultant to conduct an inspection.
E. K.E.C. to notify the Architect upon completion of equipment installation, for the kitchen to be inspected by the Consultant prior to the Health Department’s inspection. A follow-up inspection shall be conducted after all items have been addressed from the initial punch report.
F. Consultant to submit all inspection reports to the Architect and Owner.
G. All loose parts or attic stock items must be labeled and turned over to the Owner during final inspection.
H. One (1) year warranty kitchen equipment inspection will be conducted by the Consultant to assess the performance of the equipment. Warranty items will be submitted to the K.E.C. for necessary repairs during the warranty period.

3.2 PREPARATION

A. Foodservice equipment drawings are diagrammatic and intended to show layout, arrangement, mechanical and electrical requirements.
B. Field verify all measurements at the building prior to fabrication of custom equipment. Coordinate measurements and dimensions with rough-in and space requirements.

3.3 INSTALLATION

A. The K.E.C. shall coordinate his delivery schedule with the Contractor to ensure adequate openings in the building to receive the equipment.
B. Equipment shall be un-crated, fully assembled and set level in position for final connections. Parts shipped loose but required for connection shall be properly tagged and shall be accompanied by the necessary installation instructions.

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C. Provide a competent, experienced foreman to supervise installation and final connections with other trades.

D. Remote Refrigeration Systems:

1. All refrigeration work where applicable to this contract shall be accomplished in an approved manner, using finest quality fittings, controls, valves, etc.
2. Refrigeration items shall be started up, tested, adjusted, and turned over to the Owner in first class condition and left running in accordance with the manufacturer's instructions.
3. Refrigeration lines and hook-ups shall be completed by the K.E.C. with the exception of electric, water, and drain line final connections unless otherwise specified.
4. All copper tubing shall be refrigerant grade A.C.R. or type "L".
5. Silver solder and/or Sil-Fos shall be used for all refrigerant piping. Soft solder is not acceptable.
6. All refrigerant lines in pipe sleeves or conduit shall be effectively caulked at ends to prevent entrance of water or vermin and at penetrations through walls or floors.
7. All tubing shall be securely anchored with clamps, and suspended lines shall be supported with adjustable hangers at 6'-0" o.c. maximum.
8. Wrap drain line in freezer compartment(s) with approved heat-tape for final connection by Electrical Contractor.

E. Sealing and Caulking:

1. Prior to the application of sealant, all surfaces shall be thoroughly cleaned and de-greased.
2. Apply around each unit of permanent installation at all intersections with walls, floors, curbs or other permanent items of equipment.
3. Joints shall be air-tight, water-tight, vermin-proof, and sanitary for cleaning purposes.
4. In general, joints shall be not less than 1/8" wide, with backer rod to shape sealant bead properly at 1/4" depth. Shape exposed surfaces of sealant slightly concave, with edges flush with faces of materials at joint.
5. At internal corner joints, apply sealant or gaskets to form a sanitary cove, of not less than 3/8" radius.
6. Provide sealant-filled joints up to 3/4" in joint width. Trim strips for wider joints shall be set in a bed of sealant and attached with stainless steel fasteners, 48" o.c., or less, to insure suitable fastening and prevent buckling of the metals fastened.

F. Cutting:

1. All cutting, fitting, or patching required during installation shall be accomplished by the K.E.C., at his own expense, so as to make the work conform to the plans and specifications.
2. The K.E.C. shall not cut or otherwise alter, except with the consent of the Owner, the work of any other Contractor.
3. Provide cut-outs in foodservice equipment where required to run plumbing, electric, or steam lines through equipment items for final connections.

3.4 FIELD QUALITY CONTROL

A. Inspection:

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1. Provide access to shop fabrication areas during normal working hours to facilitate inspection of the equipment, during construction, by the Architect or his authorized representative.
2. Errors found during these inspections shall be corrected to the extent required within the scope of the plans, specifications, and approved drawings.

B. Start-Up and Testing:

1. Delay start-up of foodservice equipment until service lines have been tested, balanced, and adjusted for pressure, voltage, and similar considerations; and until water and steam lines have been cleaned and treated for sanitation.
2. Before testing, lubricate each equipment item in accordance with manufacturer's recommendations.
3. Supply a trained person or persons who shall start up all equipment, test and make adjustments as necessary, resulting in each item of equipment, including controls and safety devices, performing in accordance with the manufacturer's specifications.
4. All gas-fired equipment shall be checked by the local gas company as to calibration, air adjustments, etc., and adjustments made as required.
5. Repair or replace any equipment found to be defective in its operation, including items which are below capacity or operating with excessive noise or vibration.
6. Furnish start up reports for the walk-in cooler/freezer, refrigeration system, cooking equipment, utility raceway and ventilator in accordance with Article 1.5 Submittals, Paragraph F.

C. Demonstration:

1. Provide an operating demonstration of all equipment at a time of Owner's convenience, to be held in the presence of authorized representatives of the Architect and Owner. K.E.C. to coordinate scheduling with manufacturer’s representatives.
2. At the time of demonstration, furnish complete, bound, operation/maintenance manuals and certificates of warranty for all items of equipment provided, in accordance with Article 1.5 Submittals, Paragraph F, at this demonstration time. All manuals are to be provided in digital format All manuals are to be provided in digital format to DFNSOffice@mcpsmd.org AND (insert email address for Facilities, Construction, & Maintenance).
3. Provide a digital and physical checklist of every piece of equipment, including the warranty expiration date, and maintenance routines.
4. Provide a follow-up kitchen demonstration three (3) months after the initial demonstration or kitchen opening, or at the Owners requested timeline. K.E.C. to coordinate scheduling with all manufacturer’s representatives.
5. Provide training or demonstration for all equipment to ensure new staff are properly trained on equipment.
6. Demonstration shall be performed by manufacturer's representative knowledgeable in all aspects of his equipment.
7. During the demonstration, instruct the Owner's operating personnel in the proper operation and maintenance of the equipment.
8. Equipment manufacturer to provide factory-approved instructional videos.

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3.5 ADJUST AND CLEAN

A. Upon completion of installation and tests, clean and sanitize foodservice equipment, and leave in condition ready for use in food service.
B. Remove all protective coverings, and thoroughly clean equipment both internally and externally with stainless steel cleaner.
C. Make and check final adjustments required for proper operation of the equipment.
D. Restore finishes marred during installation to remove abrasions, dents, and other damages. Polish stainless steel surfaces, and touch-up painted surfaces with original paint.
E. Clean up all refuse, rubbish, scrap materials, and debris caused by the work of this Section, and put the site in a neat, orderly, and broom-clean condition.

3.6 ITEMIZED EQUIPMENT

ITEM #1: UTILITY CART, MOBILE

QUANTITY: Three
MANUFACTURER: InterMetro Industries Corporation
MODEL NO.: MetroMax (N058)
PERTINENT DATA: 24" x 36" Shelf Size, 600-lb. Capacity, Polymer
UTILITIES REQ'D: ----
ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101; Manufacturer's Instructions and the following:

1. Three (3) #MXUC2436G-25 two-shelf units.

2. Reduce unit height to 34" A.F.F.

ITEM #2: DUNNAGE RACK, MOBILE

QUANTITY: Three (3)
MANUFACTURER: InterMetro Industries Corporation
MODEL NO.: Super Erecta (N058)
PERTINENT DATA: Open-Grid Shelf Mat, Heavy-Duty, Metroseal 3
UTILITIES REQ'D: ----
ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101; Manufacturer's Instructions and the following:

Cooler:

1. One (1) #MHP55K3 unit; 24" W x 48" L.

Freezer:

1. One (1) #MHP55K3 unit; 24" W x 48" L.

Dry Storage:

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1. One (1) #MHP55K3 unit; 24" W x 48" L.

ITEM #3: SHELVING, MOBILE

QUANTITY: Eight (8)
MANUFACTURER: InterMetro Industries Corporation
MODEL NO.: MetroMax Q Series (N058)
PERTINENT DATA: Open-Grid Shelf Mat, Polymer, Epoxy-Coated Posts
UTILITIES REQ'D: ----
ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Instructions and the following:

Dry Storage:

1. Four (4) #MQ2436G sections; 24" W x 36" L x 5-tier high.
2. Four (4) #MQ2448G sections; 24" W x 48" L x 5-tier high.
3. Thirty-two (32) #MQ74UPE epoxy-coated posts for stem casters, 73-3/16" high.
4. Sixteen (16) #5MPX polyurethane swivel casters with bumpers.
5. Sixteen (16) #5MPBX polyurethane swivel casters with brakes and bumpers.
6. Plastic wedge lock connectors, quantity as required.
7. Locate bottom shelf @ 12" A.F.F., space remaining shelves equally.

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ITEM #4: SOAP STORAGE CABINET, MOBILE

QUANTITY: One (1)
MANUFACTURER: Custom Fabricated
MODEL NO.: #14 GA Stainless Steel
PERTINENT DATA: 36" Wide x 24" Deep x 78" High, All Stainless Steel
UTILITIES REQ'D: ----
ALTERNATE MFRS.: None

Fabricate and set-in-place per Equipment Plan, Sheet K-101, and the following:

1. Constructed per Detail 6.1 & 6.1.1.

ITEM #5: WALK-IN COOLER/FREEZER

QUANTITY: One (1)
MANUFACTURER: Thermo-Kool
MODEL NO.: Indoor Installation (N058)
PERTINENT DATA: 4" Foamed-In-Place Urethane Panels, Class I, NSF Construction

UTILITIES REQ'D: 1500W, 120V, 1PH; (2) 3/4" IW
ALTERNATE MFRS.: Kolpak;Norbec; American Panel

ITEM #5: (Continued)

Furnish and install per Equipment Plan, Sheet K-101; Building Conditions Plan, Sheet K-102; Manufacturer's Shop Drawing and the following:

1. Two Section Unit, -40% Cooler and 60% Freezer of the total square footage.

2. Exterior Finish:
   -- 26 GA stucco embossed galvanized where unexposed.
   -- 22 GA stucco embossed stainless steel where exposed.

3. Interior Finish:
   -- White acrylic enamel baked-on .040 stucco embossed aluminum walls.
   -- White acrylic enamel baked-on 26 GA smooth galvanized steel ceiling.

4. Interior Floor:
   -- 4" prefabricated. heavy-duty structural floor panels installed over hot asphalt paper or 10 MIL polyethylene sheets on building floor slab.
   -- 2" setting bed with two (2) layers of wire reinforcing mesh fabric and quarry tile floor material with 6" high integral coved base, interior and exterior of box, installed over prefabricated floor panel by Flooring Contractor.
   -- Provide venting floor system under walk-in cooler/freezer over 400 square feet per manufacturer recommendation.

5. Entrance Doors:
   -- Two (2) flush-mounted, self-closing doors with 34" x 84" net opening, hinged per Equipment Plan.
   -- Polished chrome camlift hinges with lift-off capability. Provide one (1) extra hinge per door, three (3) total.
   -- Kason #0027C safeguard deadbolt locking latch with quarter turn inside release and strike.
   -- -- Hydraulic door closer.
   -- Standard 2" diameter dial indicating thermometer factory mounted in door frame. Probe wires to be secured in wall with cable holders and stainless steel fasteners at 18" on center.
   -- Foot treadle door opener.
   -- 36" high aluminum diamond tread kickplates, interior and exterior of door, jamb, and frame.
   -- 14" x 24" heated observation window, each compartment.
   -- Kason #1806 LED light fixture with high-impact plastic cover centered over door opening to avoid conflict with shelving, each compartment. Extend wiring in conduit, foamed within door panel header, to junction box mounted on top of walk-in ceiling, each compartment.
   -- Undercut doors for quarry tile floor.
   -- Kason #907 interior door handle, factory mounted, with concealed metal backing plate.
   -- 12-gauge heavy-duty stainless steel heated threshold, each compartment.
   -- Engraved phenolic plastic compartment sign - 12" long x 2" high; white in color with 1" high blue CAPITAL letters mounted on each door above observation window; (1) - COOLER, (1) - FREEZER.
   -- Reinforced freezer and cooler door panels for Air Screen Door.

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6. One (1) heated pressure relief port in freezer.

7. Two (2) Kason #1810L21248LB 48" long LED light fixtures with shatter-proof high impact plastic covers centrally-mounted to walk-in ceiling, one (1) for the cooler, one (1) for the freezer. Fixtures to be shipped loose and mounted by K.E.C. Final connection by Electrical Contractor. K.E.C. to seal and insulate with silicone sealant all knock-outs in fixture casing to prevent moisture infiltration.

ITEM #5: (Continued)

8. One (1) #TK4700 walk-in monitor system with #TK4 light control and panic button factory mounted in each door panel and inter-wired with building monitoring system, as required by Electrical Contractor. Provide engraved identification label mounted above each alarm.

9. Provide and install trim strips of matching exterior finish between ends of walk-in panels and building walls from floor to finished ceiling. K.E.C. to verify ceiling height.

10. Provide and install closure panels of matching exterior finish between top of walk-in and finished ceiling. K.E.C. to verify ceiling height.

11. All electrical conduit shall be run concealed above walk-in ceiling per Detail, Sheet K-104.

12. Evaporator coil drain lines shall be run to floor drain with "P" trap on exterior of box by K.E.C.

13. Black flexible "Armaflex" insulation applied to exposed drain lines and fittings within interior of box by K.E.C.

14. Spiral heat tape applied to drain line within interior of freezer compartment prior to application of insulation by K.E.C. Drain line heating cable shall be installed for continuous 24-hour operation.

15. Coordinate location of sprinkler head drops and provide penetrations, where necessary.

16. Seal and insulate all openings to prevent infiltration of warm air into cooler/freezer compartments.

17. Accessories:
    -- One (1) Kolpak #HAL-C2-N1 or #HAR-C2-N1 air shield mounted vertically on the hinge side of doorjamb inside cooler and/or freezer compartment. Electrical Contractor to provide power receptacle and final connection.
    -- #16 ga. stainless steel hat-channel bumper rail with closed ends installed to front face of walk-in, full-length, mounted @ 36" A.F.F. Provide 1/8" diamond tread kickplates from top of finish floor coved base to bottom of bumper rail. Align bumper rail with 36" high aluminum kickplate on doors.
    -- 6" high aluminum cove baseboard, to be installed where exposed surfaces at kitchen side, fastened with countersink screws and seal with gray-color silicone sealant to finish floor and walk-in panels.

ITEM #6: COOLER REFRIGERATION SYSTEM

QUANTITY: One (1)
MANUFACTURER: Bohn Refrigeration Products
MODEL NO.: BCH0010MCACZC0897 (N058)

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PERTINENT DATA: Air-Cooled, Outdoor Installation, Remote, With IntelliGen System Controls
UTILITIES REQ'D: 15.0A, 208V, 3PH
ALTERNATE MFRS.: None

Furnish and install per Equipment Plan, Sheet K-101; Manufacturer's Shop Drawing and the following:

1. Condensing Unit: Factory pre-assembled, scroll, medium-temperature, R448A

ITEM #6: (Continued)

2. Mounted on building roof above walk-in on roof curb per Detail Sheet K-102. Refer to roof plan for exact location.

3. Complete winterization package and condensing unit weatherproof cover.

4. Factory installed air defrost timer with contactors and relays.

5. Overall size: 25⅛" L x 28½" W x 19¾" H.

6. Weight: 179 lbs.

7. Evaporator Coil with High-Efficiency ECM Motors: Low-Profile, End-Mount Type, Model BEL0095AS6AMAB0200; 1.8A, 120V, 1PH.
   -- System to operate at +35º F.
   -- Furnished complete with solid state temperature sensors, electric expansion valve, transformer, coil compressor contactor, low-pressure time-delay switch, and pressure transducer ready for final connection by Refrigeration Contractor.

8. Factory installed main-fused disconnect switch.

9. Factory certified installers to provide complete refrigeration system warrantee: five (5) years for the compressor, two (2) years for the condensing unit, and two (2) years for all parts of the evaporator coil.

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ITEM #7: FREEZER REFRIGERATION SYSTEM

QUANTITY: One (1)
MANUFACTURER: Bohn Refrigeration Products
MODEL NO.: BCH0035LCBCZ0897 (N058)
PERTINENT DATA: Air-Cooled, Outdoor Installation, Remote, With IntelliGen System Controls
UTILITIES REQ'D: 20.0A, 208V, 3PH
ALTERNATE MFRS.: None

Furnish and install per Equipment Plan, Sheet K-101; Manufacturer's Shop Drawing and the following:

1. Condensing Unit: Factory pre-assembled, scroll compressor, low-temperature, R448A.

2. Mounted on building roof above walk-in on roof curb per Detail Sheet K-102. Refer to roof plan for exact location.

3. Complete winterization package and condensing unit weatherproof cover.

4. Factory installed electric defrost timer with contactors and relays.

5. Overall size: 39⅛" L x 28 5/16" W x 19¾" H.

6. Weight: 232 lbs.

7. Evaporator Coil with High-Efficiency ECM Motors: Low-Profile, End-Mount Type, Model BEL0100BS6EMAB0200, 1.0A, 208V, 1PH (Fan); 9.1A, 208V, 1PH (Defrost Heater)

ITEM #7: (Continued)

-- System to operate at -10º F.
-- Furnished complete with solid state temperature sensors, electric expansion valve, transformer, coil compressor contactor, low-pressure time-delay switch and pressure transducer ready for final connection including low voltage wiring to compressor by Refrigeration Contractor.

8. Factory installed main-fused disconnect switch.

9. Furnish one (1) IntelliGen Refrigeration Controller mounted to front face of Item #5: Walk-In Cooler/Freezer @ 66" A.F.F. centered between entrance doors. Controller shall be capable of monitoring characteristics of both cooler and freezer systems. Refrigeration Controller low voltage wiring and final connection by Refrigeration Contractor.

10. Factory certified installers to provide complete refrigeration system warrantee: five (5) years for the compressor, two (2) years for the condensing unit, and two (2) years for all parts of the evaporator.

ITEM #8: SHELVING, MOBILE

QUANTITY: Ten (10)
MANUFACTURER: InterMetro Industries Corporation
MODEL NO.: MetroMax i (N058)
PERTINENT DATA: Four-Tier, Open-Grid Shelf Mat, Polymer
UTILITIES REQ'D: ----
ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101; Manufacturer's Instructions and the following:

Cooler:

1. Four (4) #MX1836G sections; 18" W x 36" L x 4-tier high.

2. One (1) #MX1848G section; 18" W x 48" L x 4-tier high.

3. Twenty (20) #MX63UP polymer posts for stem casters, 61-3/16" high.

4. Ten (10) #5MPX polyurethane swivel casters with bumpers.

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5. Ten (10) #5MPBX polyurethane swivel casters with brakes and bumpers.

6. Plastic wedge lock connectors, quantity as required.

7. Locate bottom shelf @ 12" A.F.F.; space remaining shelves equally.

Freezer:

1. Four (4) #MX1836G sections; 18" W x 36" L x 4-tier high.

2. One (1) #MX1848G section; 18" W x 48" L x 4-tier high.

3. Twenty (20) #MX63UP polymer posts for stem casters, 61-3/16" high.

ITEM #8: (Continued)

4. Ten (10) #5MPX polyurethane swivel casters with bumpers.

5. Ten (10) #5MPBX polyurethane swivel casters with brakes and bumpers.

6. Plastic wedge lock connectors, quantity as required.

7. Locate bottom shelf @ 12" A.F.F.; space remaining shelves equally.

ITEM #9: WIRE BASKET DOLLY, MOBILE

QUANTITY: Twenty (20)
MANUFACTURER: Arlington Wire & Metal Products, Inc.
MODEL NO.: ARL#45 (N058)
PERTINENT DATA: Angular Aluminum Frame, 27-1/2"W x 26-1/2"L
UTILITIES REQ'D: ----
ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101 and Manufacturer's Instructions.

1. Accessories:
   -- Five hundred (500) Arlington ARL#47SS stainless steel wire baskets. Baskets to be delivered to MCPS Central Commissary at 8401 Turkey Thicket Drive, Gaithersburg, MD 20879.

ITEM #10: HAND SINK

QUANTITY: Two (2)
MANUFACTURER: Eagle Foodservice Equipment Company
MODEL NO.: HSA-10-FA-1P (N058)
PERTINENT DATA: Pedestal Mount, Single Foot Pedal With Mixing Valve
UTILITIES REQ'D: 1/2" HW, 1/2" CW, 1-1/2" W
ALTERNATE MFRS.: Advance/Tabco; John Boos

Furnish and set-in-place per Equipment Plan, Sheet K-101; Manufacturer's Instructions and the following:

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1. Gooseneck faucet, stopper, pedestal, "P" trap, tailpiece, and pedal valve.

2. All plumbing lines and components chrome-plated or stainless steel.

3. Accessories:
   -- Left and right integral stainless steel splash shields.

ITEM #11: SOAP & TOWEL DISPENSER -- (N.I.K.E.C. – SPECIFIED BY ARCHITECT)

QUANTITY: Two (2)

ITEM #13: MICROWAVE OVEN

QUANTITY: One (1)
MANUFACTURER: Amana, Inc.
MODEL NO.: RCS10TS (N058)
PERTINENT DATA: 1.2 Cu. Ft. Capacity, Stainless Interior & Exterior
UTILITIES REQ'D: 1.55 KW, 120 V, 1PH
ALTERNATE MFRS.: Sharp; Panasonic

Furnish and set-in-place per Equipment Plan, Sheet K-101; Manufacturer's Instructions and the following:

1. Cord and plug set.

ITEM #14: ROLL-IN TRANSPORT DOLLY, MOBILE

QUANTITY: Two (2)
MANUFACTURER: Blodgett Oven Company, Inc.
MODEL NO.: CTRG (N058)
PERTINENT DATA: For Single Electric Ovens
UTILITIES REQ'D: ----
ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101; Manufacturer's Instructions and the following:

1. Accessories:
   -- Two (2) Model #DBRI-L roll-in basket dollies.

ITEM #15: REACH-IN REFRIGERATOR, MOBILE

QUANTITY: One (1)
MANUFACTURER: Traulsen & Company, Inc.
MODEL NO.: RHT132-NUT-HHS (N058)

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PERTINENT DATA: One-Section, Self-Contained, Stainless Steel Exterior/Interior
UTILITIES REQ'D: 6.7A, 120V, 1PH
ALTERNATE MFRS.: Continental, Victory

ITEM #15: (Continued)

Furnish and set-in-place per Equipment Plan, Sheet K-101; Manufacturer's Instructions and the following:

1. Standard six (6) year parts and labor warranty; seven (7) year compressor.

2. Half-height solid doors hinged per Equipment Plan.

3. Cylinder door locks keyed-alike.

4. Stainless steel shelves in lieu of standard epoxy coated. Furnish three (3) shelves per compartment, six (6) total.

5. Exterior mounted digital thermometer.

6. Set of four (4) heavy-duty, 5" diameter polyurethane swivel-type locking casters with brakes.

7. Cord and plug set.

ITEM #16: EXHAUST CANOPY

QUANTITY: One (1)
MANUFACTURER: Captive-Aire Systems, Inc.
MODEL NO.: 6030VHB G-ND (N058)
PERTINENT DATA: Stainless Steel, Type II Non-Grease Hood, Heat/Vapor Removal Only
UTILITIES REQ'D: 750 CFM Exhaust; 350W, 120V, 1PH (Lights)
ALTERNATE MFRS.: Avtec; Gaylord; Accurex

Furnish and install per Equipment Plan, Sheet K-101; Exhaust Canopy Details, Sheet K-502; Manufacturer's Shop Drawing and the following:

1. 5'-0" long x 5'-0" wide x 2'-6" high, with bottom edge mounted at 6'-8" A.F.F. Length comprised of one (1) 5'-0" long section. Entire unit constructed of 18 GA stainless steel type 304 with liquid tight all welded external continuous seams and joints per N.F.P.A. 96, U.L. and State of Maryland Codes.

2. Three (3) U.L. Listed, NSF-Approved, recessed round LED light fixtures, equally spaced.

3. Mount on/off light and fan switches to front face of hood.

4. Matching stainless steel perimeter closure panels to finished ceiling by K.E.C.; verify ceiling height.

5. Hanger rods and support system from structure above by other contract. K.E.C. to coordinate method and location with other trades.

6. Integral stainless steel hanger brackets.

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7. 1" wide full-perimeter integral gutter with 1" turn-up and 3/4" stainless steel drain connection.

8. Accessories:
   -- #18GA stainless steel wall flashing from bottom edge of hood to top of finish floor base. Extend full-length of hood body. Attach to wall with non-exposed fasteners.

ITEM #16: (Continued)

-- Field wrapper.
-- Structural front panel.

ITEM #17: CONVECTION OVEN

QUANTITY:	One (1)
MANUFACTURER:	Blodgett Oven Company, Inc.
MODEL NO.:	Zephaire-200-E/200-ERI (N058)
PERTINENT DATA:	Double Deck, Full Size, Bakery Depth, Solid State Infinite Control
UTILITIES REQ'D:	(2) 11.0 KW, 208V, 3PH
ALTERNATE MFRS.:	None

Furnish and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Instructions and the following:

Upper Section:

1. Shall be fitted for standard baking and roasting use with chrome plated steel wire supports and racks.

2. Standard compliment of wire racks, five (5) total.

3. Stainless steel top, front, sides, and solid back panel.

4. Both doors with dual pane insulated glass windows and interior light package.

Lower Section:

1. Fitted for roll-in use with Item #14: Transport Dolly complete with stainless steel track assembly mounted on liner bottom.

2. Docking and locking assembly.

3. Stainless steel front, sides, solid back panel, and 6" high legs with adjustable bullet feet.

4. Both doors with dual pane insulated glass windows and interior light package.

ITEM #18: PREP SINK

QUANTITY:	One (1)
MANUFACTURER:	Custom Fabricated
MODEL NO.:	#14 GA Stainless Steel
PERTINENT DATA:	8'-0" Long x 2'-6" Wide x 2'-10" High

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UTILITIES REQ'D: 1/2" HW, 1/2" CW, 1-1/2" IW
ALTERNATE MFRS.: None

Fabricate and set-in-place per Equipment Plan, Sheet K-101; Fabrication Detail, Sheet K-501; Manufacturer's Shop Drawing and the following:

ITEM #18: (Continued)

1. Front and end edge rolls per Detail 1.02M.

2. 13" high back splash per Detail 1.04A with finished back.

3. Framework per Detail 1.05.

4. Legs per Detail 1.07. Flanged feet on each corner leg.

5. Stainless steel undershelf per Detail 1.11.

6. 30" x 24" x 14" deep utility sink per Detail 3.04 with stainless steel waste lever angle bracket fully welded to underside of sink.

7. Sound-deaden underside of tabletop and sink with NSF-approved sound dampening material.

8. Accessories:
   -- One (1) T&S #B-5115-12-CRB8P pre-rinse spray faucet with 12" swing-spout add-on faucet, 6" wall bracket and backflow preventer. Provide 2"x4" stainless steel column for pre-rinse unit bracket.
   -- One (1) T&S #B-3950-01 twist handle drain with rear-connected over-flows, handle bracket and basket strainer.
   -- One (1) 20"x20" one-piece removable #22 gauge perforated stainless steel scrap basket.

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ITEM #19: WORKTABLE

QUANTITY: Three (3)
MANUFACTURER: Custom Fabricated
MODEL NO.: #14 GA Stainless Steel
PERTINENT DATA: 8'-0" Long x 2'-6" Wide x 2'-10" High
UTILITIES REQ'D: ----
ALTERNATE MFRS.: None

Fabricate and set-in-place per Equipment Plan, Sheet K-101; Fabrication Detail, Sheet K-501; Manufacturer's Shop Drawing and the following:

1. Perimeter edge rolls per Detail 1.02M.

2. Framework per Detail 1.05.

3. Legs per Detail 1.07.

4. Full-length stainless steel undershelf per Detail 1.11.

5. Two (2) stainless steel drawer assemblies per Detail 1.14, Type I, with locks.

6. Worktable per Detail 2.01.

7.

ITEM #19: (Continued)

8. Where units are side-by-side or back-to-back, join with interlocking, spring-loaded mechanism. Refer to Equipment Plan for locations.

9. Sound-deaden underside of tabletop with NSF-approved sound dampening material.

10. Accessories:
    -- One (1) Hamilton Beach #HCO500 manual can opener.

ITEM #20: SPARE NUMBER

ITEM #21: ELECTRIC CAN OPENER

QUANTITY: One (1)
MANUFACTURER: Edlund Company, Inc.
MODEL NO.: 270B (N058)
PERTINENT DATA: Countertop, Dual-Speed, 200 Cans/Day Capacity
UTILITIES REQ'D: 1.5A, 120V, 1PH
ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101; Manufacturer's Instructions and the following:

1. Cord and plug set.

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ITEM #22: ELECTRIC WEIGHING SCALE

QUANTITY: One (1)
MANUFACTURER: Edlund Company, Inc.
MODEL NO.: EDL-10 OP (N058)
PERTINENT DATA: Countertop, Stainless Steel Construction
UTILITIES REQ'D: ----
ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101 and Manufacturer's Instructions.

ITEM #23: BLENDER

QUANTITY: Two (2)

MANUFACTURER: Vitamix
MODEL NO.: 036019 (N058)
PERTINENT DATA: Countertop, With 48-Ounce Clear Container, Blade Assembly, Lid and Lock Cover
UTILITIES REQ'D: 15.0A, 120V, 1PH
ALTERNATE MFR.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Instructions and the following:

ITEM #23: (Continued)

1. Cord and plug set.

ITEM #24: HEATED TRANSPORT CABINET, MOBILE

QUANTITY: One (1)
MANUFACTURER: InterMetro Industries Corp.
MODEL NO.: C5™ 3 Series MOD. (For Montgomery Co., Public Schools) (N058)
PERTINENT DATA: One-Section, Insulated, Aluminum Interior/Exterior, Dutch Door
UTILITIES REQ'D: 16.7A, 120V, 1PH
ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101; Manufacturer's Instructions and the following:

1. Full-height solid door hinged per Equipment Plan.

2. Tray slide to hold 13-1/2" x 26" Arlington wire baskets @ 3" spacing, eighteen (18) total and full-size sheet pans.

3. Set of four (4) heavy-duty, 5" diameter polyurethane swivel-type locking casters with brakes.

4. Cord and plug set.

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ITEM #25: PAN RACK CART, MOBILE

QUANTITY: One (1)
MANUFACTURER: New Age
MODEL NO.: 1331 (N058)
PERTINENT DATA: Fixed Angles, (20) 18"x26" Pan Capacity, Welded Aluminum Construction
UTILITIES REQ'D: ----
ALTERNATE MFRS.: CresCor; InterMetro

Furnish and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Instructions and the following:

1. #PB full perimeter non-marking wrap-around vinyl bumper.

2. Solid base panel.

ITEM #26: TRAY & FLATWARE DISPENSER, MOBILE

QUANTITY: One (1)
MANUFACTURER: Steril-Sil
MODEL NO.: E1-ENC36-1V1HP (N058)
PERTINENT DATA: 36" Enclosed Base With Locking Door and 8" Ledge, With Corner Bumpers and (4) Locking Casters, Stainless Steel Construction
UTILITIES REQ'D: ----
ALTERNATE MFRS.: None

ITEM #26: (Continued)

Furnish and set-in-place per Equipment Plan, Sheet K-101; Manufacturer's Instructions and the following:

1. Accessories:
   -- #E1-BS6OE-RP full size drop-in silverware basket with (6) RP-25 cylinders. Color: Black
   -- #E1-XHP-1VH full size food pan insert
   -- Three (3) 1/3-size 4" deep black plastic hotel pans.

2. Reduce unit height to 30" A.F.F.

ITEM #27: MILK MERCHANDISER, MOBILE

QUANTITY: One (1)
MANUFACTURER: Federal Industries
MODEL NO.: LMDM4878SC (N058)
PERTINENT DATA: Free-Standing, Self-Contained, (2) Shelves
UTILITIES REQ'D: 20.0A, 208V, 1PH
ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Instructions and the following:

1. Accessories:
   -- Laminate finish to match serving counter color.
   -- Roll-down security cover.
   -- Sliding rear access doors.
   -- Rear door locks.
   -- Additional adjustable shelf.

ITEM #28: SERVING COUNTER

QUANTITY: One (1)
MANUFACTURER: Shelleysteel by The Delfield Company
MODEL NO.: Modular Stainless Steel Interlocking Sections
PERTINENT DATA: Straight Line Configuration, #14 Ga S/S Tops
UTILITIES REQ'D: ----
ALTERNATE MFRS.: SpecLine by Low Temp Industries, Inc.

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Refer to individual counter components listed under alpha headings for specification.

ITEM #28A: HOT FOOD COUNTER

QUANTITY:	One (1)
MANUFACTURER:	Shelleysteel by The Delfield Company
MODEL NO.:	KC-74-NU-MOD (N058)
PERTINENT DATA:	Electrically Heated, Lowerator Base, Two Compartment
UTILITIES REQ'D:	12.7A, 120/208V, 1PH
ALTERNATE MFRS.:	SpecLine by Low Temp Industries, Inc.

Furnish and set-in-place per Equipment Plan, Sheet K-101; Manufacturer's Shop Drawing and the following:

1. (B) - 10" wide full-length solid stainless steel tray slide mounted on rigid brackets @28" A.F.F.

2. (F) - Line-up interlocks for countertop and tray slide.

3. (V) - 6" high stainless steel legs with adjustable bullet feet.

4. Modified counter height of 33" A.F.F.

6. Two (2) self-leveling heated compartments with removable covers and locking handle assemblies. Provide hinged stainless steel access doors to heated base cabinet.

7. Cord and plug set. Double cord hooks on bottom of unit.

8. Exterior body color: Black.

9. Recess temperature controls in counter apron, server's side.

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ITEM #28C: REFRIGERATED COLD PAN COUNTER

QUANTITY:	One (1)
MANUFACTURER:	Shelleysteel by The Delfield Company
MODEL NO.:	SC-60-NU-MOD (N058)
PERTINENT DATA:	Mechanically Cooled, Open Base, With Slanted Top Cold Pan
UTILITIES REQ'D:	7.0A, 120V, 1PH; 1" IW
ALTERNATE MFRS.:	SpecLine by Low Temp Industries, Inc.

Furnish and set-in-place per Equipment Plan, Sheet K-101; Manufacturer's Shop Drawing and the following:

1. (B) - 10" wide full-length solid stainless steel tray slide mounted on rigid brackets @ 28" A.F.F.

2. FlexiShield® #DCFSKS single-tier display full-length food shields with stainless steel finish uprights

and LED light.

3. (F) - Line up interlocks for countertop and tray slide.

4. Stainless steel adapter bars.

5. Cord and plug set. Double cord hooks on bottom of unit.

6. (SS) - 6" high stainless steel legs with adjustable bullet feet.

ITEM #28B: (Continued)

7. Modified counter height of 30 A.F.F.

8. Provide drain line less shut-off valve. Plumber to extend piping to nearest floor sink.

9. Provide cut-out in top for drop-in cold pan.

11. Exterior body color: Black.

12. Accessories:
    -- One (1) Delfield #N8156BP-MOD drop-in sloped mechanically cooled cold pan.
    -- Two (2) Cambro #12CW110 Camwear® full-size 2½" deep black polycarbonate food pans.
    -- Four (4) Cambro #22LPCW110 Camwear® half-size long 2½" deep black polycarbonate food pans.
    -- Eight (8) Cambro #32CW110 Camwear® one-third size 2½" deep black polycarbonate food pans.
    -- Eight (8) Cambro #62CW110 Camwear® one-sixth size 2½" deep black polycarbonate food pans.
    -- Two (2) Cambro #26CF110 ColdFest® half-size 6" deep black food pans with covers.
    -- Two (2) Cambro #36CF110 ColdFest® one-third-size 6" deep black food pans with covers.
    -- Two (2) Cambro #66CF110 ColdFest® one-sixth size 6" deep black food pans with covers.

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ITEM #28B: SOLID TOP COUNTER

QUANTITY: One (1)
MANUFACTURER: Shelleysteel by The Delfield Company
MODEL NO.: SC-28-NU-MOD (N058)
PERTINENT DATA: Open Base, 28" Long
UTILITIES REQ'D: ----
ALTERNATE MFRS.: SpecLine by Low Temp Industries, Inc.

Furnish and set-in-place per Equipment Plan, Sheet K-101; Manufacturer's Shop Drawing and the following:

1. (B) - 10" wide full-length solid stainless steel tray slide mounted on rigid brackets @ 28" A.F.F.

2. (F) - Line up interlocks for countertop and tray slide.

3. (V) - 6" high stainless steel legs with adjustable bullet feet.

4. Modified counter height of 30" A.F.F.

5. Open understorage with bottom and intermediate shelf.

ITEM #28C: (Continued)

6. Exterior body color: Black.

ITEM #28D: CASHIER'S STAND

QUANTITY: Two (2)
MANUFACTURER: Shelleysteel by The Delfield Company
MODEL NO.: SCS-30-MOD (N058)
PERTINENT DATA: 30" L x 30" W
UTILITIES REQ'D: 15A (Dedicated Circuit), 120V, 1PH
ALTERNATE MFRS.: SpecLine by Low Temp Industries, Inc.

Furnish and set-in-place per Equipment Plan, Sheet K-101; Manufacturer's Shop Drawing and the following:

1. (B) - 10" wide full-length solid stainless steel tray slide mounted on rigid brackets @ 28" A.F.F.
2. (F) – Line-up interlocks for countertop and tray slide.
3. (Q) - Convenience outlet mounted in counter base with die-raised opening in top for power cord access.
4. Standard utility drawer with locking provision mounted on end.
5. (V) - 6" high stainless steel legs with adjustable bullet feet.
6. Cord and plug set. Double cord hooks on bottom of unit.
7. Standard counter height of 36" A.F.F.
8. Turn countertop down to align and interlock with adjacent frost top counter.
9. Exterior body color: Black.

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ITEM #29: CASH REGISTER -- (N.I.K.E.C. – FURNISHED BY OWNER)

QUANTITY: Two (2)

ITEM #30: POT WASHING SINK

QUANTITY: One (1)
MANUFACTURER: Custom Fabricated
MODEL NO.: #14 GA Stainless Steel
PERTINENT DATA: 11'-6" Long x 2'-6" Wide x 2'-10" High
UTILITIES REQ'D: (2) 3/4" HW, (2) 3/4" CW, (3) 2" IW
ALTERNATE MFRS.: None

ITEM #30: (Continued)

Fabricate and set-in-place per Equipment Plan, Sheet K-101; Fabrication Detail, Sheet K-501; Manufacturer's Shop Drawing and the following:

1. Front and end edge rolls per Detail 1.02B.

2. 13" high backsplash per Detail 1.04A.

3. Framework per Detail 1.05.

4. Legs per Detail 1.07.

5. Crossbracing per Detail 1.10.

6. Stainless steel undershelf on both ends per Detail 1.11.

7. Pot sink and drainboards per Detail 3.01.

8. Sound-deaden underside of sinks and drainboards with NSF-approved sound dampening material.

9. Taper sink bowl front edge height by 3" for ease of access to sink.

10. Accessories:
    -- Two (2) T&S #B-290 backsplash mounted swing spout faucets.
    -- Three (3) T&S #B-3950-01 twist-handle drain valves with rear-connected overflows and basket strainers.

11. Item shall remain shrink-wrapped until ready for final connection by Plumbing Contractor. Immediately following completion of final connections, K.E.C. shall re-shrink-wrap tubs or provide removable panel to avoid use by construction trades.

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ITEM #31: WALL MOUNTED OVERSHELF

QUANTITY:	One (1)
MANUFACTURER:	Custom Fabricated
MODEL NO.:	#14 GA Stainless Steel
PERTINENT DATA:	5'-6" Wide x 1'-0" Deep, All Stainless Steel, Louvered, With Sliding Pot Hooks
UTILITIES REQ'D:	----
ALTERNATE MFRS.:	None

Fabricate and set-in-place per Equipment Plan, Sheet K-101; Fabrication Detail, Sheet K-501; Manufacturer's Shop Drawing and the following:

1. Constructed per Detail 1.18.2.

2. Mount item to wall @ 5'-6" A.F.F..

ITEM #32: POT & PAN SHELVING, MOBILE

QUANTITY: One (1)
MANUFACTURER: InterMetro Industries Corporation
MODEL NO.: MetroMax i (N058)
PERTINENT DATA: Open Grid Shelf, Polymer
UTILITIES REQ'D: ----
ALTERNATE MFR.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Instructions and the following:

1. One (1) #MX2448G section; 24" W x 48" L x 4-tier high.

2. Four (4) #MX63UP polymer posts for stem casters, 61-3/16" high.

3. Two (2) #5MPX polyurethane swivel casters with donut bumpers.

4. Two (2) #5MPBX polyurethane casters with brakes and donut bumpers.

5. Plastic wedge lock connectors, quantity as required.

6. Locate bottom shelf @ 18" A.F.F., space remaining shelves equally.

7. Accessories:
   -- Two (2) #MTR2448XE tray drying racks.
   -- Five (5) #MXD24-8 shelf dividers.
   -- One (1) #XDRIP drip tray assembly.

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ITEM #33: RETRACTABLE CORD REEL

QUANTITY: Two (2)
MANUFACTURER: APC Group Inc.
MODEL NO.: Kitchen Leash #KL-152012-D (N058)
PERTINENT DATA: Ceiling-Mounted, With Adjustable Stop, Non-GFI Receptacle
UTILITIES REQ'D:20.0A, 120V, 1PH
ALTERNATE MFR.: None

Furnish and install per Equipment Plan, Sheet K-101; Equipment Schedule, Sheet K-102; Manufacturer's Instructions and the following:

1. Electrical Contractor to furnish and install GFCI type breaker at kitchen electrical panel board.

2. Set bottom of receptacle at 60” A.F.F.

(END OF FOODSERVICE ITEMIZED SPECIFICATIONS)

END OF SECTION 114000

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SECTION 114000
FOODSERVICE EQUIPMENT – MIDDLE AND HIGH SCHOOLS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope: Furnish all labor, materials, services, equipment and appliances required to provide and deliver all foodservice equipment hereinafter specified into the building, uncrate, assemble, hang, set-in-place, level, and completely install, exclusive of final utility connections. Demonstration and training shall be performed by manufacturer's representative knowledgeable in all aspects of this equipment.

B. Related Work Specified Elsewhere:

1. All plumbing, electrical and ventilating work required in conjunction with commercial foodservice equipment including rough-in to points indicated on mechanical drawings, and final connections from rough-in points, electrical service to points of connection and final connections shall be by Divisions 22, 23 and 26.
2. Refrigeration work will be done by the Kitchen Equipment Contractor except for electrical and plumbing connections to and between compressors, blower coils, controls, etc. These final connections shall be by Divisions 22, 23 and 26.
3. All traps, steam traps, grease traps, line strainers, tail pieces, valves, stops, shut-offs, and fittings necessary for equipment specified will be furnished and installed under mechanical contract by Division 22 unless specifically called for otherwise under each item.
4. All line and disconnect switches, safety cut-offs and fittings, convenience boxes or other electrical controls, fittings and connections will be furnished and installed under electrical contract by Division 26, unless specifically indicated otherwise in the item specifications. Starting switches for certain specified pieces of foodservice equipment are to be provided by Kitchen Equipment Contractor. Those starting switches, if furnished loose as standard by Foodservice Manufacturers (other than fabricated items), shall be mounted and wired complete under Division 26.
5. Any sleeves or conduit required for refrigeration, syrup tubing, or carbonation tubing will be furnished and installed under Division 22.
6. Unless specifically called for in the Item Specifications, ventilating fans and all duct work between same and ceiling rough-in openings, and from same to discharge opening in building will be furnished and installed by Division 22.

1.2 DEFINITIONS

A. All references to the terms "Contractor", "Kitchen Equipment Contractor", or "K.E.C." in the specifications and/or on the drawings shall be defined to mean the Kitchen Equipment Contractor.

B. All references to the term "Owner" in the specifications and/or on the drawings shall be defined to mean the Owner or Owner's designated representative and the Foodservice

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Equipment Consultant.

C. All references to the term "Consultant" or "Foodservice Equipment Consultant" in the specifications and/or on the drawings shall be defined to mean **NYIKOS GARCIA FOODSERVICE DESIGN, INC.** its employees, and authorized representatives and is referred to throughout the contract documents as if singular in number and masculine in gender.

D. The phrase "The K.E.C. shall" or "by the K.E.C.", as applicable, is understood to be included as a part of each sentence, paragraph or article of these specifications unless otherwise indicated or specified.

1.3 QUALITY ASSURANCE

A. Qualification of Suppliers:

1. Commercial foodservice equipment suppliers shall submit satisfactory evidence of compliance with the following qualifications and conditions to be approved.

    a. Successful completion of jobs of comparable scope.
    b. Have manufacturer's authorization to distribute and install specified factory items of equipment.
    c. Maintain a permanent staff experienced in the installation of foodservice equipment and preparation of professional style rough-in drawings and brochures.
    d. Maintain or have access to fabrication shop meeting N.S.F. requirements. If other than foodservice equipment suppliers own fabrication shop, obtain Consultant approval of fabrication shop desired to be used.
    e. Maintain or have access to a readily available stock of repair and replacement parts, together with authorized service personnel.

B. Qualification of Fabricators:

1. Fabricators shall be an N.S.F. approved organization with trained personnel and facilities to properly design, detail and fabricate equipment in accordance with the specifications and standard details contained herein.
2. Custom fabricated equipment shall bear the National Sanitation Foundation seal of approval and listed as such under N.S.F. Standards No. 2 and No. 33.
3. Only one (1) fabricator shall be used for this project, and all equipment will be fabricated at the same shop. Where units cannot be fully shop-fabricated, complete fabrication at project site.
4. Acceptable fabricators are:

    a. Pro Stainless, Inc.; Keyser, WV
    b. Commercial Stainless, Inc.; Bloomsburg, PA
    c. Keystone Custom Fabricators, Inc.; Elizabeth, PA
    d. Aero Manufacturing; Clifton, NJ
    e. Titan Stainless; Pageland, SC
    f. Other fabricators, as approved by Consultant.

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C. Qualification of Manufacturers:

1. Manufacturers shall be regularly engaged in the production of items furnished and shall have demonstrated the capability to furnish similar equipment that performs the functions specified or indicated herein.

D. Standard Products:

1. Materials, products, and equipment furnished under this contract shall be the standard items of manufacturers regularly engaged in the production of such materials, products, and equipment and shall be of the manufacturer's latest design that complies with the specifications which have been produced and used successfully on other projects and in similar applications.
2. Discrepancies within contract documents should immediately be brought to the attention of the Consultant in writing for clarification prior to fabrication or ordering of standard items.

1.4 PLANS & SPECIFICATIONS

A. Specifications and drawings have been prepared to form the basis for procurement, erection, start-up and adjustment of all equipment in this contract. Plans and specifications shall be considered as mutually explanatory and work required by one, but not the other, shall be performed as though required by both. Items required by one, but not by the other shall be provided as though required by both. Work shall be accomplished as called for in specifications and shown on drawings, so that all items of equipment shall be completely functional for purpose for which they were designed. When there is any discrepancy between drawings and specifications, drawings shall govern. Bidders should seek clarification of any discrepancies from the Consultant prior to bidding.

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1.5 SUBMITTALS

A. General Requirements:

1. Assemble and submit all shop drawings, rough-in drawings, brochures, color samples, etc. as a complete package. There will be no review of partial submittals.
2. Any and all costs, to all trades and parties involved, arising from delay of project due to non-submittal of the complete package by the K.E.C. within a reasonable time period shall be borne solely by the K.E.C.
3. Identify each submittal by project name, date, contractor, submittal name, and any other necessary information to distinguish it from other submittals.

B. Shop Drawings:

1. Submit electronic copy of shop drawings on sheets equal in size to Contract Documents of equipment specified for custom fabrication including all accessories attached to each item.
2. Drawings shall be detailed and fully dimensioned to a minimum scale of 3/4"=1'-0" for plan and elevation views, and 1-1/2"=1'-0" for sections, based on

the floor plan(s) and following item specifications. Drawings will be checked for thoroughness, accuracy, completeness, neatness, and returned for corrections, if necessary.

C. Rough-in Drawings:

1. Submit electronic copy of rough-in drawings on sheets equal in size to Contract Documents of detailed arrangement plans professionally prepared from architects dimensioned plans (not traced from Contract Documents) at a minimum scale of 1/4"=1'-0".
2. Equipment Layout Plan showing arrangement of all items specified and identified on schedule of equipment listing item number, description, quantity, manufacturer, model number, and remarks.
3. Ventilation Plan showing dimensioned locations of all duct openings for ventilators and dishmachines identifying size, c.f.m. required (exhaust and supply), static pressures, and connection heights.
4. Plumbing/Electrical Plans showing dimensioned locations, sizes, elevations and capacities of all utility services required for each item of equipment in relation to finished walls, columns, and heights above finished floor.
5. Special Conditions Plan showing exact dimensions and details of all masonry bases, floor depressions, critical partition locations/heights, wall openings, reinforcing for wall and/or ceiling mounted equipment, and conduit locations for soda and compressed gas lines.

D. Equipment Brochures:

1. Submit electronic copy of manufacturer's illustrations and technical data for approval prior to procurement. All items of Standard Manufacture shall be submitted, including items purchased to be built into fabricated equipment. Each illustration shall be marked to accurately describe the item to be furnished as specified. Include all deviations from standard information (i.e., voltage, phase, load, etc.).
2. Include a separate information sheet ahead of each illustration sheet showing all service connection sizes, electrical requirements, loads, consumptions, and all accessories specified.
3. Manufacturer's suggested schematic drawings for connection of mechanical and electrical services for such items as booster heaters, disposers, or any other item of equipment that may require the same.

E. Miscellaneous Shop Drawings:

1. Submit electronic copy of manufactured equipment specified requiring clarification and approval such as, walk-in cooler/freezer drawings, ventilator drawings, utility raceway drawings, and refrigeration system drawings.

F. Operation and Maintenance Manuals:

1. Submit electronic copy for all mechanically operated equipment of standard manufacture. Include operating and cleaning/maintenance instructions, parts listing, recommended parts inventory listing and purchase source, copy of

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warranties, and similar applicable information.
2. Brochure covers shall bear the job name, date, and name of contractor.
3. Submit start-up report for food service equipment such as walk-in cooler/ freezer, refrigeration system, utility raceway, ventilator and cooking equipment.

G. Manufacturer's List:

1. The K.E.C. shall submit in writing a list of all manufacturer's representatives of the food service equipment such as convection ovens, ranges, etc., and their authorized service agencies' addresses and telephone numbers; to be presented after submission of manufacture data.

H. Samples:

1. Samples of materials, products, and fabrication methods shall be submitted for approval upon request at no additional cost, before proceeding with work.

I. Re-submission Requirements:

1. Shop Drawings:

a. Revise initial drawings as required and resubmit in accordance with submittal procedures.
b. Indicate on drawings all changes which have been made in addition to those requested by Consultant.

2. Product Data and Samples:

g. Submit new data and samples as required for initial submittal.
h. Make all re-submittals within fourteen (14) working days from date of Consultants previous action.

J. Approvals:

1. After approval of the submittals listed above, furnish as many prints and copies as are required for the various trades, the Owner, the Architect, and the Consultant.
2. The approval of the shop drawings will be general and shall not relieve the K.E.C. of responsibility for proper fitting, finishing, quantities, and erection of work in strict accordance with the contract requirements, nor does it relieve him of the responsibility of furnishing material and workmanship not indicated on approved shop drawings but required for the completion of his work.
3. Approval by the Consultant and/or Owner of the manufacturer's data submitted by the K.E.C. does not waive the responsibility of K.E.C. to furnish each item of equipment in complete compliance with the specifications and drawings. Discrepancies between Contract Documents and furnished equipment shall be corrected even after approval and installation of this equipment at no additional cost to the Owner.

K. Green Globes Submittals: Comply with Section 018113.

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1. Food service equipment, if available: Product data demonstrating ENERGY STAR or FEMP.
2. Combination oven: Product data stating water usage in gallons per hour.
3. Pre-rinse valves: Product data stating water usage in gallons per minute (GPM).
4. Interior field-applied adhesives and sealants: Product data demonstrating low-emitting requirements.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery:

1. Equipment shall be delivered to the job site only after the building is weather-safe and vandal-safe.

B. Storage:

1. Store equipment in an area convenient to the point of installation in such a way that it is protected from the weather and job hazards.

C. Protection:

1. Wrapping and protective coatings shall remain on all items until ready for use and in the case of stainless steel items, until installation is complete, and the job is ready for cleaning.

D. Damage:

1. All responsibility shall rest with the K.E.C. for any damage or loss incurred prior to final acceptance. Such items as may be lost or damaged shall immediately be replaced or repaired to a new condition to the complete satisfaction of and at no additional cost to the Owner.

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1.7 JURISDICTION TRADE AGREEMENTS AND RESTRICTIONS

A. Include the work specified, shown or reasonably infer able as part of foodservice equipment. Portions of this work may be subcontracted to those qualified to do such work, as may be necessary because of jurisdictional trade agreements and restrictions.

1.8 REGULATIONS AND CODES

A. Except as otherwise indicated, each item of equipment shall comply with the latest current edition of the following standards as applicable to the manufacture, fabrication, and installation of the work in this section.

1. N.S.F. Standards: Comply with National Sanitation Foundation Standards and criteria and provide N.S.F. "Seal of Approval" on each manufactured item and major items of custom-fabricated work.
2. U.L. Standards: For electrical components and assemblies, provide either U.L.

labeled products or, where no labeling service is available, provide a complete index of the components used as selected from the U.L. "Recognized Component Index".

3. A.N.S.I. Standards: For gas-burning equipment, comply with A.N.S.I. Z21-Series standards. Comply with A.N.S.I. B57.1 for compressed gas cylinder connections and with applicable standards of the Compressed Gas Association for water connection air gaps and vacuum breakers.
4. A.G.A.: All gas-fired equipment shall be A.G.A. Approved, equipped to operate on the type of gas available at the job site and shall contain 100% automatic safety shut-off devices.
5. N.F.P.A. Standards: Comply with N.F.P.A. Bulletin 96 for exhaust systems and with N.F.P.A. Bulletins 17 & 96, and U.L. 300 for fire extinguishing systems.
6. A.S.M.E. Code: Comply with A.S.M.E. boiler code requirements for steam generating and steam heated equipment. Provide A.S.M.E. inspection, stamps, and certification of registration with National Board.
7. National Electric Code: Comply with N.E.C. Volume 5 for electrical wiring and devices included with foodservice equipment.
8. Code of Maryland Regulation, COMAR 10.15.03 for Food Service Facilities.
9. All authorities having jurisdiction over this type of equipment and/or installation.
10. Where specifications and/or drawings require mechanical, electrical or refrigeration work to be performed, such work shall be done in strict conformance to other portions of the Base Building Specification which sets forth standards for this type of work.
11. Where there exists two standards or codes for one type of work, the stricter method shall govern.

1.9 WARRANTIES

A. Warrantee in writing all equipment and fabrication against defects and workmanship for a period of two (2) years from date of acceptance.

1. Each piece of mechanical equipment shall be listed, together with the authorized service and repair agency whom the Owner will call should malfunctions occur within the two-year (2) guarantee period.

B. Refrigeration system compressors shall be warranted for five (5) years by the manufacturer. Free refrigeration preventive maintenance service, including parts and labor, shall be furnished for two (2) years from date of acceptance, unless otherwise specified.

1.10 JOB CONDITIONS

A. Visit the job site to field check actual wall dimensions and roughing-in and shall be responsible for fabricating and installing the equipment in accordance with the available space and utility services as they exist on the job site.

B. Check all door openings, passageways, elevators, etc., to be sure that the equipment can be conveyed to its proper location within the building and if necessary, check the possibility of holding wall erection, placement of doorjambs, windows, etc. for the purpose of moving the equipment to its proper location with the Contractor. Any removal

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and rebuilding of walls, partitions, doorjambs, etc. necessary to place the equipment, or if caused by incorrect information on the Contractor's drawings, shall be done at the expense of the K.E.C., at no additional cost to the Owner.

C. Notify the Consultant and Owner before fabrication of equipment of any discrepancies between plans and specifications and actual conditions on the job.

D. Before finished floors, walls, and/or ceilings are in place, physically check the location of all "rough-ins" at the job site. Report discrepancies in writing.

E. Any changes required after fabrication has been started to ensure equipment accurately fitting the space as it exists and conforming to actual field dimensions on the job shall be made at no additional cost to the Owner.

F. If special hoisting equipment and operators are required, include such cost as part of the bid for this work.

1.11 CHANGES IN THE WORK

A. The Owner reserves the right to require reasonable modification to be made in the routing of work and relocation of equipment. This specifically refers to conditions where interference occurs or where more desirable accessibility can be obtained or whose materials cannot be installed because of structural or mechanical conditions encountered. Such changes shall be made at no additional cost to the Owner.

1.12 PATENTS

A. Hold harmless and save the Owner and its officers, consultants, servants and employees from liability of any nature or kind, including costs and expenses for or on account of any copyrighted, patented, or un-patented invention, process, trademark, design, device, material, article, or appliance manufactured or used in the performance of the contract, including its use by the Owner, unless otherwise specifically stipulated in the Contract Documents.

B. If the Contractor has information that the process or article specified is an infringement of a patent, he shall be responsible for such loss unless he promptly gives such information to the Owner in writing. The contract price shall include all royalties or costs arising from the use of any or all of the above which are, in any way, involved in the contract.

1.13 CONTRACTOR'S WARRANTY

A. The Contractor represents and warrants:

1. That he is financially solvent and that he is experienced in and competent to perform the types of work or to furnish the plans, materials, supplies or equipment, to be so performed or furnished by him.
2. That he is familiar with all Federal, State, municipal, and department laws, ordinances, orders, and regulations, which may, in any way, affect the work of those employed therein, including, but not limited to, any special acts relating to the work or to the project of which it is a part.

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3. That such temporary and permanent work required by the contract as is to be done by him can be satisfactorily constructed and used for the purpose for which it is intended and that such construction will not injure any person or damage any property.
4. That he has carefully examined the plans, specifications, addenda, if any, and the site of the work and that, from his own investigations, he has satisfied himself as to the nature and location of the work, the character, quality, and quantity of materials likely to be encountered, the character of equipment and other facilities needed for the performance of the work, the general and local conditions, and all other materials which may, in any way, affect the work or its performance.
5. That he has satisfied himself as to the existing openings and accesses to the foodservice area through which his equipment shall be required to pass and that he is responsible for his equipment being delivered in as many sections as necessary to conform to the available space dictated by these existing limitations.

1.14 SUBSTITUTIONS

A. Bids submitted shall be for the specific manufacturer and model, size, capacity, and accessories, as specified or shown on the drawings.

B. The K.E.C. may quote upon brands and models of equipment other than those specified as a substitute, but he must also bid the primary item. In the event that it is desired to request approval of substitute material, product, article, process, or item of equipment in lieu of that which is specified, submit a written request at the time of submitting bid on a separate sheet attached to, but not part of, the base bid, setting forth the proposed substitution in detail, including an itemized analysis of the addition or deduction in the amount of the contract, if any, which will result if the substitution is approved. Each such request shall include a complete description of the proposed substitute, the name of the proposed substitute, the name of the material or equipment for which it is to be substituted, drawings, cuts, performance and test data and any other data or information necessary for a complete evaluation. If approved, bidders will be notified in the form of addendum.

C. The Contractor shall be held responsible for additional costs to himself or any other prime contractor for changes required to install materials, devices, equipment, etc., which the Contractor has substituted for that specified.

D. The Owner reserves the right to award a contract or contracts based upon the inclusion or exclusion of one or more of the alternate estimates. The description of all workmanship and materials under the various headings of the specifications shall have the same meaning and force when applied to similar workmanship and materials in the alternate. If the descriptions are not specific, the workmanship shall be the best quality and the materials the best commercial grade.

E. Whenever any product is specified in the Contract Documents by reference to the name, trade name, make, or catalog number of any manufacturer or supplier, the intent is not to limit competition but to establish a standard of quality which is necessary for the project. Products of other manufacturers meeting the established criteria will be

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considered. However, please take note that the plumbing, electrical, steam, heating, ventilating, and air-conditioning drawings prepared by the consulting engineers, have been engineered based on the first product named under each item number designation. Therefore, any other product which is submitted for approval in lieu of the primary item specified, shall conform to the rough-in requirements established for the first product named, as well as physical size and building construction requirements.

F. Any equipment listed, which is not in accordance with the provisions of these specifications, will be rejected. If the Contractor fails to submit for approval within the specified time the list of equipment as required herein, the Consultant shall then have the right to make the final equipment selection. The selection made by the Consultant shall strictly conform to these specifications and will be final and binding, and the items shall be furnished and installed by the Contractor without change in the contract price at the time of completion.

G. It shall be the responsibility of the K.E.C. to prove that substitutions are equal to specified items. **NYIKOS GARCIA FOODSERVICE DESIGN, INC.** as the Owner's representative, shall be the determining authority as to the acceptability or equality of the substitutions. No substitutions shall be approved after bids are received.

1.15 DESIGN/MODEL CHANGE, DISCONTINUED ITEMS

A. All equipment specified shall be of latest design. Any improvements made in design and construction of prefabricated items before equipment is actually delivered to the project site, shall be incorporated in equipment, at no additional cost, provided such incorporation does not delay delivery date of equipment.

B. In the event of an item being discontinued after specified and prior to delivery to project site, the K.E.C. shall be responsible for notifying the Consultant in writing of the discontinued item and request an alternate of equal performance, including all accessories, at no additional cost to the Owner.

PART 2 PRODUCTS

2.1 GENERAL

A. The equipment and its component parts shall be new and unused. All items of standard manufactured equipment shall be current models at the time of delivery. All parts subject to wear, breakage, or distortion shall be accessible for adjustment, replacement, and repair.

B. Means shall be provided to ensure adequate lubrication for all moving parts. All oil holes, grease fittings, and filler caps shall be accessible without the use of tools.

C. The design of the equipment shall be such as to provide for safe and convenient operation. Covers or other safety devices shall be provided for all items of equipment presenting safety hazards. Such guards or safety devices shall not present substantial interference to the operation of the equipment. All guards shall provide easy access to the guarded parts.

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D. Trim shall not be an acceptable substitute for accuracy and neatness. When trim is required and accepted by the Consultant and the Owner in lieu of rejection of items of equipment, it shall be the K.E.C.'s responsibility to provide same at no additional cost.

E. Unless otherwise specified herein, no material lighter than #20 gauge shall be incorporated into the work. All gauges for sheet iron and sheet steel shall be U.S. Standard Gauges and finished equipment gauge thickness shall not vary more than 5% plus or minus from the thickness indicated below.

GAUGE	THICKNESS	GAUGE	THICKNESS
#10	0.1406	#16	0.0625
#12	0.1094	#18	0.0500
#14	0.0781	#20	0.0375

F. Materials or work described in words which have a well-known and acceptable trade meaning shall be held to refer to such accepted meanings.

2.2 MATERIALS

A. Refrigeration Systems:

1. Self-contained:

   a. Whether the units be top-mounted or cabinet-mounted, they shall be started by the K.E.C. and shall be tested for maintenance of temperature.
   b. All units shall be furnished with condensate evaporators.

2. Remote: Provide and install complete refrigeration system(s), charged, started, and operating properly, according to the Item Specifications and the following.

   a. Single stage compressors with air-cooled condensers operating within the recommended range of suction discharge pressure of economical operation and within the required capacity.
   b. All units shall be new and factory assembled, to operate with the refrigerant specified. Refrigerant R-404A shall be used for all medium and low temperature applications. Due to the unsettled nature of refrigerants, no refrigerant shall be used with a phase-out date of less than ten (10) years from the date of installation.
   c. Compressors shall be accessible scroll type, Copeland or approved equal, and shall be equipped with high-low pressure control, liquid line drier, sight glass, suction and discharge vibration eliminator, and head pressure control.
   d. The system shall have a factory mounted and pre-wired control panel complete with main fused disconnect, compressor circuit breakers, contactors, and time clocks wired for single point power connection.
   e. The supporting frame shall be constructed of structural steel, fully welded, and protected against rust and corrosion with one (1) coat primer, and two (2) coats paint, unless otherwise specified.
   f. Systems specified for outdoor installation shall be fully protected in a weather-proofed housing with louvered front panel and hinged top,

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constructed to resist rust and corrosion, and furnished with low ambient controls. Crankcase heater shall be provided with every compressor.

3. Where specifications call for pre-piped lines (i.e., from a fixture to a valve compartment, etc.), provide such work in strict conformance with other sections of the specifications which set forth standards for this type of work or in conformity with the requirements of the Board of Fire Underwriters or ASHRAE Standards, whichever is greater.
4. Each refrigeration item specification is written to provide minimum specifications and scope of work. All refrigeration equipment shall be designed and installed to maintain the following general temperatures unless otherwise specified.

TYPE	REFRIGERATORS	FREEZERS
a. Walk-In	+35º F./1.7º C.	-10º F./-23.3º C.
b. Reach-In	+35º F./1.7º C.	-10º F./-23.3º C.
c. Undercounter	+35º F./1.7º C.	-10º F./-23.3º C.
d. Fabricated	+35º F./1.7º C.	-10º F./-23.3º C.
e. Cold Pans	+0º F./-17.8º C.	
f. Work Rooms	+50º F./10º C.	

5. Provide (including payment if subcontracted) all electrical and refrigeration components needed by the completed system and complete (or have completed by the respective trades) all connections of and to said components.
6. An evaporator coil defrost system shall be provided and installed by the K.E.C. on all refrigeration systems designed to operate at an evaporator coil temperature of less than +35º F. Evaporator coil units provided without electric defrost feature shall be installed with a solenoid valve in the liquid line, controlled by the time clock so as to shut off the flow of refrigerant and allow the compressor to pump down and shut off by activation of the pressure control switch.
7. Verify the requirements of and provide any or all additional refrigeration specialty(s) or component(s) required or recommended by the manufacturer for proper operation under the specific operating conditions and location of each system specified.
8. Verify and provide manufacturer's certification that the equipment selection hereinafter specified for each refrigeration system is properly sized and shall meet the operating requirements set forth for each system regarding maintaining specified operating temperature, hours of compressor running time, and system pressures and velocities as recommended by the equipment manufacturer(s).
9. All refrigeration systems shall be installed and wired in strict conformance with the manufacturer's instructions and recommendations.

B. Motors and Heating Elements:

1. Motors up to and including 1/2 HP shall be wired for 120 volt, single phase

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service. Motors larger than 1/2 HP shall be wired for 208 volt, single or three phase service as indicated. Motors shall be of the drip-proof, splash-proof, or totally enclosed type, having a continuous duty cycle and ball bearings, except small timing motors which may have sleeve bearings. All motors shall have windings impregnated to resist moisture. Motors located where subject to deposits of dust, lint, or other similar matter shall be of the totally enclosed type. Motors shall have ample power to operate the machines for which designated under full load operating conditions without exceeding their nameplate ratings. Insulation shall be N.E.M.A. Class B or better.

2. Heating elements having a connected load up to and including 1,000 watts shall be wired for 120 or 208 volt, single phase service, or as indicated on the drawings.
   a. Any heating element larger than 1,000 watts or any combination of elements in one fixture totaling more than 1,000 watts shall be wired for 208 volt single or three phase service, as indicated on the drawings.
   b. Fixtures having multiple heating elements may be wired for three phase service with the load balanced as equally as possible within the fixture.

C. Switches and Controls:

1. Provide recognized commercial grade signals, "on-off" pushbuttons or switches, and other speed and temperature controls as required for operation of each item, complete with pilot lights and permanent graphics, conspicuously labeled, to assist the user of each item.
2. Mount switches and controls directly adjacent the piece of equipment for which it involves, on operator's side of counter body apron, out of view to the public.
3. Provide on or for each motor-driven appliance or electrical heating or control unit, a suitable control switch or starter of the proper type and rating and in accordance with Underwriter's Code wherever such equipment is not built in. All other line switches, safety cut-outs, control panels, fuse boxes, other control fittings and connections, when not an integral part of the unit or furnished loose by the manufacturer will be furnished and installed by the Electrical Contractor, unless otherwise specified. All electrical controls, switches, or devices provided loose for field installation as a part of the item specified shall be installed in the field by the Contractor unless otherwise specified.
4. Appliances shall be furnished complete with motors, driving mechanisms, starters, and controllers, including master switches, timers, cut-outs, reversing mechanisms, and other electrical equipment if and as applicable.

D. Cover Plates:

1. All controls mounted on vertical surfaces of fixtures shall be set into recessed die stamped stainless steel cups or mounted onto removable cover plates in such a fashion as to not protrude or interfere with the operation of each item.
2. Cover plates shall be furnished and installed for all electrical outlets, receptacles, switches and controls furnished by the K.E.C., and shall match the material and finish of the equipment to which they will be fastened.

E. Wiring and Conduit:

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1. Wiring shall be properly protected in N.E.M.A. and U.L. approved metal enclosures. Only rigid steel conduit shall be used, zinc coated where unexposed and chrome plated where exposed. All wiring shall be run concealed wherever possible.
2. All equipment furnished under this contract shall be so wired, wound, or constructed so as to conform with the electrical characteristics at the job site.
3. Wiring and connection diagrams shall be furnished with electrically operated machines and for all electrically wired fabricated equipment.
4. Furnish all foodservice equipment completely wired internally using wire and conduit suitable for a wet location. Where an Electrician's services are required, the work shall be done in the K.E.C.'s factory or at his expense at the job site at no additional cost to the Owner. Provide all electrical outlets and receptacles required to be mounted on or in fabricated equipment and interconnect to a master circuit breaker panel with all wires neatly tagged showing item number, voltage characteristics, and load information. Final connection shall be made by the Electrical Contractor.

F. Cords, Plugs, and Receptacles:

1. The Electrical Contractor shall provide three- or four-wire, grounding-type receptacles for all wall and floor mounted outlets to be used for plug-in equipment with characteristics as noted on the drawings. Provide "Hubbell" three-wire or four-wire grounding-type connectors and neoprene cords installed on each item of plug-in equipment, as indicated on drawings and item specifications.
2. K.E.C. shall coordinate with the Electrical Contractor so that the receptacles provided will match the specific plugs provided as part of the plug-in equipment. Any changes in cords and plugs required in the field due to lack of coordination between the Electrical Contractor and the K.E.C. shall be the latter's responsibility.
3. Reduce the length of all cords furnished with the specified equipment to a suitable or appropriate length so they do not interfere with other equipment or operations.
4. Pedestal receptacles that are part of fabricated equipment exposed to view, shall be similar to T&S Model No. B-1508DD single face, single gang or Model No. B-1528DD single face, double gang.

G. Water Inlets:

1. Water inlets shall be located above the positive water level wherever possible to prevent siphoning of liquids into the water supply system. Wherever conditions shall require a submerged inlet, a suitable type of check valve (except in jurisdictions where check valves are prohibited) and vacuum breaker shall be placed on the fixture to form a part of same to prevent siphoning. Where exposed to view, piping and fittings shall be chrome-plated.

H. Drain Lines:

1. Plumbing Contractor shall provide and install indirect waste lines from

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equipment which will discharge into floor drains or safe wastes in accordance with Plumbing Rough-In Plans, chrome-plated where exposed. Extend to a point at least 1" (or as required by local codes) above the rim of the floor drain, cut bottom on 45° angle and secure in position.

2. All horizontal piping lines shall be run at the highest possible elevation and not less than 6" above finished floor, through equipment where possible.
3. No exposed piping in or around fixtures or in other conspicuous places shall show tool marks of more than one thread at the fitting.
4. All steam operating valves on or in fabricated and purchased foodservice equipment shall be provided with composition hand wheels, which shall remain reasonably cool in service.
5. Provide suitable pressure regulating valves for all equipment with such components that might reasonably be expected to be affected over a period of time by adverse pressure conditions.

I. Faucets, Valves and Fittings:

1. All sinks shall be fitted with chromium plated, swing spout faucets of same manufacturer throughout as follows, or otherwise specified in Item Specifications.

    a. Prep and Utility Sinks:
        1) Splash-Mounted:
            a) T&S Brass and Bronze Works, Inc., Model B-231.
            b) Fisher Manufacturing Company, Model 3253.
        2) Deck-Mounted:
            a) T&S Brass and Bronze Works, Inc., Model B-221.
            b) Fisher Manufacturing Company, Model 3313.
    b. Pot Sinks:
        1) Splash-Mounted:
            a) T&S Brass and Bronze Works, Inc., Model B-290.
            b) Fisher Manufacturing Company, Model 5214.

2. Pre-Rinse Assemblies:

    a. Splash-Mounted:
        1) T&S Brass and Bronze Works, Inc., Model B-133 with B-109 wall bracket.
        2) Fisher Manufacturing Company, Model 2210 with 2902-12 wall bracket.
    b. Deck-Mounted:
        1) T&S Brass and Bronze Works, Inc., Model B-143 with B-510 mixing valve and B-109 wall bracket.
        2) Fisher Manufacturing Company, Model 2810 with 2805-CV mixing valve and 2902-12 wall bracket.

3. Vacuum Breakers:

    a. General Use:
        1) Fisher Manufacturing Company, Model 3990-8000.
    b. Disposers:

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1) Splash-Mounted:
   a) T&S Brass and Bronze Works, Inc., Model B-455.
   b) Fisher Manufacturing Company, Model 3990.
2) Deck-Mounted:
   a) T&S Brass and Bronze Works, Inc., Model B-456.
   b) Fisher Manufacturing Company, Model 3991.

4. Trough Inlets:
   a. Fisher Manufacturing Company, Model No. 2905.

5. Other specialty faucets, pre-rinse assemblies, vacuum breakers, and trough inlets, as specified under Item Specifications.
6. All sink compartments shall be fitted with 2" NPT male, chrome-plated, brass rotary waste valves complete with overflow assemblies and stainless steel strainers.

   a. Prep and General Utility Sinks:
      1) Fisher Manufacturing Company, Model No. 6100.
   b. Pot Sinks:
      1) Fisher Manufacturing Company, Model No. 6102.

7. Refer to Division 22 for all other fittings.

J. Metals and Alloys:

1. Stainless steel sheets shall conform to ASTM 240, Type 302, Condition A, 18-8, of U.S. Standard Gauges as previously indicated under paragraph 2.1.E.

   a. All exposed surfaces shall have a No. 4 finish. A No. 2B finish shall be acceptable on surfaces of equipment not exposed to view.
   b. All sheets shall be uniform throughout in color, finish, and appearance.
   c. Rolled shapes shall be of cold rolled type conforming to ASTM A36.

2. Stainless steel tubing and pipe shall be Type 304, 18-8, having a No. 4 finish, and shall conform to either ASTM A213 if seamless or ASTM A249 if welded.
3. Where galvanized metal is specified, it shall be copper-bearing galvanized iron, cold-rolled, stretcher leveled, bonderized, re-rolled to insure a smooth surface, and used in the largest possible sizes with as few joints as necessary.
4. Galvanizing shall be applied to rolled shapes in conformance with ASTM A123, and to sheets in conformance with ASTM A526, coating designation G-90.

K. Castings:

1. Castings shall consist of corrosion resisting metal (white metal) containing not less than 30% nickel. All castings shall be rough ground, polished, and buffed to bright lustre and free from pit marks, runs, checks, burrs, and other imperfections. In lieu of corrosion resisting metal castings, die-stamped or cast 18-8 stainless steel will be acceptable.

L. Hardware and Casters:

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1. All hardware shall be of heavy-duty type, satin finished chromium plated brass, cast or forged or highlighted stainless steel of uniform design. All hardware shall be a well-known brand and shall be identified by the manufacturer's name and model number for easy replacement of broken or worn parts.
2. Casters on custom-built equipment shall be heavy-duty type, ball bearing, solid or disc wheel, with grease-proof rubber, neoprene, or polyurethane tire. Wheel shall be 5" diameter, minimum width of tread 1-3/16", minimum capacity per caster 250 pounds, unless otherwise noted.

    a. Solid material wheels are to be provided with stainless steel rotating wheel guard.
    b. All casters shall have sealed wheel and swivel bearings, polished plated finish and be N.S.F. approved.
    c. All equipment specified with casters shall have a minimum of two (2) with brakes installed on opposite corners, unless otherwise noted.

M. Locks:

1. When specified, doors and drawers of all custom fabricated or manufactured equipment shall be provided with cylinder locks, disc tumbler type with stainless steel faceplate as manufactured by Standard-Keil Mfg. Co. or approved equal.

    a. Provide two (2) sets of keys for each lock.
    b. All locks shall be keyed alike, except at cashiers' stations or unless otherwise specified.

N. Thermometers:

1. All fabricated refrigerated compartments shall be fitted with exterior mounted, adjustable, dial or digital thermometers with flush bezels, and shall be calibrated after installation.

O. Sealants:

1. Sealant, wherever required, shall conform to ASTM C 920; Type S Grade NS, Class 25, Use Nt, with characteristics that when fully cured and washed meets requirements of Food and Drug Administration Regulation 21 CFR 177.2600 and N.S.F. RTV-732 for use in areas where it comes in contact with food.
2. Dow-Corning #780 or General Electric "Silastic", or approved equal, in either clear or approved color to match surrounding surfaces and applied in accordance with sealant manufacturers recommendations for a smooth, sealed finish.

P. Millwork:

1. All millwork materials shall be free from defects impairing strength, durability, or appearance; straight and free from warpage; and of the best grade for their particular function. All wood shall be well seasoned, kiln dried, and shall have

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an average moisture content of 8%, a max. of 10% and a min. of 5%.

2. Plywood and other woodwork of treatable species, where so required by code, shall be fire-retardant treated to result in a flame spread rating of 25 or less with no evidence of significant progressive combustion when tested for 30 minutes duration under ASTM E84 and shall bear the testing laboratory mark on the surface to be concealed.
3. Concealed softwood or hardwood lumber shall be of poplar, douglas fir, basswood, red oak, birch, maple, beech or other stable wood and shall be select or better grade, unselected for color and grain, surfaced four sides, square-edged, and straight. Basswood may be used where fire-retardant materials are required.
4. Plywood for transparent finish shall conform to U.S. Product Standard PS-51-71, Type I (fully waterproofed bond), with architectural grade face veneers of species as specified, free of all pin knots, patches, color streaks and spots, sapwood, and other defects. Plywood designated to have plywood cores shall be of either 5 or 7 ply construction. Plywood so designated on the drawings and plywood not otherwise shown shall have a particle board core, cross banding of veneers, and face and back veneers. Particle board cores shall have a 45 pound density, except where the fire retardant treatment requires cores of lesser density.
5. Face veneers shall be matched for color and grain to produce balance and continuity of character. Mineral streaks and other discolorations, worm holes, ruptured grain, loose texture, doze, or shake will not be permitted. Face veneer leaves on each surface shall be full-length, book-matched, center-matched, and sequence-matched. Surfaces shall be sequence and blueprint matched. Veneers not otherwise indicated shall be plain sliced. Backing veneers for concealed surfaces shall be of a species and thickness to balance the pull of the face veneers.
6. Hardwood plywood for painted surfaces shall conform to U.S. Product Standard PS-51-71, Type I, and shall have sound birch, maple or other approved close grain hardwood faces suitable for a paint finish.
7. Perforated hardboard shall be a tempered hardboard, 1/4" thick, conforming to Federal Specification LLL-B-810B, Type I, SIS, Finish B (primed), Design B (perforated), with 1/4" diameter holes spaced on 1" centers both ways.
8. Plywood for laminate assemblies shown or specified with plywood core shall be of the 5 or 7 ply construction with sanded close-grain hardwood face and back veneers, laminated with waterproof glue, in thickness shown, conforming to U.S. Product Standard PS-51-71.
9. Particle board for plastic laminate assemblies shown or specified with particle board wood core shall conform to U.S. Product Standard CS-236-66, Type 1, or 2, Grade B (45 pound density), class 2: except where fire-retardant treatment is required the density shall conform to the treatment requirements.

Q. Plastic Laminate:

1. Plastic laminate surfaces shall be laminated with thermosetting decorative sheets of the color, pattern, and style as selected by the Architect.

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a. Horizontal surfaces shall be laminated with sheets conforming to Federal Specification L-P-508F, Style D, Type I (general purpose), Grade HP, Class 1, 1/16" thick, satin finish, with rough sanded backs.
b. Vertical surfaces shall be laminated with sheets conforming to Federal Specification L-P-598F, Style D, Type II, (vertical Surface), Grade HP, Class 1, non-forming, satin finish, 1/32" thick or heavier.
c. Curved surfaces shall be laminated from sheets conforming to Federal Specification L-P-508F, Style D, Type III (post-forming), Grade HP, Class 1, satin finish.
d. Balance sheets for backs in concealed locations shall be either reject material of the same type and thickness as the general purpose grade facing or may be .020" thick laminate backing sheets conforming to Federal Specification L-P-00508E, Style ND, Type V (backing sheet), Grade HP.

2. Adhesives:

a. For application of plastic laminate to wood substrates of horizontal surfaces shall be a phenolic, resorcinol, or melamine adhesive conforming to Federal Specification MMM-A-181C, producing a waterproof bond.
b. For applying plastic laminate to vertical surfaces shall be either a waterproof type or a water-resistant type such as a modified urea-formaldehyde resin liquid glue conforming to Federal Specification MMM-A-188C.
c. Contact adhesive will not be acceptable.

2.3 FABRICATION AND MANUFACTURE

A. Materials and Workmanship:

1. Unless otherwise specified or shown on drawings, all materials shall be new, of best quality, perfect, and without flaws. Material shall be delivered and maintained on the job in an undamaged condition.
2. Fabrication shall be equal to the standards of manufacture used by all first class equipment manufacturers, performed by qualified, efficient, and skilled mechanics of the trades involved.
3. All items of standard equipment shall be the latest model at time of delivery.
4. All fabricated work shall be the product of one manufacturer of uniform design and finish.
5. Each fabricated item of equipment shall include all necessary reinforcing, bracing, and welding with the proper number and spacing of uprights and cross members for strength.
6. Wherever standard sheet sizes will permit, the tops of all tables, shelves, exterior panels of cabinet type fixtures, and all doors and drainboards shall be constructed of a single sheet of metal.
7. Except where required to be removable, all flat surfaces shall be secured to vertical and horizontal bracing members by welding or other approved means to eliminate all buckle, warp, rattle, and wobble. All equipment not braced in a rigid manner, and which is subject to rattle and wobble shall be unacceptable, and the K.E.C. shall add additional bracing in an approved manner to achieve acceptance.

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B. Sanitary Construction:

1. All fabricated equipment shall be constructed in strict compliance with the standards of the National Sanitation Foundation as outlined in their Bulletin on Food Service Equipment entitled "Standard No. 2" dated October 1952, and in compliance with the local and State Public Health Regulations in which the installation will occur.
2. All fabricated equipment shall bear the N.S.F. "Seal of Approval".

C. Construction Methods:

1. Welding:

a. All welding shall be the heliarc method with welding rod of the same composition as the sheets or parts welded. Welds shall be complete, strong, and ductile with excess metal ground off and joints finished smooth to match adjoining surfaces; free of mechanical imperfections such as gas holes, pits, cracks, etc., and shall be continuously welded so that the fixtures shall appear as one-piece construction. Butt welds made by spot solder and finished by grinding shall not be acceptable.
b. Spot welds shall have a maximum spacing of 3". Tack welds shall be of at least 1/4" length and spaced no greater than 4" from center to center. Weld spacing at the ends of the channel battens shall not exceed 2" centers.
c. In no case shall soldering be considered as a replacement for welding, nor shall any soldering operation be done where dependence is placed on stability and strength of the joint.
d. Fixtures shall be shop fabricated of one piece and shipped to the job completely assembled wherever possible. Equipment too large to transport or enter the building in one piece shall be constructed so that the field joints can be welded at the job site.
e. All exposed joints shall be ground flush with adjoining material and finished to harmonize therewith. Whenever material has been sunk or depressed by welding operation, depression shall be suitably hammered and peened flush with the adjoining surface and ground to eliminate low spots. In all cases the grain of rough grinding shall be removed by successive fine polishing operations.
f. All unexposed welded joints on undershelves of tables or counters of stainless steel shall be suitably coated at the factory with an approved metallic-based paint.
g. After galvanized steel members have been welded, all welds and areas where galvanizing has been damaged shall have a zinc dust coating applied in conformance with Military Specification Number MIL-P-26915.

2. Joints:

a. Butt joints and contact joints, wherever they occur, shall be close fitting and shall not require a filler. Wherever break bends occur, they shall be free of undue extrudence and shall not be flaky, scaly, or cracked in appearance; where such breaks do mar the uniform surface appearance of the material, all such marks shall be removed by suitable grinding, polishing, and

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finishing. Wherever sheared edges occur, they shall be free of burrs, fins, and irregular projections and shall be finished to obviate all danger of laceration when the hand is drawn over them. In no case shall overlapping materials be acceptable where miters or bullnosed edges occur.

b. Field welded joints shall be ground smooth without dips and irregularities and finished to match original finish.

3. Bolt, Screw and Rivet Construction:

a. All exposed surfaces shall be free from bolt and screw heads. When bolts are required, they shall be of the concealed type and be of similar composition as the metal to which they are applied.
b. Where bolt or screw threads on the interior of fixtures are visible or may come into contact with hands or wiping cloths, they shall be capped with a stainless steel or chrome acorn nut and stainless steel lock washer.
c. If rivets are used to fasten rear paneling to the body of the fixture, such rivets shall be stainless steel. In no case shall iron rivets be used.

4. Sound Deadening:
a. Schnee Butyl-Sealant 1/2" wide rope continuously between all frame members and underside of stainless steel table tops, overshelves and undershelves.
b. Tighten stud bolts for maximum compression of sealant.

5. Hi-Liting:

a. All horizontal edges of stainless steel tops, splashes, tops of raised rolled rims, and edges of all exposed doors, handles and shelf edges shall be hi-lited, in uniform design by grinding with abrasive not coarser than #240 grit, then polishing with compound to a uniform mirror finish.

6. Polishing:

a. The grain of polishing shall run in the same direction on all horizontal and on all vertical surfaces of each item of fabricated equipment except in the case where the finish of the horizontal sections of each shall terminate in a mitered edge.
b. Where sinks and adjacent drainboards are equipped with backsplash, the grain of the polishing shall be consistent in direction throughout the length of the backsplash and sink compartment.

7. Finishes:

a. Paint and coatings shall be of an N.S.F. approved type suitable for use in conjunction with foodservice equipment. Such paint or coating shall be durable, non-toxic, non-dusting, non-flaking and mildew resistant, shall comply with all governing regulations, and shall be applied in accordance with the manufacturer’s recommendations.
b. All exterior, galvanized parts, exposed members of framework, and wrought steel pipe where specified to be painted shall be cleaned, primed with rust

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inhibiting primer, de-greased, and finished with two (2) coats of glossy enamel grey hammertone paint, unless otherwise noted.

c. Where baked enamel finishes are specified, they shall be oven baked on the fixtures for a minimum of 1-1/2 hours at a minimum temperature of 300º Fahrenheit.
d. Fabricated equipment shall be spray coated with plastic suitable for protecting the equipment during transport and installation. The coating shall be easily removable after the equipment installation is complete at the job site, and final clean-up has begun.

D. Construction:

1. Legs:

a. All tubular stands for open base tables, sinks, or dishtables shall have legs constructed of 1-5/8" O.D. stainless steel tubing, with 1-1/4" O.D., #16 gauge stainless steel crossbracing running between legs at a point 10" above finished floor.
b. All joints between legs and crossbracing shall be welded and ground smooth, full 360E.
c. The top end of legs shall be closely fitted into fully-enclosed stainless steel conical gussets no less than 3" high, similar to Klein #481-58 or #483-58 or approved equal.
d. Gussets shall be fully welded to framing reinforcing members, so that, set screw is not visible from front.
e. Legs without crossrails will not be accepted.
f. Legs shall be spaced at not more than 5'-6" on centers, unless otherwise specified.

2. Feet:

a. All tubular legs will be swedged for appearance and close fit to United Show Case #BF-158, or approved equal, fully enclosed, stainless steel bullet-shaped foot.
    1) The foot shall be threaded into a collar and completely welded inside the tubular leg to permit a maximum adjustment of 2" without any thread exposure.
    2) Threads shall be National Course Series Class 2 fit or better, machined to prevent end play when foot is at maximum adjustment.
    3) The bullet-shaped foot shall have slightly rounded bottom to protect the floor, and a minimum bearing surface of 3/4" diameter of stainless steel-to-floor contact.
    4) Bottom of tubular leg shall be finished off smoothly to provide a sanitary fitting and prevent the accumulation of grease or other debris.
b. Cabinet type fixtures shall be mounted on 8" high die-stamped, sanitary, two-piece stainless steel legs no less than 2-3/4" in diameter at the top, Component Hardware #A72-0811, or approved equal.
    1) The bottom fully enclosed, stainless steel, bullet-shaped foot threads up into the inside of the upper member, with a male threaded 5/8" bushing to permit maximum adjustment of 2" without thread exposure.

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2) The upper section shall be stamped in a neat design with a flared inverted shoulder and fully welded to a base plate designed for anchoring to the channel underbracing.

3. Table Tops:

a. Tables shall be constructed of stainless steel, and of a thickness not less than #14 gauge with 1-3/4" by 120º rolled edges, or as otherwise specified and detailed.
b. All corners shall be bull-nosed and of the same radius as rolled edges.
c. Joints where required shall be butt-welded and ground smooth to present a uniform one-piece appearance.
d. All tops shall be reinforced on the underside with a fully welded framework of 1-1/2"x1-1/2"x1/8" galvanized steel angles with the framing extending around the top perimeter and crossbraced on 24" maximum centers.
e. 1"x4"x1" galvanized or stainless steel, fully welded, cross channel, closed end members placed at each pair of legs with one (1) channel running lengthwise will also be acceptable.
f. All tops shall be reinforced so that there will be no noticeable deflection.
g. Metal tops where adjacent to walls or other items of equipment, shall be constructed with integral, coved, back and/or endsplashes as required and specified in accordance with the standard details contained herein. Close all ends of splashes.

4. Enclosed Bases:

a. All enclosed bases or cabinet bodies shall be of seamless #18 gauge stainless steel construction, enclosed on the ends and sides as required and called for under each item.
b. Ends of body shall terminate at front or operator's side in a 2" wide mullion, vertical, and completely enclosed. All intermediate mullions shall be completely enclosed.
c. The bases shall be reinforced at the top with a framework of 1-1/2"x1-1/2"x1/8" galvanized angles, with all corners mitered and welded solid.
d. Underside of top shall be reinforced with channels and gussets where necessary. Additional angles and cross members shall be provided to reinforce shelves and support tops under heavy tabletop equipment.
e. Where sinks or other drop-in equipment occur, provide additional reinforcing extending crosswise, both sides of opening.
f. In the case of fixtures fitting against or between walls, the bodies shall be set in 1" or 2" from the wall line, with the tops continuing to the wall line with integral, coved splashes as specified. Extend vertical face of body to the wall line only. This will permit adjustment to wall irregularities. Vertical trim strips will not be accepted.
g. Bodies shall be fitted with counter style stainless steel legs as hereinbefore specified.

5. Drawers:

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a. Drawers, where specified, shall have removable pan inserts of #18 gauge stainless steel, and shall be approximately 20"x20"x5" deep unless otherwise specified.
   1) Perimeter top edge shall be flanged out 1/2".
   2) All interior horizontal corners shall be rounded on a 1" radius, and all interior vertical corners shall be rounded on a 2" radius.
b. Fronts shall be double pan #16 gauge stainless steel construction, 1" thick, insulated with a semi-rigid, fiberglass board, unfaced, having a three-pound density.
   1) The top of the drawer face shall be formed as an integral pull by breaking the front pan back on a 45º angle 1", then straight up 1", back to front 1", and then down at the front 3/4".
   2) Drawer front shall have all edges and corners ground smooth with a radius edge pull.
   3.) Provide hard rubber button bumpers attached to rear of drawer face at each corner.
c. The drawer shall have an all welded frame of 1"x1", #16 gauge stainless steel angles sized to fit the removable pan insert.
d. Drawers shall operate on #14 gauge full-extension slides with stainless steel roller bearings with hardened and ground raceways, Component Hardware, S52 Series, or approved equal. Slides shall be pitched approximately 3/8" per foot to permit self-closing action.
e. Drawers shall be adequately and neatly fitted to the guides to permit easy operation without rattle or binding.
f. Slides and frame shall be reinforced to support a dead weight of 150 pounds when drawer is fully extended.
g. Adjustable stops shall be provided for each drawer at the fully-opened position and be readily liftable by hand for easy removal of drawer.
h. All drawers not mounted inside a cabinet body shall be completely enclosed in an #18 gauge stainless steel box-type enclosure and suspended from angle framing under the fixture top. The housing bottom shall be flanged and welded to an #18 gauge stainless steel reinforcing channel extending across the open end.

6. Sliding Doors:

a. Sliding doors shall be of the double pan type, with the exterior pan constructed of #18 gauge stainless steel with all four sides channeled and corners welded. The interior pan shall be similarly constructed of #20 gauge stainless steel, set into the exterior pan, and welded in place.
b. All doors shall be insulated with semi-rigid fiberglass board, un-faced, having a three-pound density. Styrofoam shall not be acceptable.
c. Doors 18" wide or greater, shall have internally welded 4" wide reinforcing channels to prevent warpage.
d. Each door shall be fitted with a positive flush-type stainless steel pull, Standard-Kiel #1262-1014-1283 recessed handle or approved equal.
e. In the back of each door install a 1"x1", #16 gauge stainless steel angle stop welded in a suitable location to prevent the doors from overpassing the flush pulls.
f. Doors in the closed position shall overlap each other by no more than 2".

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g. Each door shall be fitted with two (2), 1-3/8" ball bearing sheaves fastened to 1"x1/8" stainless steel bar stock welded to the top corners of each door for suspending on an overhead #16 gauge stainless steel channel track. The hangers shall be tapped for 1/4"-20 thumb screw vertical locks which prevent the doors from jumping the track in operation while permitting easy removal for cleaning without tools.
h. Insure that the bottom of the doors are positively and continuously guided to assure proper alignment and passing regardless of the position of each door.
i. Provide hard rubber bumpers for doors to close against to insure quiet operation.

7. Hinged Doors:

a. Hinged doors shall be of the same materials and construction as sliding doors previously specified.
b. Hinges shall be heavy duty, stainless steel, removable type, and fastened by tapping into 1/4"x3/4" stainless steel bar stock inside the door pan and behind the door jamb.
c. The door face shall be flush with the cabinet body when fully closed.
d. Size widths of doors equally when installed in pairs, or in series with other pairs, with no door being greater than 36" in width.
e. Doors shall be held closed by permanent magnetic closure devices of an approved type and of sufficient strength to hold the doors shut. Install two (2) per door (minimum), mounted to the door jamb, top and bottom, with opposing chrome-plated steel plates securely fastened to the inner panel of the doors.

8. Undershelves:

a. All open base tables shall be provided with full-length undershelves of #16 gauge stainless steel fully welded to legs with all joints ground smooth and polished.
b. Front edge shall turn down 1-1/2" and under 1/2".
c. Turn up rear and ends 2", with integral coved radius, when specified.
d. If required by width, provide 1-1/2"x1-1/2"x1/8" galvanized angle bracing mounted to underside, full length.

9. Interior Shelves:

a. All interior shelves within cabinet bodies, enclosed bases and overhead cabinets, shall be of #16 gauge stainless steel.
b. Removable shelves shall be constructed in equal sections, and rest in 1-1/2"x1-1/2"x1/8" stainless steel angle frame. Cove all horizontal corners in accordance with N.S.F. requirements.
c. Stationary shelves shall have 2" turn-up on back and ends, and continuously welded to cabinet body, polished and ground smooth to form a one-piece interior free of any crevices.
d. Front edge shall turn down 1-1/2" and under 1/2” and finished with "z" bar forming completely enclosed edge for maximum strength and sanitation.

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e. Provide 1-1/2"x1-1/2"x1/8" angle bracing mounted to underside, full length.

10. Elevated Shelves:

a. Shelves over equipment not adjacent to a wall shall be mounted on 1" diameter #16 gauge stainless steel tubular standards neatly fitted with stainless steel base flanges, unless otherwise specified.
b. The top of the tubular standards shall be completely welded to #14 gauge stainless steel support channels, full width of overshelf.
c. Inside the tubular standard, and welded to same, provide 1/2" diameter steel tension rod extended through countertop and securely anchored to lower framework reinforcing with nuts and lock washers in such a manner as to assure a stable, sway-free structure.
d. If required by width, provide 1-1/2"x1-1/2"x1/8" stainless steel angle bracing mounted to underside, full length.
e. Cantilevered shelves, when called for, shall be #16 gauge stainless steel supported on #14 gauge stainless steel brackets welded to 1-5/8" O.D. stainless steel tubular standards extending through the backsplash, and fully welded to the table framework. Provide Klein #481-SH welded sleeves where standards penetrate backsplash.

11. Wall Shelves:

a. Open wall shelves shall be constructed of #16 gauge stainless steel with back and ends turned up 2", positioned 2" out from face of wall, with all corners welded, and supported on #14 gauge stainless steel brackets.
b. Brackets shall be flanged inward beneath the shelf and at the wall 1-1/2" with intersecting flanges completely welded, and attached to shelf with studs welded to the underside and bolted with stainless steel lock washers and chrome-plated cap nuts.
c. Each bracket shall be fastened to the wall with a minimum of two (2) 1/4"-20 stainless steel bolts anchored securely by means of toggles or expansion shields.

12. Sinks:

a. All sinks shall be the size and shape as shown on drawings, and constructed of #14 gauge stainless steel with backs, bottoms and fronts formed of one continuous sheet and the ends welded in place.
b. Sinks shall have all corners, both vertical and horizontal, coved on a 3/4" radius electrically welded, ground smooth and polished. Solder in filleted corners will not be acceptable.
c. Multiple compartment sinks shall be divided with double wall, #14 gauge stainless steel partitions with a 1/2" radius on top and all corners rounded as other corners, continuously welded, ground smooth and polished.
d. The bottom of each compartment shall be creased to a die stamped recess, tapered and shaped to receive a lever type waste without the use of solder, rivets, or welding.
e. Provide #14 gauge stainless steel waste lever angle bracket mounted to underside of compartment at front.

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f. The front and exposed ends of sinks shall be fabricated with a 1-1/2", 180 degree rolled edge. The back and ends adjacent to walls or other fixtures shall be turned up with integral coved edge 12" high and returned 2-1/2" at the top on a 45º angle. Cap ends of all exposed splashes.
g. Unless otherwise specified, two (2) faucet holes on 8" centers shall be provided, located over the centerline of partitions between compartments, 2-1/2" down from splash break.
h. Gussets for legs shall be fully welded all around to #12 gauge stainless steel triangular plates fully welded to underside of sink.
i. Sinks fabricated into working surfaces shall be constructed of the same material and in like manner to sinks specified above, except rolled edge and backsplash shall be omitted and the bowl shall be completely welded integral and flush with the working surface. Where basket type wastes are called for, they shall be fitted with removable seats.
j. Where sink bowls are exposed, the exterior shall also be polished to a #4 finish.

13. Sink Drainboards:

a. Drainboards shall be constructed of the same material as the sinks and shall be welded integral to same.
b. The front portion of drainboards shall continue the 1-1/2", 180º rolled edge of sink bowls on a continuous and level horizontal plane.
c. The surface of the drainboard shall pitch from 2-1/2" at the end furthest from the sink, to 3" at the bowl; or 1/8" per foot. In addition, the bottom surface shall be dished toward the center for complete drainage.
d. The backsplash of the drainboard shall match the rear of the sink contour and shall be welded integral thereto, running parallel to the floor.
e. Drainboards shall be reinforced on the underside with a framework of 1"x4"x1" stainless steel channel underbracing placed at each pair of legs, with exposed ends capped, and one (1) channel running lengthwise.
f. Where disposer cones are fabricated into drainboards, additional 1"x4"x1" stainless steel channels shall be welded into the top framing, spanning the drainboard from front-to-back on both sides of the cone and located not more than 3" to either side.
g. Disposer control panels or switches shall be supported beneath drainboards, when specified, by means of a #12 gauge stainless steel mounting bracket.

14. Dishtable Tops:

a. Dishtables shall be constructed of #14 gauge stainless steel with all corners, both vertical and horizontal, coved on a 3/4" radius electrically welded, ground smooth and polished. Solder in filleted corners will not be acceptable.
b. Fronts and exposed ends shall be fabricated with a 3" high, 1-1/2", 180E rolled edge with rounded corners. The back and ends adjacent to walls or other fixtures shall be turned up with integral coved edge 12" high and returned 2-1/2" at the top on a 45º angle. Cap ends of all exposed splashes.
c. All tops shall slope 1/8" per foot (minimum).

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d. Dishtables shall be reinforced on the underside with a framework of 1"x4"x1" stainless steel channel underbracing placed at each pair of legs, with exposed ends capped, and one (1) channel running lengthwise fully welded between front-to-back channels.
e. Where tops fit into dishmachines, they shall turn down and into, forming a sealed watertight fit, and attached according to dishmachine manufacturer's instructions.
f. On each side of dishmachine, tables shall be provided with integral splash shields as part of the backsplash.
g. Silicon filling of gaps caused by poor fit will not be acceptable.
h. On corner-type door machines, provide #14 gauge stainless steel wall-mounted, splash panel to protect adjacent wall, full width of door opening.

15. Cafeteria Style Counters:

a. All counters shall be constructed as previously specified under Enclosed Bases.
b. Provide top and bottom framing for each counter food pan, cold pan, coffee urn, ice cream unit, ice bin, dish dispenser, etc., whether a drop-in unit or a cutout for a portable unit.
c. Where plate shelves occur, frame horizontally 8-1/2" back from counter edge or as design dictates, and at bottom of shelf at counteredge.
d. The countertop shall be constructed of #14 gauge stainless steel, as previously specified, with all joints welded, ground and polished.
e. Fronts and exposed ends shall be stainless steel, plastic laminate or other material as noted in the Item Specifications.
f. All display glass shelving shall be 1/4" polished plate glass and fully trimmed with #18 gauge stainless steel formed channels. Top shelves shall be the same width as the shelf below. Shelves shall be supported on 5/8" square, #16 gauge stainless steel perimeter tubing fully welded to 1-1/4" square, #16 gauge stainless steel tubing uprights.
g. Provide appropriate adjustable glass sneeze or breath guards trimmed in stainless steel along front, entire length, mounted in Klein 4465-A brackets.
h. Protector shelf over hot food wells shall be #16 gauge stainless steel supported on 1-1/4" square, #16 gauge stainless steel tubing uprights, with 1/4" polished plate glass front and end panels trimmed in #18 gauge stainless steel channels. When specified for self-service, mount bottom edge of front panel 8" above countertop.
i. All display and protector shelves shall be furnished with full-length LED lights wired to on/off switch in counter apron, with lamps and protective shields. Conceal all wiring in tubular uprights.
j. Refer to Item Specification for changes, as required.
k. Counter shall be internally wired complete by the K.E.C., and in such a way as to meet the requirements of the Electrical Code of the job location.
l. Refer to manufacturer's serving counter details shown on the Contract Documents.

2.4 EQUIPMENT

A. All items listed on the Contract Documents under the heading "Equipment Schedule"

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shall be furnished in strict accordance with the foregoing specifications and with the following detailed Itemized Specifications.

B. Manufacturer's names and model numbers are shown establishing quality, size, and finish required, representing the Owner's and Consultant's requirements and basis for bid. Equipment is listed hereinafter with same item numbers as shown on Contract Documents.

PART 3 EXECUTION

3.1 INSPECTION

A. Before beginning the installation of foodservice equipment, the spaces and existing conditions shall be examined by the K.E.C. and any deficiencies, discrepancies, or unsatisfactory conditions for proper installation of foodservice equipment shall be reported to the Architect in writing.

1. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner satisfactory to the installer.
2. Beginning installation shall constitute acceptance of the area.

B. Prior to concrete pouring, the K.E.C. shall notify the Architect once drainage, water inlets and electrical conduits are laid in ground for the Consultant to schedule and conduct underslab inspection.

C. Pre-installation meetings must take place prior to any kitchen equipment installations.

D. Once all walk-in box compartments are constructed and all ventilators have been installed, notify the Architect for the Consultant to conduct an inspection.

E. K.E.C. to notify the Architect upon completion of equipment installation, for the kitchen to be inspected by the Consultant prior to the Health Department’s inspection. A follow-up inspection shall be conducted after all items have been addressed from the initial punch report.

F. Consultant to submit all inspection reports to the Architect and Owner.

G. All loose parts or attic stock items must be labeled and turned over to the Owner during final inspection.

H. One (1) year warranty kitchen equipment inspection will be conducted by the Consultant to assess the performance of the equipment. Warranty items will be submitted to the K.E.C. for necessary repairs during the warranty period.

3.2 PREPARATION

A. Foodservice equipment drawings are diagrammatic and intended to show layout, arrangement, mechanical and electrical requirements.

B. Field verify all measurements at the building prior to fabrication of custom equipment.

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Coordinate measurements and dimensions with rough-in and space requirements.

3.3 INSTALLATION

A. The K.E.C. shall coordinate his delivery schedule with the Contractor to ensure adequate openings in the building to receive the equipment.

B. Equipment shall be un-crated, fully assembled and set level in position for final connections. Parts shipped loose but required for connection shall be properly tagged and shall be accompanied by the necessary installation instructions.

C. Provide a competent, experienced foreman to supervise installation and final connections with other trades.

D. Remote Refrigeration Systems:

1. All refrigeration work where applicable to this contract shall be accomplished in an approved manner, using finest quality fittings, controls, valves, etc.
2. Refrigeration items shall be started up, tested, adjusted, and turned over to the Owner in first class condition and left running in accordance with the manufacturer's instructions.
3. Refrigeration lines and hook-ups shall be completed by the K.E.C. with the exception of electric, water, and drain line final connections unless otherwise specified.
4. All copper tubing shall be refrigerant grade A.C.R. or type "L".
5. Silver solder and/or Sil-Fos shall be used for all refrigerant piping. Soft solder is not acceptable.
6. All refrigerant lines in pipe sleeves or conduit shall be effectively caulked at ends to prevent entrance of water or vermin and at penetrations through walls or floors.
7. All tubing shall be securely anchored with clamps, and suspended lines shall be supported with adjustable hangers at 6'-0" o.c. maximum.
8. Wrap drain line in freezer compartment(s) with approved heat-tape for final connection by Electrical Contractor.

E. Sealing and Caulking:

1. Prior to the application of sealant, all surfaces shall be thoroughly cleaned and de-greased.
2. Apply around each unit of permanent installation at all intersections with walls, floors, curbs or other permanent items of equipment.
3. Joints shall be air-tight, water-tight, vermin-proof, and sanitary for cleaning purposes.
4. In general, joints shall be not less than 1/8" wide, with backer rod to shape sealant bead properly at 1/4" depth. Shape exposed surfaces of sealant slightly concave, with edges flush with faces of materials at joint.
5. At internal corner joints, apply sealant or gaskets to form a sanitary cove, of not less than 3/8" radius.
6. Provide sealant-filled joints up to 3/4" in joint width. Trim strips for wider joints shall be set in a bed of sealant and attached with stainless steel fasteners, 48"

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o.c., or less, to insure suitable fastening and prevent buckling of the metals fastened.

F. Cutting:

1. All cutting, fitting, or patching required during installation shall be accomplished by the K.E.C., at his own expense, so as to make the work conform to the plans and specifications.
2. The K.E.C. shall not cut or otherwise alter, except with the consent of the Owner, the work of any other Contractor.
3. Provide cut-outs in foodservice equipment where required to run plumbing, electric, or steam lines through equipment items for final connections.

3.4 FIELD QUALITY CONTROL

A. Inspection:

1. Provide access to shop fabrication areas during normal working hours to facilitate inspection of the equipment, during construction, by the Architect or his authorized representative.
2. Errors found during these inspections shall be corrected to the extent required within the scope of the plans, specifications, and approved drawings.

B. Start-Up and Testing:

1. Delay start-up of foodservice equipment until service lines have been tested, balanced, and adjusted for pressure, voltage, and similar considerations; and until water and steam lines have been cleaned and treated for sanitation.
2. Before testing, lubricate each equipment item in accordance with manufacturer's recommendations.
3. Supply a trained person or persons who shall start up all equipment, test and make adjustments as necessary, resulting in each item of equipment, including controls and safety devices, performing in accordance with the manufacturer's specifications.
4. All gas-fired equipment shall be checked by the local gas company as to calibration, air adjustments, etc., and adjustments made as required.
5. Repair or replace any equipment found to be defective in its operation, including items which are below capacity or operating with excessive noise or vibration.
6. Furnish start up reports for the walk-in cooler/freezer, refrigeration system, cooking equipment, utility raceway and ventilator in accordance with Article 1.5 Submittals, Paragraph F.

C. Demonstration:

1. Provide an operating demonstration of all equipment at a time of Owner's convenience, to be held in the presence of authorized representatives of the Architect and Owner. K.E.C. to coordinate scheduling with manufacturer’s representatives.
2. At the time of demonstration, furnish complete, bound, operation/maintenance

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manuals and certificates of warranty for all items of equipment provided, in accordance with Article 1.5 Submittals, Paragraph F, at this demonstration time. All manuals are to be provided in digital format to DFNSOffice@mcpsmd.org AND (insert email address for Facilities, Construction, & Maintenance).

3. . Provide a digital and physical checklist of every piece of equipment, including the warranty expiration date, and maintenance routines.
4. Provide a follow-up kitchen demonstration three (3) months after the initial demonstration or kitchen opening or at the Owners requested timeline. K.E.C. to coordinate scheduling with all manufacturer's representatives.
5. Provide training or demonstration for all equipment to ensure new staff are properly trained on equipment.
6. Demonstration shall be performed by manufacturer's representative knowledgeable in all aspects of his equipment.
7. During the demonstration, instruct the Owner's operating personnel in the proper operation and maintenance of the equipment.
8. Equipment manufacturer to provide factory-approved instructional videos.

3.5 ADJUST AND CLEAN

A. Upon completion of installation and tests, clean and sanitize foodservice equipment, and leave in condition ready for use in food service.

B. Remove all protective coverings, and thoroughly clean equipment both internally and externally with stainless steel cleaner.

C. Make and check final adjustments required for proper operation of the equipment.

D. Restore finishes marred during installation to remove abrasions, dents, and other damages. Polish stainless steel surfaces, and touch-up painted surfaces with original paint.

E. Clean up all refuse, rubbish, scrap materials, and debris caused by the work of this Section, and put the site in a neat, orderly, and broom-clean condition.

3.6 ITEMIZED EQUIPMENT

ITEM #1: UTILITY CART, MOBILE

QUANTITY: Six (6)
MANUFACTURER: InterMetro Industries Corporation
MODEL NO.: MetroMax (N058)
PERTINENT DATA: 24" x 36" Shelf Size, Open Grid Mat, Polymer
UTILITIES REQ'D: ----
ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Instructions and the following:

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1. Three (3) #MXUC2436G-25 two-shelf units; three (3) #MXUC2436G-35, three-shelf units.

ITEM #2: WALK-IN COOLER/FREEZER

QUANTITY:	One (1)
MANUFACTURER:	Thermo-Kool
MODEL NO.:	Indoor Installation (N058)
PERTINENT DATA:	4" Foamed-In-Place Durathane Panels, Class I, NSF Construction
UTILITIES REQ'D:	1500W, 120V, 1PH; (2) 3/4" IW
ALTERNATE MFRS.:	Norbec; Kolpak; American Panel

Furnish and install per Equipment Plan, Sheet K-101; Building Conditions Plan, Sheet K-102; Manufacturer's Shop Drawing and the following:

1. Two Section Unit, 36'-6" L x 13'-6" D x 9'-6" H. Interior width: Cooler - 14'-1" wide, Freezer - 21'-5" wide.

2. Exterior Finish:
   -- 26 GA stucco embossed galvanized where unexposed.
   -- 22 GA stucco embossed stainless steel where exposed.

3. Interior Finish:
   -- White acrylic enamel baked-on .040 stucco embossed aluminum walls.
   -- White acrylic enamel baked-on 26 GA smooth galvanized steel ceiling.

ITEM #1: (Continued)

4. Interior Floor:
   -- 4" prefabricated floor panels installed in 6" deep floor recess over hot asphalt paper or 10 MIL polyethylene sheets on building floor slab.
   -- 2" setting bed with two (2) layers of wire reinforcing mesh fabric and quarry tile floor material with 6" high integral coved base by others, interior and exterior of box, installed over prefabricated floor panel by Flooring Contractor.
   -- Provide venting floor system under walk-in cooler/freezer larger than 400 square feet per manufacturer’s recommendations.

5. Entrance Doors:
   -- Two (2) flush-mounted, self-closing, doors with 34" x 80" net opening, hinged per Equipment Plan.
   -- Brushed chrome camlift hinges with lift-off capability. Provide one (1) extra hinge per door, three (3) total.
   -- Kason #0027C safeguard deadbolt locking latch with quarter turn inside release and strike.
   -- Hydraulic door closer.
   -- Standard 2" diameter dial indicating thermometer factory mounted in door frame, each compartment.
   -- Foot treadle door opener.
   -- 36" high aluminum diamond tread kickplates, interior and exterior of door, jamb, and frame.

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-- 14" x 24" heated observation window, each compartment.
-- Undercut doors for quarry tile floor.
-- Kason #1806 LED light fixture with high-impact plastic cover centered over door opening to avoid conflict with shelving, each compartment. Extend wiring in conduit, foamed within door panel header, to junction box mounted on top of walk-in ceiling, each compartment.
-- Kason #907 interior door handle, factory mounted, with concealed metal backing plate.
-- 12-gauge heavy-duty flat stainless steel heated threshold, both doors.
-- Engraved phenolic plastic compartment sign - 12" long x 2" high; white in color with 1" high blue CAPITAL letters mounted on each door above observation window; (1) - COOLER, (1) - FREEZER.
-- Round vinyl door bumper mounted to front exterior face to protect handle from puncturing wall when door in fully open position.

6. One (1) heated pressure relief port in freezer.

7. Five (5) Kason #1810L21248LB 48" long LED light fixtures with shatter-proof high impact plastic covers centrally-mounted to walk-in ceiling per Detail, Sheet K-104; three (3) for the freezer, two (2) for the cooler. Extend conduit connection up thru top. Fixtures shipped loose and mounted by K.E.C., final connection by Electrical Contractor. K.E.C. to seal and insulate with silicone sealant all knock-outs in fixture casing to prevent moisture infiltration.

8. One (1) #TK4700 walk-in monitor system with #TK4 light control and panic button factory mounted in each door panel and inter-wired with building monitoring system, as required by Electrical Contractor.

ITEM #2: (Continued)

9. Provide and install trim strips of matching exterior finish between ends of walk-in panels and building walls from floor to 6” above finished ceiling. K.E.C. to verify ceiling height.

10. Provide and install closure panels of matching exterior finish between top of walk-in and finished ceiling. K.E.C. to verify ceiling height.

11. All electrical conduit shall be run concealed above walk-in ceiling per Detail, Sheet K-104.

12. Evaporator coil drain lines shall be run to approved drain with P-trap on exterior of box by K.E.C.

13. Black flexible "Armaflex" insulation applied to exposed drain lines and fittings within interior of box by K.E.C., both compartments.

14. Spiral heat tape applied to drain line within interior of freezer compartment prior to application of insulation by K.E.C. Drain line heating cable shall be installed for continuous 24-hour operation. Final connection by Electrical Contractor.

15. Coordinate location of sprinkler head drops and provide penetrations, where necessary.

16. K.E.C. to seal and insulate all openings to prevent infiltration of warm air into cooler/freezer compartments.

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17. Accessories:
    -- One (1) Kolpak #HAL-C2-N1 or #HAR-C2-N1 air shield with magnetic activation switch, factory-mounted vertically, adjacent to the hinge side of cooler and/or freezer door on the interior wall surface. Electrical Contractor to provide power and final connection.
    -- #16 ga. stainless steel hat-channel bumper rail with closed ends installed to exposed front face and ends of walk-in unit, mounted @ 36" A.F.F. Provide 1/8" diamond tread kickplates from top of finish floor coved base to bottom of bumper rail. Align bumper rail with 36" high aluminum kickplate on doors.
    -- 6" high 1/8" thick aluminum cove baseboard, to be installed where panels are exposed at kitchen side, fastened with countersink screws and seal with gray-color silicone sealant to finish floor and walk-in panels.

ITEM #3: COOLER REFRIGERATION SYSTEM

QUANTITY:	One (1)
MANUFACTURER:	Bohn Refrigeration Products
MODEL NO.:	BCH0015MCACZ(N058)
PERTINENT DATA:	Air-Cooled, Outdoor Installation, Remote, With IntelliGen/Beacon II Smart Controls
UTILITIES REQ'D:	15.0A, 208V, 3PH
ALTERNATE MFRS.:	None

Furnish and install per Equipment Plan, Sheet K-101, Manufacturer's Shop Drawing and the following:

ITEM #3: (Continued)

1. Condensing Unit: Factory pre-assembled, scroll, medium-temperature, R-448A

2. Mounted on building roof above walk-in on roof curb per Detail Sheet K-102. See Mechanical Roof Plan, Sheet M1-135 for exact location.

3. Complete winterization package and condensing unit weatherproof cover.

4. Factory installed air defrost timer with contactors and relays.

5. Overall size: 39-1/8" L x 28-5/16" W x 19-3/4" H.

6. Weight: 221 lbs.

7. Evaporator Coil with High-Efficiency EC Motors: Low-Profile, End-Mount Type, Model BEL0115AS6AMA; 1.8A, 120V, 1PH.
    -- System to operate at +35º F.
    -- Furnished complete with solid state temperature sensors, electric expansion valve, transformer, coil compressor contactor, low-pressure time-delay switch and pressure transducer ready for final connection by Refrigeration Contractor.

8. Factory installed main-fused disconnect switch.

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9. Factory certified installers to provide complete refrigeration system warrantee: five (5) years for the compressor, two (2) years for the condensing unit, and two (2) years for all parts of the evaporator coil.

ITEM #4: FREEZER REFRIGERATION SYSTEM

QUANTITY:	One (1)
MANUFACTURER:	Bohn Refrigeration Products
MODEL NO.:	BCH0060LCACZ (N058)
PERTINENT DATA:	Air-Cooled, Outdoor Installation, Remote, With IntelliGen/Beacon II Smart Controls
UTILITIES REQ'D:	30.3A, 208V, 3PH
ALTERNATE MFRS.:	None

Furnish and install per Equipment Plan, Sheet K-101, Manufacturer's Shop Drawing and the following:

1. Condensing Unit: Factory pre-assembled, scroll compressor, low-temperature, R-448A.

2. Mounted on building roof above walk-in on roof curb per Detail Sheet K-102. See Mechanical Roof Plan, Sheet M1-135 for exact location.

3. Complete winterization package and condensing unit weatherproof cover.

4. Factory installed electric defrost timer with contactors and relays.

ITEM #4: (Continued)

5. Overall size: 43-7/8" L x 30-1/2" W x 29-1/4" H.

6. Weight: 327 lbs.

7. Evaporator Coil with High-Efficiency EC Motors: Low-Profile, End-Mount Type, Model BEL0220BS4EMA, 2.5A, 208V, 1PH (Fan); 22.8A, 208V, 1PH (Defrost Heater)
   -- System to operate at -10º F.
   -- Furnished complete with solid state temperature sensors, electric expansion valve, transformer, coil compressor contactor, low-pressure time-delay switch and pressure transducer ready for final connection including low voltage wiring to compressor by Refrigeration Contractor.

8. Factory installed main-fused disconnect switch.

9. Furnish one (1) IntelliGen/Beacon II Smart Controller mounted to front face of Item #2: Walk-In Cooler/Freezer @ 66" A.F.F. centered between entrance doors. Controller shall be capable of monitoring characteristics of both cooler and freezer systems. Smart Controller low voltage wiring and final connection by Refrigeration Contractor.

10. Factory certified installers to provide complete refrigeration system warrantee: five (5) years for the compressor, two (2) years for the condensing unit, and two (2) years for all parts of the evaporator coil.

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ITEM #5: DUNNAGE RACK, MOBILE

QUANTITY: Two (2)
MANUFACTURER: InterMetro Industries Corporation
MODEL NO.: MetroMax i (N058)
PERTINENT DATA: Open-Grid Mat, Polymer
UTILITIES REQ'D: ----
ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Instructions and the following:

Cooler:

1. One (1) #MHP2448G shelf unit; 24"W x 48"L.
2. One (1) #M3TF2448E three-sided frame.
3. Four (4) #MX9UP polymer posts for stem casters, 9-3/16" high.
4. Two (2) #5MPX polyurethane swivel casters with bumpers.
5. Two (2) #5MPBX polyurethane swivel casters with brakes and bumpers.

ITEM #5: (Continued)

Freezer:

1. One (1) #MHP2448G shelf unit; 24"W x 48"L.
2. One (1) #M3TF2448E three-sided frame.
3. Four (4) #MX9UP polymer posts for stem casters, 9-3/16" high.
4. Two (2) #5MPX polyurethane swivel casters with bumpers.
5. Two (2) #5MPBX polyurethane swivel casters with brakes and bumpers.

ITEM #6: SHELVING, MOBILE

QUANTITY: Ten (10)
MANUFACTURER: InterMetro Industries Corporation
MODEL NO.: MetroMax i® (N058)
PERTINENT DATA: Open-Grid Shelf Mat, Polymer
UTILITIES REQ'D: ----
ALTERNATE MFRS.: None

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Furnish and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Instructions and the following:

Cooler:

1. One (1) #MX2436G section; 24" W x 36" L x 4-tier high.
2. Three (3) #MX2448G sections; 24" W x 48" L x 4-tier high.
3. Sixteen (16) #MX63UP polymer posts for stem casters, 61-3/16" high.
4. Eight (8) #5MPX polyurethane swivel casters with bumpers.
5. Eight (8) #5MPBX polyurethane swivel casters with brakes and bumpers.
6. Plastic wedge lock connectors, quantity as required.
7. Locate bottom shelf @ 10" A.F.F., space remaining shelves equally.

Freezer:

1. Six (6) #MX2448G sections; 24" W x 48" L x 4-tier high.
2. Twenty-four (24) #MX63UP polymer posts for stem casters, 61-3/16" high.
3. Twelve (12) #5MPX polyurethane swivel casters with bumpers.

ITEM #6: (Continued)

4. Twelve (12) #5MPBX polyurethane swivel casters with brakes and bumpers.
5. Plastic wedge lock connectors, quantity as required.
6. Locate bottom shelf @ 10" A.F.F., space remaining shelves equally.

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ITEM #8: PAN RACK CART, MOBILE

QUANTITY:	Six (6)
MANUFACTURER:	New Age Industrial Corp., Inc.
MODEL NO.:	1331-PBE (N058)
PERTINENT DATA:	Fixed Angles, (20) 18"x26" Pan Capacity, All-Welded Aluminum Construction
UTILITIES REQ'D:	----
ALTERNATE MFRS.:	None

Furnish and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Instructions and the following:

1. #PB full-perimeter wrap-around non-marking vinyl bumper.

2. Solid base panel.

ITEM #9: DUNNAGE RACK, MOBILE

QUANTITY: One (1)
MANUFACTURER: InterMetro Industries Corporation
MODEL NO.: MetroMax i (N058)
PERTINENT DATA: Open-Grid Mat, Polymer
UTILITIES REQ'D: ----
ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Instructions and the following:

Dry Storage:

1. One (1) #MHP2448G shelf unit; 24"W x 48"L.

2. One (1) #M3TF2448E three-sided frame.

3. Four (4) #MX9UP polymer posts for stem casters, 9-3/16" high.

4. Two (2) #5MPX polyurethane swivel casters with bumpers.

5. Two (2) #5MPBX polyurethane swivel casters with brakes and bumpers.

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ITEM #10: SHELVING

QUANTITY: Three (3)
MANUFACTURER: InterMetro Industries Corporation
MODEL NO.: MetroMaxQ (N058)
PERTINENT DATA: Five-Tier High, Free-Standing, Polymer
UTILITIES REQ'D: ----
ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Instructions and the following:

Dry Storage:

1. Three (3) #MQ2448G sections; 24" W x 48" L x 5-tier high.

2. Twelve (12) #MQ74PE polymer posts; 74-3/16" high.

3. Plastic wedge lock connectors, quantity as required.

4. Locate bottom shelf @ 12" A.F.F., space remaining shelves equally.

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ITEM #12: WORKTABLE

QUANTITY:	One (1)
MANUFACTURER:	Custom Fabricated
MODEL NO.:	#14 GA Stainless Steel
PERTINENT DATA:	10'-0" Long x 2'-6" Wide x 3'-0" High
UTILITIES REQ'D:	----
ALTERNATE MFRS.:	None

Fabricate and set-in-place per Equipment Plan, Sheet K-101; Fabrication Detail, Sheet K-501; and the following:

1. Front and end edge rolls per Detail 1.02.1M.

2. 6" high back splash per Detail 1.04A.

3. Framework per Detail 1.05.

4. Legs per Detail 1.07.

5. Stainless steel undershelf per Detail 1.11.

6. Two (2) stainless steel drawer assemblies per Detail 1.14, Type I with locks.

7. Worktable per Detail 2.01.

8. Sound-deaden underside of tabletop with NSF-approved sound dampening material.

9. Accessories:
   -- One (1) duplex receptacle with stainless steel faceplate mounted on each end, pre-wired to common junction box below undershelf per Detail, Sheet K-104. Conceal wiring within tubular leg.

-- One (1) Hamilton Beach #GCO500 manual can opener mounted on right-end as shown on Equipment Plan, Sheet K-101.

ITEM #13: SPARE NUMBER

ITEM #15: HAND SINK

QUANTITY: Six (6)
MANUFACTURER: Eagle Foodservice Equipment Company
MODEL NO.: HSA-10-FA-1P (N058)
PERTINENT DATA: Pedestal Mount, With Mixing Valve
UTILITIES REQ'D: 1/2" HW, 1/2" CW, 1-1/2" W
ALTERNATE MFRS.: Advance/Tabco; John Boos

Furnish and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Instructions and the following:

1. Gooseneck faucet, stopper, pedestal, P-trap, tailpiece and pedal valve.

2. All plumbing lines and components chrome-plated or stainless steel.

3. Accessories: (each unit)
   -- Left and right integral splash shields.
   -- #326015 temperature adjustment valves.
   -- #379294 0.5 GPM low-flow aerator.

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ITEM #16: SOAP & TOWEL DISPENSER - (N.I.K.E.C - REFER TO ARCHT'L. DRAWING)

QUANTITY: Six (6)

ITEM #17: ELECTRIC WEIGHING SCALE

QUANTITY: One (1)
MANUFACTURER: Edlund Company, Inc.
MODEL NO.: EDL-10 OP (N058)
PERTINENT DATA: Countertop, Stainless Steel Construction, With Rechargeable Battery Pack
UTILITIES REQ'D: ----
ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101 and Manufacturer's Instructions.

ITEM #18: ELECTRIC CAN OPENER

QUANTITY: Two (2)
MANUFACTURER: Edlund Company, Inc.
MODEL NO.: 270 (N058)
PERTINENT DATA: Countertop, Dual-Speed
UTILITIES REQ'D: 1.5A, 120V, 1PH
ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Instructions and the following:

1. Cord and plug set.

ITEM #19: BLENDER

QUANTITY: One (1)
MANUFACTURER: Vitamix
MODEL NO.: 036019 (N058)
PERTINENT DATA: Countertop, With 48-Ounce Clear Container, Blade Assembly, Lid and Twist Lock Cover
UTILITIES REQ'D: 15.0A, 120V, 1PH
ALTERNATE MFR.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Instructions and the following:

1. Cord and plug set.

ITEM #19.1: BLENDER

QUANTITY: Two (2)
MANUFACTURER: Vitamix
MODEL NO.: 5201 (N058)
PERTINENT DATA: Countertop, With 1.5-Gallon and 64-Ounce Clear Containers, Blade Assembly and Lid
UTILITIES REQ'D: 15.0A, 120V, 1PH
ALTERNATE MFR.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Instructions and the following:

1. Cord and plug set.

ITEM #20: WORKTABLE

QUANTITY: One (1)
MANUFACTURER: Custom Fabricated
MODEL NO.: #14 GA Stainless Steel

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PERTINENT DATA: 8'-0" Long x 2'-6" Wide x 3'-0" High
UTILITIES REQ'D: ----
ALTERNATE MFRS.: None

Fabricate and set-in-place per Equipment Plan, Sheet K-101; Fabrication Detail, Sheet K-501; and the following:

1. Front and end edge rolls per Detail 1.02.1M.

2. 6" high back and partial left end splash per Detail 1.04A.

3. Framework per Detail 1.05.

4. Legs per Detail 1.07.

ITEM #20: (Continued)

5. Stainless steel undershelf per Detail 1.11.

6. Two (2) stainless steel drawer assemblies per Detail 1.14, Type I with locks.

7. Worktable per Detail 2.01.

8. Sound-deaden underside of tabletop with NSF-approved sound dampening material.

ITEM #21: PREP SINK

QUANTITY: One (1)
MANUFACTURER: Custom Fabricated
MODEL NO.: #14 GA Stainless Steel
PERTINENT DATA: 9'-0" Long x 2'-6" Wide x 2'-10" High
UTILITIES REQ'D: 1/2" HW, 1/2" CW, (2)1-1/2" IW
ALTERNATE MFRS.: None

Fabricate and set-in-place per Equipment Plan, Sheet K-101; Fabrication Detail, Sheet K-501; and the following:

1. Front and end edge rolls per Detail 1.02B.

2. 13" high backsplash per Detail 1.04A.

3. Framework per Detail 1.05.

4. Legs per Detail 1.07.

5. Stainless steel undershelf on both ends per Detail 1.11.

6. Full-length stainless steel overshelf per Detail 1.12.

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7. Sound deaden underside of sinks and drainboards with NSF-approved sound dampening material.

8. Accessories:
   -- One (1) T&S #B-0133-ADF-12-BJ backsplash mounted pre-rinse spray faucet with swing spout add-on faucet with 12" nozzle, 6" wall bracket and #B-199-1 non-splash aerator.
   -- Two (2) T&S #B-3950-01 twist handle drains with rear-connected over-flows, handle bracket and basket strainer.
   -- One (1) 20"x20" one-piece removable #22 gauge perforated stainless steel scrap basket.

9. Item will remain shrink-wrapped until ready for final connection by Plumbing Contractor. Immediately following completion of final connections, K.E.C. shall re-shrink-wrap tubs or provide removable panel to avoid use by construction trades.

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ITEM #22: ICE MACHINE/BIN

QUANTITY:	One (1)
MANUFACTURER:	Manitowoc
MODEL NO.:	IYT0500A/D570 (N058)
PERTINENT DATA:	Air-Cooled, 520-LB. Maker, 532-LB. Bin, Half Dice Cube, LEED Compliant
UTILITIES REQ'D:	11.5A, 120V, 1PH; 0.38A, 120V, 1PH (Ice & Water Sanitizing System); 3/8" CW, 1/2" IW (Maker Drain), 3/4" IW (Bin Drain)
ALTERNATE MFRS.:	Scotsman; Hoshizaki

Furnish and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Instructions and the following:

1. Stainless steel exterior finish, ice machine and bin.

2. Accessories:
   -- One (1) Everpure #EV9324-21 InsurIce i2000² Single water filter system with primary and coarse filter mounted on manufacturer's common wall bracket.
   -- One (1) Everpure #CD385 ozone delivery ice and water sanitizing system. K.E.C. to install.
   -- 6" high stainless steel leg set with adjustable bullet feet.
   -- One (1) #K00463 ice scoop with #K00461 external scoop holder mounted to left side of bin.

3. Backflow preventor installed on incoming water line by Plumbing Contractor.

ITEM #23: CONVECTION OVEN, MOBILE

QUANTITY:	Three (3)
MANUFACTURER:	Vulcan
MODEL NO.:	VC44ED (N058)
PERTINENT DATA:	Double Deck, Standard Depth, Solid State Controls, With Removable Doors

UTILITIES REQ'D: (2)12.5KW, 480V, 3PH
ALTERNATE MFRS: None

Furnish and set-in-place per Equipment Plan, Sheet K101, Manufacturer's Instructions and the following:

1. Accessories: (for each unit)
   -- 480-volt, three-phase operation.
   -- Five (5) additional stainless steel wire racks.
   -- Cord set.
   -- Stainless steel rear enclosure.
   -- 5" diameter heavy-duty swivel casters, front two (2) with brakes.

ITEM #24: CONVECTION STEAMER

QUANTITY: Two (2)
MANUFACTURER: Cleveland
MODEL NO.: (2) 22CET66.1 (N058)
PERTINENT DATA: (2) Double Stacked, Stand-Mounted 6-Pan, Connected Boilerless
UTILITIES REQ'D: (2) 14.4A, 480V, 3PH; (2) 3/4" CW, (2) 3/4" IW
ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet K101, Manufacturer's Instructions and the following:

1. Accessories: (each unit)
   -- Two (2) Everpure #EV9797-22 KleenSteam II Twin System Water Filters mounted to wall behind the convection steamer.
   -- Two (2) Cool Drain Flow #DTV15 drain tempering kits. Plumber to install.
   -- Two (2) Dormont #W75B2Q 3/4" diameter x 24" long flexible water connectors with quick disconnect, shut off valve and restraining cable.

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ITEM #25: VENTILATOR

QUANTITY: One (1)
MANUFACTURER: Streivor Air Systems
MODEL NO.: SAWCBD 725724 (N058)
PERTINENT DATA: Wall Mounted, ExtractAire FLSS Baffle Filters, With Fire Protection System and SmartAire Segmented Air Stream Technology
UTILITIES REQ'D: 1,080 CFM Exhaust/864 CFM Supply; 350W, 120V, 1PH (Lights); 20.0A (Cir), 120V, 1PH, 24-Hour Dedicated Service (Fire Protection System)
ALTERNATE MFRS.: None

Furnish and install per Equipment Plan, Sheet K-101; Ventilator Detail Drawing, Sheet K-502; Manufacturer's Instructions and the following:

1. 4'-9" Wide x 6'-0" Long x 2'-6" High, with bottom edge mounted at 6'-8" A.F.F. Entire unit constructed of 18 GA - 304 stainless steel #4 mill finish with liquid tight all welded external continuous seams and joints per N.F.P.A. 96, U.L. and State of Maryland Codes.

2. Two (2) U.L. Listed, NSF-Approved, surface-mounted natural LED light fixtures, equally spaced.

3. Matching stainless steel perimeter closure panels to finished ceiling by K.E.C. Verify ceiling height.

4. Surface fire protection system nozzles and piping to be installed at manufacturer's factory at time of fabrication. All exposed pipe and fittings shall be chrome-plate or stainless steel.

5. Hanger rods and support system from structure above by General Contractor. K.E.C. to coordinate method and location with other trades.

6. Stainless steel hanger brackets.

7. 3” integral stand-off at rear for semi-combustible compliance.

8. U.L. Classified stainless steel baffle filters.

9. Internal hood fan, 90CFM.

10. Semi-concealed stainless steel grease trough sloped to removable grease cups.

11. Factory supervision of installation and start-up.

12. Accessories:
    -- 12" wide utility cabinet mounted on right end with factory pre-piped PyroChem fire suppression system and DemandAire Control Panel.
    -- Six-month and twelve-month inspections, servicing, and replacement of components of fire protection system as per NFPA-96 Latest Edition.
    -- One (1) PyroChem K Class wall mounted 6 liter wet chemical fire extinguisher.
    -- Field wrapper.

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ITEM #25: (Continued)

-- End panels.
-- #18 gauge stainless steel wall flashing full length of hood to extend from top of finish floor coved base up to bottom edge of hood body. Attach to wall with non-exposed fasteners and seal with clear silicone sealant.

ITEM #27: WORKTABLE WITH SINK

QUANTITY: One (1)
MANUFACTURER: Custom Fabricated

MODEL NO.: #14 GA Stainless Steel
PERTINENT DATA: 7'-4" Long x 2'-6" Wide x 3'-0" High
UTILITIES REQ'D: 1/2" HW, 1/2" CW, 1-1/2" IW
ALTERNATE MFRS.: None

Fabricate and set-in-place per Equipment Plan, Sheet K-101; Fabrication Detail, Sheet K-501; Manufacturer's Shop Drawing and the following:

1. Perimeter edge rolls per Detail 1.02.1M.

2. Framework per Detail 1.05.

3. Legs per Detail 1.07, with flanged feet on each corner leg.

4. Crossbracing per Detail 1.10.

5. Stainless steel undershelf per Detail 1.11.

ITEM #27: (Continued)

6. One (1) stainless steel drawer assembly per Detail 1.14, Type I, with lock.

7. Worktable per Detail 2.01.

8. 12" x 16 " x 8" deep utility sink per Detail 3.04 with stainless steel waste lever angle bracket fully welded to underside of sink and stainless steel apron to conceal plumbing piping.

9. Sound-deaden underside of tabletop and sink with NSF-approved sound dampening material.

10. Accessories:
    -- One (1) T&S #B-325 deck-mounted swing-spout gooseneck faucet with #B-199-2 aerator.
    -- One (1) duplex receptacle with stainless steel faceplate mounted on each end, pre-wired to common junction box below undershelf per Detail, Sheet K-104. Conceal wiring within tubular leg.

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ITEM #28: WORKCOUNTER

QUANTITY: Two (2)
MANUFACTURER: Custom Fabricated
MODEL NO.: #14 GA Stainless Steel
PERTINENT DATA: 7'-0" Long x 2'-5" Wide x 3'-0" High
UTILITIES REQ'D: ----
ALTERNATE MFRS.: None

Fabricate and set-in-place per Equipment Plan, Sheet K-101; Fabrication Detail, Sheet K-501; and the following:

1. Perimeter edge rolls per Detail 1.02.1M.

2. Framework per Detail 1.06.

3. Legs per Detail 1.08. Flanged feet on each corner leg.

5. One (1) three-tier high stainless steel drawer assembly per Detail 1.14, Type I, with locks.

4. Workcounter per Detail 4.01.

5. Stainless steel sliding doors per Detail 4.28, with locks.

6. Sound-deaden underside of countertop with NSF-approved sound dampening material.

7. Accessories:
   -- One (1) duplex receptacle with stainless steel faceplate mounted as shown on Electrical Rough-In Plan, Sheet K-104.

ITEM #29: PASS-THRU HEATED CABINET, MOBILE

QUANTITY: Four (4)
MANUFACTURER: Traulsen & Company, Inc.
MODEL NO.: RHF 232WP-HHS/FHG (N058)
PERTINENT DATA: Two-Section, Self-Contained, Stainless Steel Interior/Exterior
UTILITIES REQ'D: 15.5A, 120/208V, 1PH
ALTERNATE MFRS.: True; Continental; Victory; Delfield

Furnish and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Instructions and the following:

1. Half-height solid doors on serving side, full-height glass doors on kitchen side, hinged per Equipment Plan.

2. Cylinder door locks, keyed-alike.

3. #16 gauge stainless steel, universal angle type, bottom support tray slides in lieu of wire shelves installed on 5" centers, five (5) pair per compartment, twenty (20) total, each unit.

4. Exterior mounted digital thermometer installed on kitchen side.

5. Set of four (4), 5" diameter heavy-duty swivel-type locking casters, all (4) with brakes.

6. Plastic laminate finish with stainless steel edge trim factory applied to exterior door fronts on serving side only; color as selected by MCPS Foodservices.

7. Cord and plug set with matching receptacle furnished and installed by Electrical Contractor.

ITEM #30: PASS-THRU REFRIGERATOR, MOBILE

QUANTITY: Four (4)
MANUFACTURER: Traulsen & Company, Inc.

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MODEL NO.: RHT 232NPUT-HHS/FHG (N058)
PERTINENT DATA: Two-Section, Self-Contained, Stainless Steel Interior/Exterior, Narrow Series
UTILITIES REQ'D: 8.6A, 120V, 1PH
ALTERNATE MFRS.: True; Continental; Victory; Delfield

Furnish and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Instructions and the following:

1. Half-height solid doors on serving side, full-height glass doors on kitchen side, hinged per Equipment Plan.

2. Cylinder door locks, keyed-alike.

3. No. 1 - #16 gauge stainless steel, angle type, bottom support tray slides in lieu of wire shelves installed on 3" centers, nine (9) pair per compartment, thirty-six (36) total, each unit.

ITEM #30: (Continued)

4. Exterior mounted digital thermometer installed on kitchen side.

5. Set of four (4), 5" diameter heavy-duty swivel-type locking casters, all (4) with brakes.

6. Plastic laminate finish with stainless steel edge trim factory applied to exterior door fronts on serving side only; color as selected by MCPS Foodservices.

7. Cord and plug set.

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ITEM #31: SERVING COUNTER

QUANTITY: Four (4)
MANUFACTURER: SelectLine by Low-Temp Industries
MODEL NO.: Stainless Steel Construction, Quartz Extended Top, Laminated Front & Exposed Side
PERTINENT DATA: L-Shaped: 13'-10" x 10'-2 Long x 3'-4" Wide x 2'-10" High
UTILITIES REQ'D: ½"HW, ¾"IW
ALTERNATE MFR.: EcoMark by The Delfield Co.; Duke Manufacturing

Fabricate and set-in-place per Equipment Plan, Sheet K-101; Manufacturer's Shop Drawing and the following:

1. Base cabinet constructed of stainless steel all-welded angle frame per Detail 4.02.

2. Stainless steel front and end paneling per Detail 4.05A. Front panels with vinyl wrap and school logo; color as selected by Architect, K.E.C. to verify.

3. Heavy-duty counter legs per Detail 1.08. Stainless steel skirting on front and exposed end.

4. Provide cut-out in top for Item #32: Cold Food Well, Item #33: Hot Food Well and Item #35: Cold Well/Frost Top.

5. 8" plate shelf on server's side set 10" below countertop with closed ends.

6. 10" wide x 72" long x ½" thick Richlite™ removable and reversible cutting board.

7. Louvered hinged doors per Detail 4.27, with locks.

8. Raised panels and washdown lighting.

9. Electrical outlets in cabinet with wiring.

ITEM #32: (Continued)

ITEM #32: COLD FOOD WELLS

QUANTITY: Two (2)
MANUFACTURER: Low Temp Industries
MODEL NO.: DI-TA454-20-05-T-SP3 (N058)
PERTINENT DATA: Five-Well, Drop-In, Sloped, Self-Contained
UTILITIES REQ'D: 5.2A, 120V, 1PH;
ALTERNATE MFR.: The Delfield Company; Duke Manufacturing

Furnish and install in Serving Counter per Equipment Plan, Sheet K-101; Manufacturer's Shop Drawing and the following:

1. Ship control panel loose for mounting into counter facia by Fabricator.

2. Accessories: (each unit)
   -- Stainless steel adapter bars for half-size pans.
   -- Ten (10) Vollrath #90242 half-size pans.

ITEM #33: HOT FOOD WELLS

QUANTITY: Two (2)
MANUFACTURER: Low Temp Industries
MODEL NO.: DI-TW-D-20-05-T (N058)
PERTINENT DATA: Five-Well, Drop-In, Dry Heat Only
UTILITIES REQ'D: 28.8A, 120/208V, 1PH;
ALTERNATE MFR.: The Delfield CompanyDuke Manufacturing

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Furnish and install in Serving Counter per Equipment Plan, Sheet K-101; Manufacturer's Shop Drawing and the following:

1. Ship control panel loose for mounting into counter facia by Fabricator.

2. Accessories: (each unit)

ITEM #33: HOT FOOD WELLS

QUANTITY: Two (2)
MANUFACTURER: Low Temp Industries
MODEL NO.: DI-TW-D-20-05-T (N058)
PERTINENT DATA: Five-Well, Drop-In, Dry Heat Only
UTILITIES REQ'D: 28.8A, 120/208V, 1PH;
ALTERNATE MFR.: The Delfield CompanyDuke Manufacturing

Furnish and install in Serving Counter per Equipment Plan, Sheet K-101; Manufacturer's Shop Drawing and the following:

1. Ship control panel loose for mounting into counter facia by Fabricator.

2. Accessories: (each unit)
   -- Five (5) Vollrath Company #30040, 12x20x 4" deep stainless steel pans.
   -- Five (5) Vollrath Company #77200 full size solid dome covers.

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ITEM #34: HEATED SANDWICH MERCHANDISER

QUANTITY: Four (4)
MANUFACTURER: Hatco Corporation
MODEL NO.: GR2SDS-42D (N058)
PERTINENT DATA: Single Service, Countertop, Dual Slant Shelf
UTILITIES REQ'D: 12.4A, 120/208V, 1PH
ALTERNATE MFR.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101; Manufacturer's Instructions and the following:

1. Accessories:
   -- Flip-up doors on customer’s side, each shelf.
   -- Designer color inset panels, color as selected by Architect, K.E.C. to verify.
   -- #DS-ITC indicating temperature control.

ITEM #35: COLD WELL/FROST TOP

QUANTITY: Four (4)
MANUFACTURER: Low Temp Industries
MODEL NO.: DI-2050TA-SP3-MOD (N058)
PERTINENT DATA: (4)-Pan Capacity, Drop-In, Self-Contained, Sloped
UTILITIES REQ'D: 7.0A, 120V, 1PH; 1" IW
ALTERNATE MFR.: The Delfield Company; Duke Manufacturing

Furnish and install in Serving Counter per Equipment Plan, Sheet K-101; Manufacturer's Shop Drawing and the following:

1. Accessories: (each unit)
   -- Stainless steel adapter bars for half-size pans.
   -- Eight (8) Vollrath #90242 half-size pans.
   -- Slope option.
   -- #2051-CFT frost top built-into custom food protector.

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ITEM #36: REFRIGERATED DISPLAY MERCHANDISER

QUANTITY: Two (2)
MANUFACTURER: Structural Concepts
MODEL NO.: B7132 (N058)
PERTINENT DATA: Self-Contained, Open Front, Rear-Loading
UTILITIES REQ'D: 15.32A, 208V, 1PH
ALTERNATE MFRS.: Oscartek

Furnish and set-in-place per Equipment Plan, Sheet K-101; Manufacturer's Instructions, and the following:

1. Accessories:
   -- Shelf lights.
   -- Roll-down security cover, locking.
   -- 5-year compressor warranty.
   -- Rear hinged doors with locks.
   -- Plastic laminate finish factory applied to exterior panels; color as selected by Architect; K.E.C. to verify.

2. Cord and plug with matching receptacle furnished and installed by Electrical Contractor.

ITEM #37: CASH REGISTER - (N.I.C – FURNISHED BY OWNER)

QUANTITY: Four (4)

ITEM #38: CASHIER STAND, MOBILE

QUANTITY: Two (2)
MANUFACTURER: SelectLine by Low-Temp Industries
MODEL NO.: Stainless Steel Construction, Quartz Extended Top, Laminated Front & Exposed Side
PERTINENT DATA: 5'-6" Long x 4'-2" Wide x 2'-10" High
UTILITIES REQ'D: ----
ALTERNATE MFR.: EcoMark by The Delfield Co.; Duke Manufacturing

Fabricate and set-in-place per Equipment Plan, Sheet K-101; Manufacturer's Shop Drawing and the following:

1. Base cabinet constructed of stainless steel all-welded angle frame per Detail 4.02.

2. 5" diameter heavy-duty polyurethane swivel casters, two (2) with brakes. Stainless steel skirting on front and exposed end.

3. Stainless steel front and end paneling per Detail 4.05A. Front panels with vinyl wrap and school logo; color as selected by Architect, K.E.C. to verify.

4. Provide cut-out in top with grommet for power cord access to receptacle in floor.

5. Two (2) cashier's drawer assemblies with stainless steel pull and cylinder lock sized for removable compartmented plastic cash tray and lock; Indiana Cash Drawer Co., Model #5-BT.

6.. Raised panels and washdown lighting.

7. Stainless steel hinged doors with cylinder locks and laminate finish per Detail 4.26.

8. Electrical outlets in cabinets with wiring.

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ITEM #39: SNACK RACK - (N.I.C – FURNISHED BY OWNER)

QUANTITY: Four (4)

ITEM #40: DIGITAL DISPLAY - (N.I.C – FURNISHED BY OWNER)

QUANTITY: Three (3)

ITEM #41: SPARE NUMBER

ITEM #43: TRASH CONTAINER, MOBILE

QUANTITY: Eight (8)
MANUFACTURER: Rubbermaid Commercial Products, Inc.
MODEL NO.: FG2632 (N058)
PERTINENT DATA: 32-Gallon Capacity
UTILITIES REQ'D: ----
ALTERNATE MFRS.: Continental Plastics

Furnish and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Instructions and the following:

1. Grey in color.

2. Accessories:
   -- Two (2) #FG2631 matching flat lids.
   -- Two (2) #FG2640 conversion dollies.

ITEM #44: POT & PAN SHELVING, MOBILE

QUANTITY: Two (2)
MANUFACTURER: InterMetro Industries Corporation
MODEL NO.: MetroMax i (N058)
PERTINENT DATA: Four-Tier High, Open Grid Shelf Mat, Polymer
UTILITIES REQ'D: ----
ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Instructions and the following:

1. Two (2) #MX2448G sections; 24" W x 48" L x 4-tier high.

2. Eight (8) #MX63UP polymer posts for stem casters, 61-3/16" high.

3. Four (4) #5MPX polyurethane swivel casters with bumpers.

4. Four (4) #5MPBX polyurethane swivel casters with brakes and bumpers.

5. Plastic wedge lock connectors, quantity as required.

6. Locate bottom shelf @ 10" A.F.F., space remaining shelves equally.

7. Accessories (each unit):
   -- Three (3) #XTR2448XE tray drying racks.
   -- One (1) #XDRIP adjustable drip tray assembly.

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ITEM #45: AUTOMATED RETAIL MERCHANDISER - COLD - (N.I.C – FURNISHED BY OWNER)

QUANTITY: Four (4)

ITEM #46: AUTOMATED RETAIL MERCHANDISER - HOT - (N.I.C – FURNISHED BY OWNER)

QUANTITY: Four (4)

ITEM #47A: NAPKIN & FLATWARE DISPENSER, MOBILE

QUANTITY: Six (6)
MANUFACTURER: Steril-Sil
MODEL NO.: E1-ENC48-4V
PERTINENT DATA: 48" Enclosed Base With Locking Door and 8" Ledge, Stainless Steel Construction
UTILITIES REQ'D: ----
ALTERNATE MFRS: None

Fabricate and set-in-place per Equipment Plan, Sheet K-101; Manufacturer's Shop Drawing and the following:

1. Accessories:
   -- One (1) #E1-BS6OE-RP-BLACK drop-in basket with six (6) #RP-25-BLACK plastic silverware cylinders.
   -- Two (2) napkin dispensers.
   -- Laminate exterior finish; color as selected by Architect, K.E.C. to verify.

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ITEM #47B: RECYCLING COUNTER, MOBILE

QUANTITY: Eight (8)
MANUFACTURER: Steril-Sil
MODEL NO.: MTC66-2-DMP (N058)
PERTINENT DATA: Stainless Steel Construction, 66" Long x 33¾" Wide x 40" High, With Casters, (2) 40-Gallon Trash Can & 7-Gallon Liquid Storage Tank
UTILITIES REQ'D: ----
ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Instructions and the following:

ITEM #47B: (Continued)

1. Accessories:
   -- Laminate exterior finish; color as selected by Architect, K.E.C. to verify.
   -- Back splash label.

ITEM #48: SPARE NUMBER

ITEM #49: SPARE NUMBER

ITEM #50: FOOD PROTECTOR

QUANTITY: Four (4)
MANUFACTURER: BSI, LLC
MODEL NO.: DECO-950 (N058)
PERTINENT DATA: Single-Tier, Adjustable Hinged Panels, NSF 2 Compliant
UTILITIES REQ'D: 160W, 120V, 1PH
ALTERNATE MFR.: Premier Metal and Glass; FlexiShield by The Delfield Co.

Furnish and install on Serving Counter per Equipment Plan, Sheet K-101; Manufacturer's Shop Drawing and the following:

1. 1" diameter round tubing uprights with brushed stainless steel finish. K.E.C. to verify with Architect.

2. Overall length as shown on plan.

3. Accessories:
   -- Full-length LED light fixture. Conceal wiring in uprights and extend to remote switch mounted in counter facia.
   -- 1/2" tempered glass top.
   -- 1/4" tempered glass end panels.

4. Mount securely to top of Item #32: Serving Counter with undercounter flange mount.

5. Furnish fully detailed shop drawings for review and approval by local health code agency.

ITEM #51: MOP SINK & RACK -- (N.I.K.E.C. - SPECIFIED BY MECHANICAL DIVISION)

QUANTITY: One (1)

ITEM #52: SHELVING, MOBILE

QUANTITY: One (1)
MANUFACTURER: InterMetro Industries Corporation
MODEL NO.: MetroMaxQ (N058)

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PERTINENT DATA: Five-Tier High, Free-Standing, Polymer
UTILITIES REQ'D: ----
ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Instructions and the following:

B.S.C:

1. One (1) #MQ2448G section; 24" W x 48" L x 5-tier high.

2. Four (4) #MQ74UPE polymer posts for stem casters; 74-3/16" high.

3. Two (2) #5MPX polyurethane swivel casters with bumpers.

4. Two (2) #5MPBX polyurethane swivel casters with brakes and bumpers.

5. Plastic wedge lock connectors, quantity as required.

6. Locate bottom shelf @ 10" A.F.F., space remaining shelves equally.

ITEM #53: WORKTABLE

QUANTITY: One (1)
MANUFACTURER: Custom Fabricated
MODEL NO.: #14 GA Stainless Steel
PERTINENT DATA: 11'-6" Long x 2'-0" Wide x 3'-0" High
UTILITIES REQ'D: ----
ALTERNATE MFRS.: None

Fabricate and set-in-place per Equipment Plan, Sheet K-101; Fabrication Detail, Sheet K-501; and the following:

1. Front and end edge rolls per Detail 1.02.1M.

2. 6" high back splash per Detail 1.04A.

3. Framework per Detail 1.05.

4. Legs per Detail 1.07.

5. Stainless steel undershelf per Detail 1.11.

6. Two (2) stainless steel drawer assemblies per Detail 1.14, Type I with locks.

ITEM #53: (Continued)

7. Worktable per Detail 2.01.

8. Sound-deaden underside of tabletop with NSF-approved sound dampening material.

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ITEM #54: ICE CREAM CABINET, MOBILE - (N.I.C – FURNISHED BY OWNER)

QUANTITY: Two (2)

ITEM #55: CORNER GUARD

QUANTITY: Thirty-Three (33)
MANUFACTURER: Custom Fabricated
MODEL NO.: Stainless Steel
PERTINENT DATA: Wall Mounted, 48" Long
UTILITIES REQ'D: None
ALTERNATE MFRS.: Eagle Group; Advance/Tabco

Fabricate and set-in-place per Equipment Plan, Sheet K-101, Manufacturer's Shop Drawing and the following:

1. Constructed per Detail 1.03.

2. Mount on wall directly above finished floor coved base with concealed fasteners and clear silicone sealant.

ITEM #56: WORKTABLE

QUANTITY: One (1)
MANUFACTURER: Custom Fabricated
MODEL NO.: #14 GA Stainless Steel
PERTINENT DATA: 11'-6" Long x 2'-0" Wide x 3'-0" High
UTILITIES REQ'D: ----
ALTERNATE MFRS.: None

Fabricate and set-in-place per Equipment Plan, Sheet K-101; Fabrication Detail, Sheet K-501; and the following:

1. Front and right end edge rolls per Detail 1.02.1M.

2. 6" high back and left end splash per Detail 1.04A.

3. Framework per Detail 1.05.

4. Legs per Detail 1.07.

ITEM #56: (Continued)

5. Stainless steel undershelf per Detail 1.11.

6. Two (2) stainless steel drawer assemblies per Detail 1.14, Type I with locks.

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7. Worktable per Detail 2.01.

8. Sound-deaden underside of tabletop with NSF-approved sound dampening material.

(END OF FOODSERVICE ITEMIZED SPECIFICATIONS)

END OF SECTION 114000

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SECTION 115213
PROJECTION SCREENS

PART 1 GENERAL

1.01 SUBMITTALS

A. Product Data: Manufacturer's catalog cuts and descriptive information on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

B. Shop Drawings: Indicate project-specific dimensions, verified field measurements, mounting details, and interface with adjacent construction.
   1. Include wiring diagrams for motor operators and actuators, wiring connections, and controls and switches.
   2. Provide details, including viewing surface sizes, masking borders, trim accessories, screen seam locations, and extra drop length.

C. Operation and Maintenance Data: Provide manufacturer's operation and maintenance instructions.

1.02 DELIVERY, STORAGE, AND HANDLING

A. Deliver projection screens to project site in manufacturer's original unopened packaging, and inspect for damage and proper size before accepting delivery.

B. Store in a protected, clean, dry area with temperature maintained above **<< 50 degrees F; or __ degrees F>>**, and stack in accordance with manufacturer's recommendations.

C. Acclimate screens to building temperatures for **<< 24; or __>>** hours prior to installation**<< , in accordance with manufacturer's recommendations; , _____; or None - N/A>>**.

PART 2 PRODUCTS

2.01 FRONT PROJECTION SCREENS

A. Manufacturers:
   1. Bretford
   2. Bloch Enterprises, Inc. (BEI)
   3. Da-Lite Screen Company
   4. Draper, Inc
   5. Stewart Filmscreen Corporation

B. Front Projection Screens: Factory assembled unless otherwise indicated.
   1. Located in **<< All Purpose Room; or _____>>**: **<< Motorized; Manual; Fixed; or _____>><< , matte light diffusing fabric; , light refracting glass beaded; , reflective fabric; or , _____>>** screen**<< , wall mounted; , ceiling mounted; , ceiling recessed; or , _____>>**.
      a. Screen Dimensions: Manufacturer's standard, approximately 81 inches high by 144 inches wide (16:9 aspect ratio), with extra black drop at top of screen. ******MCPS standards indicate preferred width of 12 feet and aspect ratio of 16:9******

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2. Located in **<< Auditorium; Cafeteria; and _____>>**: **<< Motorized; Manual; Fixed; or _____>><< , matte light diffusing fabric; , light refracting glass beaded; , reflective fabric; or , _____>>** screen**<< , wall mounted; , ceiling mounted; , ceiling recessed; or , _____>>**.
   a. Screen Dimensions: Manufacturer's standard, approximately 81 inches high by 144 inches wide(16:9 aspect ratio), with extra black drop at top of screen. ******MCPS standards indicate preferred width of 12 feet and aspect ratio of 16:9******

C. Matte Light Diffusing Fabric: Light diffusing screen fabric; washable, flame retardant per NFPA 701 and mildew resistant per ASTM G 21.
   1. Material: Matte white vinyl **<< on fiberglass backing; without backing; or _____>>**, with nominal gain of 1.0 over viewing angle not less than 70 degrees from axis, horizontally and vertically.

D. Masking Borders: Black, on four sides.

E. Exposed Screen Cases: Steel, with integral roller brackets.
   1. Finish: **<< Baked enamel; Powder coat; Laminate; Primer; or _____>>**.
   2. Color: **<< White; Black; Grey; or _____>>**.
   3. End Caps: Steel; finished to match case.
   4. Mounting: **<< Wall; Ceiling; Wall and ceiling, as indicated on drawings; or _____>>**.

F. Concealed-in-Ceiling Screen Cases: Aluminum, with integral roller brackets.
   1. Door Slat: Self trim; self-closing and -opening.
   2. Case Finish: **<< Baked enamel; Powder coat; Laminate; Primer; or _____>>**.
   3. Case Color: **<< White; Black; Grey; or _____>>**.
   4. End Caps: Aluminum; finished to match case.
   5. Electrically-Operated Screens: 1-1/2 inch aluminum door roller.

G. Manually-Operated Screens:
   1. Roller: **<< 1-3/4 inch; 2 inch; 3 inch; or __ inch>><< aluminum; steel; or _____>>**; **<< spring loaded; crank type; rope and pulley; or _____>>** with locking device.
   2. Screen Pull: Ring on bottom bar.
   3. Vertical Tensioning: Screen fabric weighted at bottom with **<< steel; aluminum; or _____>>** bar and **<< plastic; vinyl; or ____>>** end caps.

H. Electrically-Operated Screens:
   1. Roller: **<< Aluminum; Steel; or _____>>**, **<< 2 inch; 3 inch; 5-3/4 inch; 7 inch; or __ inch>>** in diameter, with locking device.
   2. Vertical Tensioning: Screen fabric weighted at bottom with **<< steel; aluminum; or _____>>** bar and **<< plastic; vinyl; or ____>>** end caps.
   3. Horizontal Tensioning: **<< Tab-guided cable system; Not required; or _____>>**.

I. Provide mounting hardware, brackets, supports, fasteners, and other mounting accessories required for a complete installation, in accordance with manufacturer's recommendations for specified substrates and mountings.

2.02 ELECTRICAL COMPONENTS

A. Electrical Components: NFPA 70 compliant, listed and classified by UL or other acceptable testing agency as suitable for the purpose specified and indicated.

B. Motors: Direct drive, **<< 110; 110/120; 220; 220/240; or _____>>** V, **<< 60; 50; or ___>>** Hz.

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1. Screen Motor: Mounted **<< inside; at end of; or _____>>** roller; **<< three wire with ground; five wire with ground; pre-wired; or _____>>**; **<< quick reverse type; lifetime lubricated; and _____>>**; equipped with **<< thermal overload cut-off; internal junction box; electric brake; pre-set accessible limit switches; and _____>>**.
   a. Electrical Characteristics: **<< 1.2; 1.4; 2.4; 2.6; or ___>>** amps.
   b. Motor mounted on **<< sound absorber; vibration dampener; or _____>>**.
2. **<< Door; Adjustable Masking; and _____>>** Motor: Mounted **<< inside; at end of; or _____>>** roller; **<< three wire with ground; pre-wired; or _____>>**; **<< quick reverse type; lifetime lubricated; and _____>>**; equipped with **<< thermal overload cut-off; internal junction box; electric brake; pre-set accessible limit switches; and _____>>**.
   a. Electrical Characteristics: 1.2**<< 1.2; or __>>** amps.

C. Controls: Three (3) position control switch with plate.
   1. Provide cover plates that match the finish of other electrical cover plates at each location. Coordinate with Division 26 electrical subcontractor.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate is finished and ready to accept screen installation.

B. If substrate preparation is the responsibility of another installer, notify **<<Architect>>** of unsatisfactory preparation before proceeding.

C. Verify that openings for recessed screens are correctly sized.

D. Verify type and location of electrical connections.

E. Do not install projection screens until climate control systems are in place and interior painting and other finishes are completed.

3.02 PREPARATION

A. Coordinate screen installation with installation of projection systems.

B. Coordinate installation with adjacent construction and fixtures, including ceilings, walls, lighting, speakers, fire suppression, display units (marker/tackboards), registers and grilles, and other indicated wall/ceiling mounted construction.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, using manufacturer's recommended hardware for relevant substrates.

B. Do not field cut screens.

C. Install screens in mountings as specified and as indicated on drawings.

D. Install plumb and level.

E. Install electrically operated screens ready for connection to power and control systems by others.

F. Adjust projection screens and related hardware in accordance with manufacturer's instructions for proper placement and operation.

G. Test electrical screens for proper working condition. Adjust as needed.

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3.04 PROTECTION

A. Protect installed products until completion of project.

B. Touch up, repair, or replace damaged products before Date of Substantial Completion.

END OF SECTION 115213

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SECTION 115223
TELEVISION BRACKETS

PART 1 GENERAL

1.01 SUBMITTALS

A. Product Data: For each type of product indicated. Provide data on mounting accessories for all applications.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

B. Shop Drawings: Indicate project-specific dimensions, verified field measurements, mounting details, and interface with adjacent construction.
   1. Include wiring diagrams for wiring connections.

C. Sustainability Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

D. Operation and Maintenance Data: Provide manufacturer's operation and maintenance instructions.

1.02 COORDINATION

A. Coordinate installation of anchorages for television brackets. Verify wall construction is suitable for wall-mounted bracket structural loading. Verify roof or floor construction is suitable for overhead-mounted bracket structural loading.

B. Electrical System Roughing-in: Coordinate layout and installation of television units and accessories with connections to electrical service and CCTV cable connection, if any.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver television brackets to project site in manufacturer's original unopened packaging, and inspect for damage and proper size before accepting delivery.

B. Store in a protected, clean, dry area and stack in accordance with manufacturer's recommendations.

1.04 WARRANTY

A. Provide 5 year manufacturer warranty for television bracket assembly.

PART 2 PRODUCTS

2.01 WALL MOUNTED TELEVISION BRACKETS

A. Fixed Wall Mounted Television Brackets: Wall-mounted steel or aluminum frame assembly capable of holding **<< <u>one screen</u>; or multiple screens in a video wall.>>**, with integral cable management.
   1. Screen Size: Capable of supporting screens from 40 inches to 75 inches.
   2. Maximum Screen Weight Supported: 110 pounds.
   3. Anchorage: Mount bracket to **<< <u>masonry</u>; <u>wood blocking</u>; or steel framing>>**.
   4. Products:
      a. ATDEC; AD-WF-5040.
      b. Chief, a brand of Legrand; RMF3.

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c. Eaton; DWF3780X.
d. Peerless-AV; SF650P.
e. Sanus, a brand of Legrand; LL11.

B. Articulating Wall Mounted Television Brackets: Wall-mounted, extendable, steel or aluminum frame assembly capable of holding one screen, vertical tilt, and lateral shift, with integral cable management.
1. Screen Size: Cable of supporting screens from 42 inches to 70 inches.
2. Maximum Screen Weight Supported: 100 pounds.
3. Anchorage: Mount bracket to **<< masonry; wood blocking; or steel framing>>**.
4. Products:
a. ATDEC; AD-WM-5060.
b. Chief, a brand of Legrand; ODMLA25.
c. Eaton; DWM3770X.
d. Peerless-AV; PA750.
e. Sanus, a brand of Legrand; VLF728.

2.02 CEILING MOUNTED TELEVISION BRACKETS

A. Ceiling Mounted Television Brackets for Single Screens: Ceiling-mounted steel or aluminum frame assembly capable of holding one screen with vertical tilt and integral cable management.
1. Screen Size: Capable of supporting screens from 42 inches to 75 inches.
2. Maximum Screen Weight Supported: 125 pounds
3. Anchorage: Mount bracket to **<< concrete; wood blocking; or steel framing>>**.
4. Products:
a. ATDEC; TH-3070-CTL.
b. Chief, a brand of Legrand; RLC1.
c. Peerless-AV; MOD-FPSKIT100-B.
d. Sanus; a brand of Legrand; LC1A.

B. Ceiling Mounted Television Brackets for Back to Back Screens: Ceiling-mounted steel or aluminum frame assembly capable of holding two screens back to back with vertical tilt and integral cable management.
1. Screen Size: Capable of supporting screens from 40 inches to 65 inches.
2. Maximum Screen Weight Supported: 220 pounds total (two screens weighing 110 pounds each).
3. Anchorage: Mount bracket to **<< concrete; wood blocking; or steel framing>>**.
4. Products:
a. ATDEC; ASBS-B2B-4TC.
b. Chief, a brand of Legrand; MCB1U.
c. Peerless-AV; DST965.
d. Sanus, a brand of Legrand; LC2A.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate is finished and ready to accept television bracket installation.

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B. If substrate preparation is the responsibility of another installer, notify **<<Architect>>** of unsatisfactory preparation before proceeding.

C. Verify type and location of electrical connections.

D. Do not install television brackets until climate control systems are in place and interior painting and other finishes are complete.

3.02 PREPARATION

A. Coordinate installation with adjacent construction and fixtures, including ceilings, walls, lighting, speakers, fire suppression, display units (marker/tackboards), registers and grilles, and other indicated wall/ceiling mounted construction.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, using manufacturer's recommended hardware for relevant substrates.

B. Install television brackets in mountings as specified and as indicated on drawings.

C. Install video walls in accordance with drawings and manufacturer's instructions. Verify that television screens are aligned horizontally and vertically, and that spacing between screens is uniform and of minimum size.

D. Install plumb and level.

3.04 ADJUSTING AND CLEANING

A. Adjust television screens and accessories in accordance with manufacturer's instructions for proper placement and operation.

B. Test television screens for proper working condition. Adjust as needed.

C. Lubricate hardware and other moving parts.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch up, repair, or replace damaged products before Date of Substantial Completion.

END OF SECTION 115223

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SECTION 115313
LABORATORY FUME HOODS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASHRAE Std 110 - Methods of Testing Performance of Laboratory Fume Hoods.

B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

C. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

D. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable.

E. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

G. SEFA 1 - Laboratory Fume Hoods.

H. SEFA 2 - Installations.

I. UL 1805 - Standard for Safety Laboratory Fume Hoods and Cabinets.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate installation of fume hoods with **<< laboratory casework; other laboratory equipment; and _____>>**.

B. Preinstallation Meeting: Conduct preinstallation meeting**<< one week; at least one week; _____; or None - N/A>>** prior to the start of the work of this section; require attendance by all affected installers.

C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.03 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>**, for submittal procedures.

B. Product Data: Provide fume hood exterior and interior dimensions and construction, utility and service requirements and locations.

C. Shop Drawings: Indicate locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, clearances required, locations and types of service fittings.

D. Manufacturer's Certificate: Certify that **<< products; or _____>>** meet or exceed **<< specified requirements; or _____>>**. Provide documentation of successful Factory Acceptance Testing.

E. Operation Data: Include description of equipment operation and required adjusting and testing.

F. Maintenance Data: Identify system maintenance requirements, servicing cycles, lubrication types required and**<< local; or None - N/A>>** spare part sources.

G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in **<<Owner>>**'s name and registered with manufacturer.

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H. Project Record Documents: Record actual locations of concealed utility connections**<< and _____; or None - N/A>>**.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with minimum **<< three; or _____>>** years of**<< documented; or None - N/A>>** experience**<< and approved by manufacturer; or None - N/A>>**.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.

1.06 FIELD CONDITIONS

A. Ambient Conditions: Maintain temperature and relative humidity at occupancy levels during and after installation of fume hoods.

1.07 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Correct defective Work within a **<< five; or ____>>** year period after Date of Substantial Completion.

C. Provide **<< one; two; five; or ____>>** year manufacturer warranty for manufacturer's standard items (listed by part number in manufacturer's official publication).

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Laboratory Fume Hoods:
   1. Kewaunee Scientific Corp.
   2. Mott Manufacturing Ltd.
   3. Multilab.
   4. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Provide laboratory fume hoods from single manufacturer.

C. Provide laboratory fume hoods from same manufacturer as laboratory casework.

2.02 VARIABLE AIR VOLUME (VAV) FUME HOODS

A. Restricted-Bypass Fume Hoods:
   1. Provide a compensating bypass arrangement above the sash to open after sash is closed to less than **<< 20; or 40>>** percent open. Bypass to maintain exhaust capacity of at least **<< 25 CFM per square foot>>** of work surface regardless of sash position.
   2. Provide an electronic control unit designed to use input from a sensor that monitors face velocity or sash position to modulate a dedicated exhaust damper in order to maintain a near-constant fume hood face velocity.
      a. Provide control unit with a manual-override switch that allows the operator to fully open the exhaust damper.
      b. Provide control unit with outputs for interfacing with **<< building's HVAC control system; or laboratory fume hood control system>>**.

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2.03 PERFORMANCE REQUIREMENTS

A. Fume hoods complying with the following when tested in accordance with **<<ASHRAE Std 110>>**:

1. As-Manufactured (AM) Rating: **<< AM 0.05 (0.05 ppm); AM 0.02 (0.02 ppm); AM 0.01 (0.01 ppm); As indicated in the Fume Hood Schedule; or _____>>**.
2. As-Installed (AI) Rating: **<< AI 0.10 (0.10 ppm); AI 0.05 (0.05 ppm); As indicated in the Fume Hood Schedule; or _____>>**.
3. Average Face Velocity: 100 FPM (0.51 m/s) plus or minus 10 percent with sashes fully open.
4. Face-Velocity Variation: Not more than **<< 10; 15; 20; or _____>>** percent of average face velocity across the face opening with sash(es) fully open.
5. Release Rate: **<< 4.0 L/min.; or 6.0 L/min.>>**
6. Static-Pressure Loss: Not more than 1/2-inch w.g. (124 Pa) at 100 FPM (0.51 m/s) face velocity with sash fully open when measured at four locations 90 degrees apart around the exhaust duct and at least three duct diameters downstream from duct collar.

2.04 FUME HOODS

A. General Requirements:

1. Comply with **<<SEFA 1>>**.
   a. Provide fume hoods UL listed and labeled for compliance with **<<UL 1805>>**. Include labeling on the face of the fume hood.
2. Pre-pipe fume hoods for service fittings.
3. Pre-wire fume hoods for **<< light fixtures; receptacles; other electrical devices; fan switches; and _____>>**.
   a. Terminate all wiring in a junction box on top of hood.
4. Coordinate with Division 22, 23, and 26 contractors to ensure utility services are properly sized and located.

B. Fume Hood:

1. Ventilation: **<< Constant Air Volume (CAV); Variable Air Volume (VAV); Ductless/Filtered; or _____>>**.
2. Configuration: **<< Standing-height; bench mounted; Sitting-height; bench mounted; Low-height; bench mounted; Stand mounted; Floor mounted; ADA-compliant; or Double-sided>>**. ******MCPS prefers double-sided fume hoods for space efficiency.******
3. Height to Work Surface: 36 inches.
4. Sash Type: **<< Vertical rising; Horizontal sliding; Vertical/horizontal combination; Vertical rising, double, postless; or _____>>**.
   a. Leak-free enclosure box, manufacturer's standard construction, for vertical rising sash.
   b. Glazing: **<< Laminated safety glass; Polycarbonate; or _____>>**.
   c. Sash Guides: Corrosion-resistant polyvinyl chloride (PVC) track.
   d. Vertical Sash mechanism: Designed to allow operation at a maximum 7 pounds of force over complete travel height. Counter-balance system shall be capable of holding sash open at any position without creep.
      1) **<< Cable: Minimum 3/32 inch (2 mm) thick stainless steel of construction standard with the manufacturer; or Chain: Hardened chain, standard with the manufacturer>>**.

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e. Vertical Sash Pull: **<< Type 316 stainless steel, with No.4 finish; or Type 316 stainless steel, with PTFE corrosion-resistant coating>>**.

5. Top Front Panel: **<< Standard integral grille stamped into panel of same materials as fume hood exterior.; Chevron integral grille, sight-tight, and shaped to create a barrier against flying debris from inside the hood.; Integral vision panel allowing viewing into top portion of fume hood.; _____ .; or None - N/A>>**
6. Exterior: **<< Sheet steel; Stainless steel; Fiberglass; or Polypropylene>>**.
7. Interior Lining: **<< Polypropylene; Type 316 stainless steel, 18 gauge thick, with No.4 finish; 1/4" thick PVC; 3/16" thick glass fiber reinforced polyester; Epoxy resin; Phenolic composite; or _____>>**.
8. Service Fittings and Fixtures:
   a. Cup Sink: Drop-in **<< Epoxy; Polyolefin; Polyethylene; Stainless Steel; or _____>>**, complete with removable stainer and waste fitting.
      1) Shape: **<< Oval; or Round>>**.
      2) Size: **<< 3 inches by 6 inches (75 by 150 mm); 3 inches by 9 inches (75 by 228 mm); or 5 inch (127mm) diameter>>**.
   b. Gooseneck faucet.
   c. Gas turret with ball valve.
   d. Recessed duplex outlet on hood face.
9. Access Panels: Provide removable panels on both sides hood exterior and interior lining panels.
10. Work Surface:
    a. Work Top for Fume Hoods Other Than Floor-mounted Type: **<< Epoxy resin; Phenolic resin; Stainless steel; or _____>>**.
       1) Edge: Raised rim with **<< rounded; beveled; or square>>** edges and corners**<< , and coved for stainless steel; or None - N/A>>**.
       2) Full width drain trough**<< at rear; at front; _____; or None - N/A>>**.

MCPS prefers double-sided hoods, but we can configure the paragraph below for a single-sided bench height hood against the wall in case it's needed.

C. Fume Hood Base Cabinets:
   1. Exterior construction: **<< Metal cabinets; and Wood Cabinets - Refer to Division 12, "Wood Laboratory Casework.">>**.
      a. Acid storage cabinets.
      b. Solvent (flammable and combustible liquids) storage cabinets.
   2. Material: **<< Sheet steel; Stainless steel; Fiberglass; Polypropylene; or Wood>>**; corrosion-resistant.
   3. Color/Finish: Matching fume hood finish.

D. Light Fixtures: UL labeled, vaporproof, **<< one-tube; two-tube; or _____>>**, **<< T-5; T-8; or _____>>** fluorescent light fixtures. Number and length of fixtures as necessary for fume hood width. Mounted above sealed safety glass panel. White baked-enamel finish on fixture interior.
   1. Average Interior Illumination Level: 80 footcandles.
   2. Coordinate access to light fixture with ceiling extension configuration and construction.

2.05 FABRICATION

A. General: Assemble fume hoods in factory to greatest extent possible. Disassemble fume hoods only as necessary for shipping and handling limitations, or as necessary to permit movement through a **<< 35 inches by 79 inches>>** clear door opening.

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B. Steel Exterior: Fabricated from steel sheet, **<< 0.048 inch>>** thick, with component parts screwed together to allow removal of end panels, front fascia, and airfoil and to allow access to plumbing lines and service fittings. Chemical-resistant finish applied to interior and exterior surfaces of component parts before assembly.

C. Ends: Fabricated with double-wall end panels. Close area between double walls at front of fume hood and as needed to house sash counterbalance weights, utility lines, and remote-control valves.

D. Lining Assembly: Unless otherwise indicated, assembled with stainless-steel fasteners or epoxy adhesive, concealed where possible. Joints sealed by filling with chemical-resistant sealant during assembly.

1. Punched fume hood lining side panels for service fittings and remote controls. Removable plug buttons for holes not used for indicated fittings.

E. Molded Glass-Fiber-Reinforced Polyester Lining: Molded unit consisting of end panels, back panel, preset rear baffle, and top bonded together into a single piece; reinforced to form a rigid assembly to which exterior is attached.

1. Punched fume hood lining side panels for service fittings and remote controls. Removable plug buttons for holes not used for indicated fittings.

F. Stainless-Steel Lining Assembly: Fully-welded unit consisting of end, back, and top panels, and work top with spill-containing raised edges; reinforced to form a rigid assembly.

G. Rear Baffle: Same material as fume hood lining, unless otherwisse indicated, at rear of hood with openings at top and bottom, with corrosion-resistant fasteners. Fabricated for removal to facilitate cleaning behind baffle.

H. Exhaust Plenum: Full width of fume hood, sized and configured to provide uniform airflow, of same material as hood lining, and with duct stub for exhaust connection.

1. Duct-Stub Material: **<< Epoxy-coated steel; stainless steel; glass-fiber-reinforced polyester; or _____>>**, unless otherwise indicated.

I. Airfoil: At bottom of fume hood face opening, with 1 inch gap between bottom of airfoil and work top. Sash to close on top of airfoil. Designed to direct airflow across work.

1. Fabricated from **<< 14 gauge, 0.0781 inch; 16 gauge, 0.0625 inch; or _____>>** stainless steel with **<< No.4; PTFE; or PVDF>>** finish.

J. Filler Strips: As needed to close spaces between fume hoods and/or fume hood base cabinets and adjacent building construction. Fabricated from same material and with same finish as fume hoods or fume hood base cabinets, as applicable. Flange, notch, and reinforce filler strips. Fabricate to form well-fitting closures, free from oil-canning.

K. Ceiling Extensions: Filler panels matching fume hood exterior to enclose space above fume hoods at front and sides of fume hoods**<< to ceiling; to approximately 4 inches (102 mm) above ceiling; _____; or None - N/A>>**. Flange, notch, and reinforce ceiling extensions as required for rigidity. Fabricate to form well-fitting closures, free from oil-canning.

1. Provide bottom-hinged access panels within the front ceiling extension filler panel to facilitate access to light fixture and other fume hood components at top of hood not readily accessible by other means.

L. Finished Back Panels: Where rear surfaces of fume hoods are exposed to view, provide finished back panels matching rest of fume hood enclosure.

M. Demonstration (teaching) Fume Hoods: **<< Single; or Double>>** chamber fume hood, with independently-operable sashes on opposite faces of fume hood. Construction similar to standard models.

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1. Optional glazed viewing window on **<< left side; or right side>>** of fume hood.

N. Comply with requirements of other sections for factory installation of water and laboratory gas service fittings, piping, electrical devices, and wiring. Securely anchor fittings, piping, and conduit to fume hoods, unless otherwise indicated.

2.06 MATERIALS

A. Steel Sheet: Cold-rolled, commercial steel (CS) sheet, complying with **<<ASTM A1008/A1008M>>**; matte finish; suitable for exposed applications.

B. Stainless-Steel Sheet: **<<ASTM A240/A240M>>** or **<<ASTM A666/A666M>>**, Type 304, stretcher-leveled standard of flatness.

C. Glass-Fiber-Reinforced Polyester: Polyester laminate with a chemical-resistant gel coat on exposed faces, and having a flame-spread index of 25 or less according to **<<ASTM E84>>**.

D. Epoxy: Factory molded, modified epoxy-resin formulation with smooth, nonspecular finish.

1. Physical Properties:
   a. Flexural Strength: Not less than 10,000 pou **<< 10,000 pounds per square inch; or _____ pounds per square inch>>**.
   b. Modulus of Elasticity: Not less than 2,000,000 pounds per square inch.
   c. Hardness (Rockwell M): Not less than 100.
   d. Water Absorption (24 Hours): Not more than 0.02 percent.
   e. Heat Distortion Point: Not less than 260 degrees.
   f. Flame-Spread Index: 25 or less according to **<<ASTM E84>>**.
2. Chemical Resistance: As follows when tested with indicated reagents according to **<<NEMA LD 3>>**, Test Procedure 3.4.5:
3. Color: **<< Black; Gray; Beige; White; As selected by Architect from manufacturer's standards; and _____>>**.

E. Laminated Safety Glass: **<<ASTM C1172>>**.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in **<<NFPA 70>>**, by a qualified testing agency, and marked for intended location and application.

G. Fasteners: Stainless-steel, where exposed to fumes.

2.07 ACCESSORIES

A. Airflow Monitors/Indicators and Alarms: Provide each fume hood with a airflow monitor/indicator complete with an audible and visual alarm that activates when airflow sensor reading is outside of preset range.

1. Source: **<< Fume hood manufacturer; Laboratory ventilation controls manufacturer; or _____>>**.
2. Airflow Monitor/Indicator Functionality:
   a. Type: A sensor module that monitors fume hood face velocity, and a display module that presents data as digital readout.
      1) Input power: 9 to 30 V AC/DC. Include power supply module or functionality.
      2) Mounting: **<< Flush; Semi-recessed; Surface-mounted; or _____>>**.
      3) Readings: Remote sensor inserted in airflow stream.
      4) Visual Status Display: Green, yellow, and red LEDs.
      5) Airflow Display: Digital display of face velocity reading.
      6) Operating temperature: **<< 55 to 86 degrees F; 32 to 120 degrees F; or _____ degrees F>>** .

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3. Airflow Alarm functionality: Audible (85 dB @ 4 inch distance), and visual alarm that activates when airflow sensor reading is outside of preset range.
    a. Reset and test mode.
    b. **<< Programmable ; or None - N/A>>**Switch: Designed to silence audible alarm and automatically reset when airflow returns to within preset range. Warning light to stay on when alarm is silenced.
    c. Capability for integration with building's HVAC system.
    d. Alarm included as an integral feature of the airflow monitor/indicator.

B. Fume Hood Controller: Airflow Indicator/monitor with built-in electronics to control a dedicated exhaust fan and/or exhaust valve.
    1. Fume hood manufacturer's standard controller.

C. Sash Stops: Spring-loaded stops to limit hood opening to **<< 50 percent of sash; _____ percent of sash; 18 inches; or _____ inch>>** height. Manually releasable to open sash fully, and to reset automatically when sash is lowered below set level.

2.08 SOURCE QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Factory **<< testing; analysis; analysis and testing; and _____>>** of each type of fume hood.

C. Non-Complying Work: See Section **<< 014000>>**.

PART 3 EXECUTION

3.01 EXAMINATION

A. Locate concealed framing, blocking, and reinforcements that support fume hoods by field measurements before being enclosed, and indicate measurements on Shop Drawings.

B. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fume hoods.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install fume hoods according to manufacturer's written instructions. Install level, plumb, and true; shim as required, using concealed shims, and securely anchor to **<< building; and adjacent laboratory casework>>**. Securely attach access panels but provide for easy removal and secure reattachment. Where fume hoods abut other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

B. Large Components: Ensure that large components can be moved into final position without damage to other construction.

C. Comply with indicated requirements for installing water and laboratory gas service fittings, and electrical and telecommunications devices.
    1. Install fittings in accordance with shop drawings, installation requirements in **<<SEFA 2>>**, and manufacturer's written instructions. Set bases and flanges of sink and work top-mounted fittings in sealant recommended by manufacturer of sink or work-top material. Securely anchor fittings to fume hoods.

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3.03 FIELD QUALITY CONTROL

A. Field test installed fume hoods in accordance with requirements of Section **<< 230593 - Testing, Adjusting, and Balancing for HVAC>>**.

3.04 ADJUSTING

A. Adjust moving parts for smooth, near silent, accurate sash operation with one hand only. Adjust sashes for uniform contact of rubber bumpers. Verify that counterbalances operate without interference.

3.05 CLEANING

A. Clean finished surfaces, including both sides of glass; touch up as required; and remove or refinish damaged or soiled areas to match original factory finish, as approved by **<<Architect>>**.

3.06 DEMONSTRATION

A. Demonstrate proper operation of fume hoods and their accessories to **<<Owner>>**'s designated representative.

END OF SECTION 115313

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SECTION 116123.16
ORCHESTRA PIT FILLERS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

B. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.

C. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

D. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes.

E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

G. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.

H. EPA (TSCA); Title VI - Toxic Substances Control Act, Title VI: Formaldehyde Standards for Composite Wood Products.

I. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

J. PS 1 - Structural Plywood.

1.02 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including finishes.
   1. Include test reports or manufacturer's certificate indicating compliance with structural loading requirement and fire testing (critical radiant flux).

B. Shop Drawings: Provide complete layout, customized to this project, that shows platform layout, locations of support column assemblies, and accessories.

C. Delegated Design Documents: Provide structural engineering drawings and calculations, sealed by Designer.

D. Sustainable Design Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

E. Designer's qualification statement.

1.03 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Include operation data on fold-up and fold-down of choral risers, and transportation and storage. Provide maintenance data including recommended cleaning and lubrication of operating parts.

B. Warranty: Submit manufacturer warranty and ensure that forms have been completed in **<<Owner>>**'s name and registered with manufacturer.

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1.04 QUALITY ASSURANCE

A. Designer Qualifications: Perform design under direct supervision of Structural Engineer experienced in design of this type of work and licensed in the State of Maryland.

1.05 WARRANTY

A. Manufacturer Warranty: Provide 10-year manufacturer warranty from date of Substantial Completion. Complete forms in Owner's's name and register with manufacturer.
   1. Warranty shall cover failures in material or workmanship, including but not limited to the following:
      a. Components that break due to normal wear and tear (vandalism is excluded).
      b. Delamination of adhesives or bonding.
      c. Warping, bowing, or other deformation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Folding and Portable Standing Choral Risers:
   1. Basis-of-Design Product: Wenger Corporation; Strata Orchestra Pit Filler.
   2. Other Acceptable Manufacturers:
      a. StageRight, Inc.
      b. Staging Concepts, Inc.

B. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.

2.02 ORCHESTRA PIT FILLERS

A. Structural Performance Requirements: As measured on a 4 foot by 6 foot rectangular deck:
   1. Standard Uniform Live Load: 150 pounds per square foot.
   2. Maximum Deflection: L/360 for a 72-inch span.
   3. Minimum Dynamic Impact Loading: 10,000 cycles of 400 lb-force at 6 locations.
   4. Point Load Rating: 1000 pounds on a 2-inch diameter.
   5. Lateral Live Side Load: 12 lbf/sq ft based on deck top surface area, meets IBC code.

B. Platform Deck Fabrication:
   1. Provide decks constructed from 1/2-inch plyron on both sides of a 2-5/8-inch thick phenolic impregnated paper honeycomb core.
   2. Deck Fabrication Components:
      a. Glass-filled nylon corners; color black.
      b. Extruded PVC edges; color black.
      c. Deck attachment consisting of spring-loaded screw assemblies.
   3. Deck Finish:
      a. 1/4-inch stage flooring; black finish.
      b. Refer to Division 9 Section "Stage Flooring Assembly."

C. Framing Components:
   1. Support Beams:
      a. Provide support beams from 6063-T6 extruded aluminum.

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b. Provide beams which incorporate dual fastener tracks to accommodate spring-loaded screw connections to platforms.
c. Provide cross beams with pin and socket connection to main support beams.

2. Column Assembly:
a. Provide column assembly legs from 6063-T6 extruded aluminum in the size and quantity required to support the specified load.
b. Provide assemblies that attach with pin connectors.
c. Provide each assembly with the ability to adjust height a minimum total of 4 inches plus or minus.

2.03 MATERIALS

A. Steel: Finish all steel components with manufacturer's standard black powder coat.
1. Steel Sections: **<<ASTM A36/A36M>>**.
2. Steel Tubing: **<<ASTM A500/A500M>>** Grade A cold-formed structural tubing.
3. Plates: **<<ASTM A283/A283M>>**.

B. Aluminum: Provide manufacturer's standard finish on all components that will be concealed.
1. Extruded Aluminum: **<<ASTM B221>>** (**<<ASTM B221M>>**), 6063 alloy, T6 temper.
2. Aluminum-Alloy Drawn Seamless Tubes: **<<ASTM B210/B210M>>**, 6063 alloy, T6 temper.

C. Plywood: **<<PS 1>>**, 5-ply southern pine or douglas fir, Grade A-C; 1/2 inch minimum thickness.
1. Composite Wood: Any composite wood materials installed inside the weatherproofing system shall meet either **<<EPA (TSCA), Title VI>>** for ultra-low-emitting formaldehyde or no added formaldehyde (ULEF / NAUF).

2.04 ACCESSORIES

A. Storage Carts:
1. Deck and Support Storage Carts:
a. Provide manufacturer's standard steel tube-framed transport carts with heavy-duty casters and clamping safety strap.
b. Provide number of carts required for layout indicated, specifically designed to efficiently store platform deck and support assembly components.
c. Provide black powder coat finish for all storage carts.

B. Anchoring and Fasteners: Provide manufacturer's approved removable fastening system to secure pit filler to stage front edge.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Verify installation location with Owner. Prior to beginning equipment assembly, verify that all construction activity is complete that may soil or damage equipment (including but not limited to painting, staining, sealing, sanding).

3.02 INSTALLATION

A. Choral Riser Installation: Assemble in accordance with manufacturer's written instructions. Verify that equipment assemblies are complete and fully functional.

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B. Demonstration and Training: Provide Owner's personnel with training in proper methods for set up and break down, handling, transportation, storage, and maintenance.

C. Choral Riser Storage: Clean risers immediately prior to storage. Fold down risers in accordance with manufacturer's instructions and store in location designated by Owner.

END OF SECTION 116123.16

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SECTION 116143
STAGE CURTAINS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

C. ASTM A391/A391M - Standard Specification for Grade 80 Alloy Steel Chain.

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

E. FM (AG) - FM Approval Guide.

F. ITS (DIR) - Directory of Listed Products.

G. NEMA MG 00001 - Motors and Generators.

H. NFPA 70 - National Electrical Code.

I. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.

J. UL (DIR) - Online Certifications Directory.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting at least two weeks prior to the start of the work of this section; require attendance by all affected installers.

1.03 SUBMITTALS

A. Product Data: Provide for each type of product as follows:
   1. Stage Curtains: Provide information on type of curtain, weight, location for use on project, and type of flame retardancy.
   2. Operators: Provide rated capacities, and operating and electrical characteristics.
   3. Tracks: Provide capacity of each curtain track to support curtain weight and control curtain operation.
   4. Pipe Grid and Rigging: Provide product data for each component of pipe grid assembly, including load capacity of pipe grid components and rigging chain and cable.

B. Shop Drawings: Indicate installation information for components not dimensioned or detailed in product data.
   1. Submit floor plans, elevations, sections, attachment details of curtains and operating clearances.
      a. Submit layout of pipe grid and battens, including attachment locations to structure.
   2. Submit documentation indicating load capacity of each batten, track, attachment, and rigging components.
   3. Submit attachment locations for each type of curtain, and corresponding loads imposed on structure.
   4. Submit locations of equipment components, switches, and controls; identify between manufacturer installed and field installed wiring.
   5. Submit wiring diagrams for power, signal, and control wiring.

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C. Selection Samples: Submit color chart for each type of stage curtain indicated that includes full range of colors, textures, and patterns available, along with **<< 12-inch; or ___-inch>>** square fabric sample, in any color, of each fabric type and seam.

D. Verification Samples: Submit fabric full width by at least **<< 12-inch; 36-inch; or ___-inch>>** long section of each selected fabric**<< from dye lot to be used for this work; or None - N/A>>**, with specified treatments applied and showing repeat of patterns; mark top and face of fabric.

E. Certificate: Certify that **<< products of this section; or _____>>** meet or exceed **<< specified requirements; or _____>>**.

F. Delegated Design Data: Indicate stage curtain system structural attachments, including analysis data signed and sealed by qualified designer responsible for their preparation.

G. Designer's Qualification Statement.

H. Installer's Qualification Statement.

I. Operation and Maintenance Data: For stage curtains and rigging operations.

J. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in **<<Owner>>**'s name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Designer Qualifications: Perform design of **<< track support system; and pipe grid>>** under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State of Maryland.

B. Installer Qualifications: Company specializing in performing work of the type specified; certified installation representative of curtain fabricator/manufacturer.

1.05 FIELD CONDITIONS

A. Ambient Conditions: Do not install stage curtains until spaces are fully enclosed and watertight, and the following:

1. Wet work in adjacent areas is complete and surfaces are dry.
2. Work at and above ceiling level has been completed.
3. Ambient temperatures and humidity of adjacent areas are maintained at levels when occupied for intended use.

B. Field Measurements: Confirm supporting structural element locations and adjacent construction for stage curtains and rigging, and complete field measurements prior to fabrication**<< and include these dimensions on shop drawings; _____; or None - N/A>>**.

1.06 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Correct defective Work within a two year period after Date of Substantial Completion.

1. Defective Work includes, but is not limited to, stage curtain support and rigging that is not operating properly.

PART 2 PRODUCTS

2.01 FABRICATORS

A. Stage Curtain and Track/Rigging Assembly Fabricators:

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1. Beck Studios Inc.; Milford, OH; https://www.beckstudios.net/
2. Georgia Stage; Duluth, GA; https://www.gastage.com/
3. IWeiss; Fairview, NJ; https://iweiss.com/
4. LuXout Stage Curtains; Richmond, VA; https://www.luxout.com/
5. Janson Industries; Canton, OH; http://www.jansonindustries.com/
6. J.R. Clancy, Inc; Syracuse, NY; https://www.jrclancy.com/
7. Texas Scenic Company, Inc; San Antonio, TX; https://www.texasscenic.com/

2.02 PERFORMANCE REQUIREMENTS

A. Stage Curtain Systems Design: Engage qualified designer to develop design of stage curtain system, including comprehensive project specific analysis of necessary structural system attachments in compliance with performance requirements.

B. Structural Performance: Ensure attachment of stage curtain system to structure withstands material weight and operational loads applicable for this project and in compliance with local building codes and authorities having jurisdiction.
   1. Design Loads: Weight of stage curtains and track system.

C. Fire-Test Characteristics: Stage curtain fabrics in compliance with **<<NFPA 701>>** flame propagation fire test requirements conducted by authorized testing agency, listed by **<<UL (DIR)>>**, **<<ITS (DIR)>>**, or **<<FM (AG)>>** and acceptable to authorities having jurisdiction.
   1. Permanently attach label to fabric of each curtain assembly indicating fabric treatment as follows:
      a. Inherently Flame Retardant (IFR), fibers/yarns that are non-combustible for life of fabric.

D. Electrical Components: Devices that are listed and labeled in compliance with **<<NFPA 70>>**, by a qualified testing agency, and marked for designated application.

2.03 STAGE CURTAIN FABRICS

A. Provide curtains of matching fabric and color from single dye lot, and when size and quantity of curtains exceeds maximum dye lot size, provide curtain or adjacent pair of curtains from only one dye lot, and arrange curtain dye lots to minimize exposure of any differences.

B. Polyester Velour: Weighing at least 22 oz/linear yd, napped fabric of 100 percent polyester with minimum pile height of 75 mil, 0.075 inch and minimum width of 54 inches.
   1. Application: **<< Main Traveler; Main Valance; Olio Traveler; Olio Legs; Olio Valance; Cyclorama Traveler; Cyclorama Legs; Cyclorama Border; and _____>>** curtains.
   2. Color: To be selected by Architect from manufacturer's full range.
   3. Texture: To be selected by Architect from manufacturer's full range.
   4. Pattern: To be selected by Architect from manufacturer's full range.
   5. Products:
      a. Dazian LLC; Angelo.
      b. Fred Krieger & Company; IFR Prism Velour 22 oz.
      c. JB Martin; Inferno.
      d. KM Fabrics, Inc; Prestige.
      e. LuXout; Prologue 22 oz.
      f. Rose Brand; Encore.

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C. Polyester Velour: Weighing at least 13 oz/linear yd, napped fabric of 100 percent polyester with minimum pile height of 75 mil, 0.075 inch and minimum width of 54 inches.
   1. Application: Legs, intermediate and rear valances, and backdrop/cyclorama curtains.
   2. Color: To be selected by Architect from manufacturer's full range.
   3. Texture: To be selected by Architect from manufacturer's full range.
   4. Pattern: To be selected by Architect from manufacturer's full range.
   5. Products:
      a. Dazian LLC; Carbonite Plus.
      b. Fred Krieger & Company; IFR Prism Velour 14 oz.
      c. JB Martin; Volcano.
      d. KM Fabrics, Inc; IFR Plateau Velvet/Velour 13 oz.
      e. LuXout; Epilogue 14 oz.
      f. Rose Brand; Apollo.

2.04 CURTAIN TRACK

A. Steel Track: Commercial quality, roll-formed, galvanized steel sheet, **<<ASTM A653/A653M>>**, with G60 coating designation; with continuous bottom slot and each half of track in single continuous piece; black finish; including support and operation accessories.
   1. Thickness: ******Verify medium- or heavy-duty with track length. General rule of thumb is use heavy-duty if over 40 feet in length. First option in each manufacturer below corresponds to medium-duty, and second option corresponds to heavy-duty******
      a. Medium-Duty: 16-gauge, 0.0598-inch minimum thickness.
      b. Heavy-Duty: 14-gauge, 0.0747-inch minimum thickness.
   2. Products:
      a. Automatic Devices Company; **<< Besteel 170 series; or Silent Steel 280 series>>**.
      b. H & H Specialties, Inc.; **<< 200 series; or 400 series>>**.
      c. iWeiss; **<< IWLC Light Channel Track series; or IWC Channel Track series>>**.

B. Curved Track: Shop fabricate curved portions of curtain track.
   1. Curved Track Cable Guides: Provide **<< outside idlers; mule pulleys; spindles; guides; and _____>>** as required for curve configuration and track length.

C. Curtain Rails: Provide **<< single; double; or _____>>** curtain capacity as indicated on drawings, and end stops.

D. Curved-Suspended-Track Stiffener: Steel pipe, **<< 1-1/4-inch; 1-1/2-inch; or ___-inch>>** nominal diameter, Grade A, Schedule 40 in accordance with **<<ASTM A53/A53M>>**; support both sections of curved suspended tracks, with curve to match track.

E. Clamp and Bracket Hangers: Steel clamps and brackets of required strength to support loads for attaching track to overhead support.

F. Track-Lap Clamp: Clamp that matches track channel finish as necessary for attaching two tracks at center overlap.

G. Operation: ******Verify operation type on case-by-case basis with MCPS******
   1. Manual Walk-Along Operation: Curtain track without a cord, cable, pulleys, or floor pulley; must walk with curtain to open and close.
   2. Manual Cord Operation: Curtain track with cord, pulleys, and floor pulley; must manually open and close the curtain.

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a. Operating Line: 3/8-inch diameter, stretch-resistant operating cord with braided synthetic-fiber cover over solid, synthetic-fiber, linear filaments.

b. End Pulleys: One single dead-end and one double live-end pulley, with sheaves having shielded ball bearings housed in plated-steel covers that match track finish, and provide with bracket for securing off-stage end of curtain.

c. Floor Pulleys: Sheave, **<< adjustable type with 3-inch (76 mm) diameter wheels; adjustable type with 5-inch (127 mm) diameter wheels; spring-tensioned type; or _____>>**, and having shielded ball bearings housed in plated-steel covers**<< , painted black; , _____; or None - N/A>>**.

3. Motorized Operation: Curtain track with cord and pulleys.

a. Operating Line: **<< 3/16-inch; 1/4-inch; or ___-inch>>** diameter, stretch-resistant operating cord with braided synthetic-fiber cover over galvanized wire cable.

b. End Pulleys: One single dead-end and one double live-end pulley, with sheaves having shielded ball bearings housed in plated-steel covers that match track finish, and with bracket for securing off-stage end of curtain.

H. Track System Components: Provide curtain track with components as recommended by manufacturer for loads and operation, including track end stops.

1. Carriers: Standard **<< plated-steel; molded nylon; or _____>>** carriers with a pair of **<< nylon; neoprene; or polyethylene>><< tired ball-bearing; _____; or None - N/A>>** wheels riveted parallel to body, and equip carriers with**<< rubber or neoprene bumpers to reduce noise; _____; or None - N/A>>** and plated-steel swivel eye**<< and trim chain; _____; or None - N/A>>** for attaching curtain snap or S-hook, and required number of curtain carriers for track length and curtain fabrication.

a. Master Curtain Carriers: One plated-steel master carrier for each leading curtain edge, with two pairs of **<< nylon; neoprene; or _____>><< tired ball-bearing; _____; or None - N/A>>** wheels and with two line **<< guides; clamps; or _____>>** per carrier.

b. End Stops: Provide manufacturer's recommended end stops, compatible with and sized for track system indicated, at all track terminations, to prevent carriers from exiting the track.

2. Pulleys: One dead-end, single-wheel pulley; one live-end, double-wheel pulley; and one adjustable pulley to maintain proper tension on operating line; each with**<< guarded; _____; or None - N/A>><< gas-filled-nylon-tired; molded-nylon-tired; _____; or None - N/A>>** ball-bearing sheaves enclosed in steel housings; pulleys with steel housing finished to match track and with bracket for securing off-stage end of curtain.

2.05 CURTAIN TRACK OPERATORS

A. General: Provide operating machine as recommended by track manufacturer of size and capacity for each motorized curtain as indicated on drawings, with electric motor and factory wired motor controls, starter, gear-reduction unit, brake, and control station.

B. Type of Operator:

1. For hoizontal curtain operation, provide manufacturer's recommended traction drive device sized for curtain sizes indicated.

2. For vertical raising and lowering of pipe grids, curtains, scenery, and set pieces, provide cable drum with grooved drum and cable tension device that automatically takes up cable slack to retain cable in grooves.

C. Motor: In compliance with **<<NEMA MG 00001>>** requirements, and sized to start, accelerate, and operate curtain in either direction and from any position on track at rated speeds and service factor.

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1. Electrical Characteristics: 120 VAC, 3-hase, 60 Hz; continous duty type.
2. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with electrical system available for each location.

D. Controllers, Disconnect Switches, Wiring and Wiring Devices: Manufacturer's standard, unless otherwise indicated.

E. Control Station: Momentary contact, three-button control station with push-button controls labeled - Open, Close, and Stop.
1. Enclosures: Key-accessed and keyed alike, with one key for each enclosure and one extra key.
2. Switches: Key-operated and keyed alike, with one key for each switch and one extra key.

F. Limit Switches: Fully closed and fully opened preset stops.

2.06 FABRICATION - CURTAINS

A. General: Provide vertical seams unless otherwise indicated, locate vertical seams so they do not fall on faces of pleats, and only use fabric that is cut greater than half the width of fabric.

B. Vertical and Top Hems: Machine sew hems as follows, unless otherwise indicated:
1. Vertical Hems: Fabricate at least **<< 2 inches>>** wide, and at least **<< 4 inches>>** wide at **<< borders; valances; teasers; tormentors, and _____>>** with at least **<< 1-inch>>** tuck and without visible selvedge material from front of curtain; sew open ends of hems closed.
2. Turnbacks: Fabricate **<< leading edge; trailing edge; and _____>>** turnbacks for **<< traveler; or _____>>** curtains by folding back at least **<< 12 inches; one-half width; or _____>>** of face fabric, with at least **<< 1-inch>>** tuck, and vertically secured by sewing.
3. Top Hems: Fabricate by double-stitching **<< 3-1/2-inch>>** wide heavy **<< jute; laminated synthetic; or _____>>** webbing to top edge at back side of curtain, and with at least **<< 2 inches>>** of face fabric turned under.

C. Fullness:
1. 50 Percent Fullness: Provide this fullness, exclusive of turnbacks and hems, and spaced at 12 inches on center along top hem reinforcement as follows:
a. Sewing additional material into 3-inch double-stitched, flat, box pleats.

D. Grommets:
1. Black Colored Curtains: **<< No. 3 brass; No, 4 brass; aluminum; or _____>>** grommets with black finish.
2. Pleated Curtains: Provide **<< grommets centered on each box pleat; double grommets for each round pleat; or _____>>** and placed **<< 1 inch>>** from corner of curtain; for snap hooks or S-hooks.

E. Bottom Hems: Machine sew hems as follows, unless otherwise indicated:
1. For Curtains With Fullness:
a. Curtains That Don't Hang to Floor: Hems at least **<< 3 inches>>** deep**<< , with weight tape; , _____; or None - N/A>><< , 3/4 inch; , ___ inch; or None - N/A>>**, and open ends of hems sewn closed.
b. Floor Length Curtains: Provide hems at least **<< 6 inches>>** deep, with individual weights in individual closed pockets sewn above finished bottom edge of curtain, and open ends of hems sewn closed.

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2.07 PIPE GRID

A. General: Fabricate pipe grid in configuration indicated on Drawings from steel pipe battens, trim and support cable and chain, clamps, and anchors, as specified in Accessories article below.
   1. Where not indicated on Drawings, provide pipe grid in 4 foot by 4 foot square grid configuration.
   2. Clamps: At pipe grid, provide a cross grid connection clamp at each intersection of battens.
   3. Suspend stage curtain track from pipe grid batten with manufacturer's recommended clamp and hanger assembly.

2.08 ACCESSORIES

A. S-Hooks: Manufacturer's standard heavy-duty plated wire hooks, at least **<< 2 inches; or ___ inches>>** long.

B. Tie Lines: **<< No. 4; No. 4-1/2; or No. ___>>** cord or braided soft cotton tape, colored **<< to best match curtain; black; white; or _____>>**; at least 5/8-inch wide by 36 inches long and **<< threaded through grommets; sewn into top hem of curtain; or _____>>**.

C. Battens: Fabricate using steel pipe and minimize the number of joints; connect pipe at joints using 18-inch long internal splice sleeve secured with **<< four flush rivets; plug welds; threaded couplings; _____; or equally strong method>>**.
   1. Steel Pipe: 1-1/4 inch nominal diameter, Grade A, Schedule 40 in accordance with **<<ASTM A53/A53M>>**.
   2. Finish: Matte black with 1-inch wide yellow-colored stripe along center of each batten.

D. Support, Clamps, and Anchors: Galvanized after fabrication sheet steel, Class B in accordance with **<<ASTM A153/A153M>>**; manufacturer's standard thickness.

E. Trim and Support Cable: 1/4-inch diameter, 7x19 galvanized steel cable with minimum breaking load (MBL) of 7,000 lb.
   1. Provide fittings in accordance with cable manufacturer's written instructions for size, number, and method of installation, including a drop-forged galvanized turnbuckle to allow for leveling.

F. Trim and Support Chain: Hardened alloy steel chain rated for overhead lifting, Grade 80 in accordance with **<<ASTM A391/A391M>>**.

G. Inserts, Bolts, Rivets, and Fasteners: Manufacturer's standard and corrosion-resistant.

H. Individual Curtain Bottom Weights: Curtain manufacturer's standard segmented weights in compliance with requirements for curtain type and location.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with installer present for compliance with requirements for supporting structural members, blocking, clearances, installation tolerances, and other conditions that may impact performance of stage curtain assembly.

B. Examine placement and condition of inserts, clips, blocking, or other supports installed by others and for use in supporting track and battens of stage curtain assembly.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.02 INSTALLATION, GENERAL

A. Install stage curtain assembly in accordance with curtain and track manufacturers written instructions.

3.03 INSTALLATION - CURTAIN

A. Track Hung: Secure curtains to track carriers using S-hooks and trim chains.

3.04 INSTALLATION - BATTENS (PIPE GRID)

A. Install battens by suspending at heights as indicated with trim and supports spaced as required to support loads; do not exceed 8 feet between supports.
   1. Cable Trim and Support:
      a. Fasten cables securely to either structure or to inserts, eye screws, or other applicable devices that are appropriate for substrate and not subject to deterioration or failure with time or elevated temperatures.
      b. Attach other end of cable to pipe clamps with turnbuckles, housed or fixed securely after adjustment to prevent loosening.
   2. Chain Support: Secure chain as required for application with load-rated terminations.

3.05 INSTALLATION - TRACK

A. Mounting of Track Assembly:
   1. Ceiling Mounted: Provide ceiling supports for mounting track direct to ceiling structure and within intervals indicated in manufacturer's written instructions for on center spacing. ******RARE - for very lightweight assemblies; more similar to cubicle curtain installation******
   2. Beam Mounted: Install track by suspending from beam clamps securely mounted to structural I-beam and within intervals indicated in manufacturer's written instructions for on center spacing. ******Can be a standard install method for smaller installs like elementary schools, if pipe grid is not needed******
   3. Wall Mounted: Install track by suspending from brackets securely mounted to wall construction and within intervals indicated in manufacturer's written instructions for on center spacing. ******Rare - may be used for specialty installs such as TV studios, or for a fixed rear curtain******
   4. Batten Mounted: Install track by suspending from pipe batten with manufacturer's acceptable track clamp hangers securely attached to batten pipe clamps and within intervals indicated in manufacturer's written instructions for on center spacing. ******Standard install method for larger stages - pipe grid battens hold stage track assemblies and lighting******

B. Track Support Spacing: Comply with manufacturer's recommendations for applied loads, and not to exceed the following dimensions between track supports:
   1. Heavy-Duty Track: 6 feet**<< 6 feet; or ___ feet>>**, maximum.
   2. Medium-Duty Track: 4 feet, maximum.
   3. Curved Walk-Along Track: 4 feet, maximum, with additional supports at curves and splices.

C. Install track for center-parting curtains with at least 24-inch overlap of track sections at center-line, and supported with track lap clamps.

3.06 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate operation of system to Owner's personnel.

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1. Use operation and maintenance data as reference during demonstration.
2. Briefly describe function, operation, and maintenance of each component.

B. Training: Train Owner's personnel on operation and maintenance of system.
1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of **<< two hours; one day; or _____>>** of training.
3. Instructor: Manufacturer's training personnel.
4. Location: At project site.

3.07 PROTECTION

A. Protect installed stage curtain assembly from subsequent construction operations until Date of Substantial Completion.

END OF SECTION 116143

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SECTION 116613
BALLET BARRES

PART 1 GENERAL

1.01 SUBMITTALS

A. Product Data: For each type of ballet barre product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, features, and finishes. Include details of anchors, hardware, and fastenings. If applicable, include assembly, disassembly, and storage instructions.

B. Sustainable Design Submittals: Refer to Division 1 Section “Sustainable Design Requirements.”

C. Shop Drawings: Show location and extent of fully assembled ballet barres. Show location and extent of disassembled equipment and components and transport and storage accessories. Include elevations, sections, and details not shown in Product Data. Show method of field assembly, connections, installation details, mountings, attachments to other Work, and relationship to adjoining work.

D. Samples for Verification: Not required.

1.02 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of ballet barre equipment through one source from a single manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Product: Gerstung USA; Designer Pro Barre Brackets.

B. Acceptable Manufacturers:
   1. American Harlequin Corp.
   2. The Cartwheel Factory.
   3. Custom Barres.
   4. Gibson Athletic.
   5. MatsMatsMats.

2.02 MATERIALS, GENERAL

A. Steel Brackets: Steel fabrication as follows:
   1. Fixed Wall Type: Bar bracket or extension stud welded to predrilled mounting plate.
   2. Adjustable Wall Type: Extension stud with wing nut, washer and nut to lock to slotted wall-mounted channel.

B. Wood Barres: Red oak or hard maple, nominal 1-5/8 to 1-3/4-inch diameter. Sanded, unfinished.

C. Anchors, Fasteners, Fittings and Hardware: Manufacturer's standard corrosion-resistant or non-corrodible units to match bracket; to suit barre and supporting construction.

D. Mounting Boards: Wood, sanded and unfinished, 1 inch thick and 2 inches wider than bracket mounting plate.

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2.03 WALL-MOUNTED BARRES

A. General: Provide wall-mounted barres with accessories and anchorage devices.

B. Fixed Ballet Barre: Wall mounted **<< single barre; or double barres>>**.

1. Fixed height (top of barre): 42 inches. Confirm with Owner. ******Use this option for a single barre.******
2. Fixed height (top of barre): 42-inches top barre, 32-inches bottom barre. Confirm with Owner. ******Use this option for double barres.******

C. Support Brackets: Steel brackets at 64-inch maximum span. Provide maximum of three brackets per barre length.

D. Wall Clearance: 7 inches from wall to inside.

E. Metal Finish: **<< Chrome-plated; or Powder-coated, color as selected from manufacturer's standards>>**.

F. Wood Finish: Sanded natural finish, with eased edges at ends. Do not apply stains or varnishes.

PART 3 EXECUTION

3.01 EXAMINATION OF STUD WALL SUBSTRATES

A. Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements have been clearly marked for installers. Locate reinforcements and mark locations if not already done.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written installation instructions. Complete equipment field assembly, where required.

B. Coordinate installation of wall-mounted ballet barres with wall-mounted mirrors specified in Section **<< 088300 - Mirrors>>**.

C. Unless otherwise indicated, install ballet barres after other finishing operations, including painting, have been completed.

D. Permanently Placed Ballet Barres: Rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated on Shop Drawings.

E. Anchoring to In-Place Construction: Use anchors and fasteners necessary for securing ballet barres to structural support and for properly transferring load to in-place construction.

3.03 CLEANING AND PROTECTION

A. After completing ballet barre installation, inspect components. Remove spots, dirt, and debris and touch up damaged shop-applied finishes according to manufacturer's written instructions.

B. Provide final protection and maintain conditions acceptable to manufacturer and Installer that ensure ballet barres are without damage or deterioration at time of Substantial Completion.

C. Replace ballet barres and finishes that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 116613

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SECTION 116623
GYMNASIUM EQUIPMENT

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

D. ASTM F355 - Standard Test Method for Impact Attenuation of Playing Surface Systems, Other Protective Sport Systems, and Materials Used for Athletics, Recreation and Play.

E. ASTM F1081 - Standard Specification for Competition Wrestling Mats.

F. ASTM F2440 - Standard Specification for Indoor Wall/Feature Padding.

G. AWS D1.1/D1.1M - Structural Welding Code - Steel.

H. NFPA 70 - National Electrical Code.

I. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.

J. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Large Components: Ensure that large components can be moved into final position without damage to other construction.

B. Electrically Operated Equipment: Coordinate location and electrical characteristics of service connection.

1. Coordinate requirements for electrical raceways, junction boxes, wiring, disconnects, connections with the electrical contractor.

1.03 SUBMITTALS

A. Product Data: Provide manufacturer's data showing configuration, sizes, materials, finishes, hardware, and accessories; include:

1. Electrical characteristics and connection and wiring locations.
2. Fire rating certifications.
3. Manufacturer's installation instructions.

B. Shop Drawings: For custom fabricated equipment indicate, in large scale detail, construction methods; method of attachment or installation; type and gauge of metal, hardware, and fittings; plan front elevation; elevations and dimensions; minimum one cross section; utility requirements as to types, sizes, and locations.

C. Design Data: For backboard assemblies, provide structural analysis data; include load calculations at points of attachment to building structure. Structural data shall be signed and sealed by the Professional Structural Engineer responsible for their preparation.

D. Samples: Submit samples of **<< wall pad coverings; and divider curtain fabric>>**, in manufacturer's available range of **<< colors; textures; graphics; and _____>>**.

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1.04 CLOSEOUT SUBMITTALS

A. Operating and maintenance data for each operating equipment item.

B. Warranty: Submit manufacturer warranties and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Source Limitations: Provide each type of gymnasium equipment from a single manufacturer; furnished through a single supplier.

B. Installer Qualifications: Company specializing in performing work of the type specified with approval by manufacturer for installation of specified equipment.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to project site in manufacturer's original packaging with factory original labels attached.

B. Do not deliver until installation space is enclosed and conditioned.

C. Store products indoors and elevated above floor; prevent warping, twisting, or sagging.

D. Store products in accordance with manufacturer's instructions; protect from extremes of weather, temperature, moisture, and other damage.

1.07 WARRANTY

A. Divider Curtains: Provide five year manufacturer warranty for divider curtains, from date of Substantial Completion. Warranty shall cover deterioration or damage to divider curtain materials and defective operation.

B. Interior Basketball Backstops: Provide 5 year manufacturer warranty for interior basketball backstops, from date of Substantial Completion.

C. Basketball Backboards (Glass): Provide lifetime manufacturer warranty.

D. Manual Goal Height Adjuster: Provide 5 year manufacturer warranty, from date of Substantial Completion.

E. Basketball Goals: Provide 5 year manufacturer warranty, from date of Substantial Completion.

F. Backboard Safety Pads: Provide 5 year manufacturer warranty, from date of Substantial Completion.

G. Volleyball Standards and Hardware: Provide 5 year manufacturer warranty on standards and 3 year manufacturer warranty on other hardware, from date of Substantial Completion.

H. Interior Scoreboards: Provide 5 year manufacturer warranty for scoreboards and accessories, from date of Substantial Completion.

1. Wireless Controls: Provide 2 year manufacturer warranty, from date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. See drawings for sizes and locations, unless noted otherwise.

B. Where mounting dimensions or sizes are not indicated, comply with applicable requirements of the National Federation of State High School Associations (NFHS) sports rules.

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C. Provide mounting plates, brackets, and anchors of sufficient size and strength to securely attach equipment to building structure; comply with requirements of Contract Documents.

D. Hardware: Heavy duty steel hardware, as recommended by manufacturer.

E. Electrical Wiring and Components: Comply with **<<NFPA 70>>**; provide UL-listed equipment.

F. Structural Steel Fabrications: Welded in accordance with **<<AWS D1.1/D1.1M>>**, using certified welders.

2.02 GYMNASIUM DIVIDER CURTAINS

A. Gymnasium Divider Curtains; Fold-Up Type:

1. Curtain Material: Class A rated, self-extinguishing vinyl coated polyester complying with **<<NFPA 701>>**.
2. Hems & Seams: Double-thickness/double-turned mesh/fabric material, welded.
3. Upper Section: Not less than 7 oz/sq yd vinyl mesh fabric white color.
4. Lower Section: Not less than 18 oz/sq yd solid vinyl coated polyester.
   a. Color: To be selected by Architect from manufacturer's full range.
   b. Height Above Floor: 8 feet.
5. Overall Curtain Height: Floor to ceiling; so that bottom of curtain is 2 inches above floor in fully extended position.
6. Provide all structural steel overhead framing members, anchorage, fasteners, and hardware, and other components as required by manufacturer for a complete assembly and for secure mounting to overhead structure.
7. Operation: Vertical lift fold-up.
8. Folding Control System: Electric hoist with 115 volt actuator, manufacturer's standard motor of horsepower required for curtain size indicated**<< , integral limit switches that provide automatic shut-off in both positions; , _____; or None - N/A>>**, and safety catch with automatic reset.
9. Controls: Three-position surface mounted wall switch; key operated. Provide two keys per switch.
10. Width: As indicated on Drawings.
11. Manufacturers:
    a. Draper, Inc.
    b. Performance Sports Systems; a Gared Holdings company.
    c. Spalding.

2.03 BASKETBALL

A. Ceiling-Suspended Backstop Assemblies: Capable of mounting both rectangular and fan-shaped backboards.

1. Framing: Center mast, 6-5/8 inch diameter structural steel tube; with sway bracing to each side; provide folding direction and bracing location as indicated per product listings below.
   a. Fittings: Attached to 6-5/8 inch diameter center mast by heavy 1/4 inch thick precision saddle die-cut formed steel fittings, secured in place by 5/8 inch diameter U-bolt hardware. Strap type half clamps are not acceptable.
   b. Provide all structural steel overhead framing members, anchorage, fasteners, and hardware, and other components as required by manufacturer for a complete assembly and for secure mounting to overhead structure.

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2. Folding Control System: Electric hoist that folds backstop with 120 V, 3/4 HP motor, integral limit switches that provide automatic shut-off in both positions, and safety catch with automatic reset.
    a. Safety Catch: Provide safety device on all folding backstops. Safety device shall consist of nylon belt in an aluminum housing that limits free fall to no more than 3 inches in the event of mechanical failure of backstop components. Safety device shall be tested to catch a minimum 1750 lb free falling load, with minimum tensile strength of 6000 lbs.
        1) Strap Retractor: Provide accessory retractor device to hold safety cables/straps away from the field of play when backstop is in the lowered position.
3. Height Adjuster: Raises or lowers assembly by 2 feet to adjust goal height.
    a. Height Control System: Manual winch.
4. Framing Color: Manufacturer's standard.
5. Manufacturers (Forward-Fold; Rear-Braced): Provide at main courts in main gymnasium.
    a. Draper, Inc. Model TF-20J.
    b. Porter Athletic; Model 90917.
    c. Progressive Sports Construction Group; Model 817-FFRB.
    d. Performance Sports Systems; Model 3102/3103.
6. Manufacturers (Side-Fold; Side-Braced): Provide at side courts in main gymnasium, and all courts in auxiliary/second gymnasium, as applicable.
    a. Draper, Inc. Model TBS-26-B.
    b. Porter Athletic; Model 90955.
    c. Progressive Sports Construction Group; Model 855-SFB.
    d. Performance Sports Systems; Model 3108/3109.

B. Backboards: Tempered glass, rectangular shaped; 72 inch wide by 42 inch high.
1. Frame: Brushed aluminum edge, steel mounting.
2. Tempered Safety Glass: 1/2 inch thick; meeting the impact requirements of **<<16 CFR 1201>>** Category II or **<<ANSI Z97.1>>** Class A.
3. Markings: Painted or integrally manufactured, as standard with manufacturer.
4. Provide safety padding for bottom edge, corners, and lower portion of left and right edges of backboard.
5. Provide mounting kit for attachment to center strut type backstop.
6. Color: Manufacturer's standard.

C. Goals: Steel rim, mounted to backboard, with attached white nylon net; complete with mounting hardware.
1. Competition Net: White nylon anti-whip cord; 12-loop; between 15 and 18 inches long and sized for rim diameter; not less than 120- or more than 144-gm thread.
2. Net Attachment Device: Tube-tie.
3. Breakaway mechanism, adjustable (180 lb or 230 lb). Rebound characteristics shall be identical to those of a fixed goal per NCAA regulation.
4. Finish: Powder coated orange.

D. Electrical Controls and Accessories:
1. Equipment Mounting Board: Provide plywood mounting board with clear coat finish for each electric motor/operator. Size as required for equipment size.
2. Controls: Key-operated wall switch. Provide two keys per switch.

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a. Unless otherwise indicated, group controls for all folding backstops in a single location.
b. Coordinate switchplate covers with Division 26 electrical cover plates to match other cover plates in the space.

2.04 FLOOR-MOUNTED EQUIPMENT

A. Volleyball Systems: Provide complete system of adjustable posts, net, floor sleeves, and tensioning winch meeting requirements for FIVB, USA Volleyball, NCAA and NFHS competition requirements. ******Provide volleyball system at middle schools and high schools******
1. Quantity: **<< _____>>**.
2. Posts: 3-inch minimum OD schedule 80 aluminum tube with height adjustments between 42 and 96 inches at maximum 1 inch intervals.
3. Net: 4-inch square #36 nylon cord with vinyl coated polyester or canvas hem, double stitched around the perimeter.
   a. Top Hem Reinforcing: 2000 pound minimum break strength galvanized steel aircraft cable in nylon coating.
   b. Bottom Hem Reinforcing: 1/4-inch diameter braided nylon rope with spring loaded, pressure type rope tensioner.
   c. Size: NFHS regulation size; 32'-0" long by 3'-0" high, with 2-inch white top hem..
4. Tensioning Winch: **<< Manual crank; Power; or ___>>** heavy duty, self-locking worm gear mechanism.
5. Provide net antenna and boundary markers.
6. Protective Pads: Polyethylene foam covered with polyester reinforced vinyl fabric.
7. Manufacturers:
   a. Performance Sports Systems; Rallyline Scholastic Telescopic One-Court System.
   b. Porter Athletic; Powr Line Competition Package.
   c. Schelde Sports; A3 Plus Volleyball System.
   d. Senoh; Indoor Volleyball System (with D1300 aluminum posts).

B. Volleyball Referee Stand: Provide one referee stand. Referee stand shall be fabricated of heavy gauge steel, freestanding, with locking wheels / casters, and shall be foldable for compact storage. Stand shall have support railing on three sides. Provide with manufacturer's accessory padding to cover vertical posts; color to be selected from manufacturer's standard range.

C. Badminton Systems: Provide complete system of adjustable posts, net, and floor sleeves. ******Provide badminton systems at middle schools and high schools******
1. Quantity: **<< _____>>**.
2. Posts: 1-1/2-inch minimum OD powdercoated steel uprights.
3. Net: Nominal 3/4- to 1-inch square nylon, cotton, or polyethylene mesh with black finish, with manufacturer's standard vinyl coated polyester top, side, and bottom hems, double stitched around the perimeter.
   a. Top Hem Reinforcing: 1/4-inch diameter braided polyethylene rope.
   b. Size: 20'-0" or 21'-0" wide as standard with manufacturer; by 2'-6" high.
4. Manufacturers:
   a. Performance Sports Systems; Heavy Duty Sleeved Badminton System.
   b. Porter Athletic; 764100 Badminton Standards with 2236110 Badminton Net.
   c. Senoh; DG012100 Badminton Net Posts with DG801000 Badminton Net.

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D. Floor Sleeves for Posts: Metal sleeve, with latch cover, cast into concrete subfloor to hold poles for nets and goals; installed flush with finish floor surface. Sleeve diameter shall be sized for submitted volleyball or badminton systems.
   1. Latch Cover: Chrome- or brass-plated, round; tamper resistant lock with key.
   2. Sleeve: Steel.
   3. Depth of Sleeve: Manufacturer's standard from floor surface to bottom, including latch cover. Coordinate with depth of gym flooring assembly, and coordinate with concrete subcontractor to ensure proper sleeve locations and for required depth and sizing of slab at sleeve locations.
   4. Elevated Floor Slabs: Provide sleeve retainer to be bolted to the underside of the floor slab.

E. Floor Anchors for Portable Gymnastics Equipment: Steel plate cast into concrete, with center screw-down button for securing tensioned elements; installed flush with finish floor surface. ******Provide for High Schools only******
   1. Quantity of Anchors: Provide four anchors for high bar and four anchors for uneven parallel bars, unless otherwise indicated on Drawings. Verify final locations and dimensions with Owner prior to installation.
   2. Screw Size: 1/2-inch diameter, with 13 threads per inch.

2.05 MAT MOVERS

A. Stationary Mat Movers: Provide motorized hoist and sling assemblies for mat storage. Provide ceiling mounted mat hoist, for hoisting three minimum 14'-0" by 42'-0" mat sections. ******Existing schools with older mats require larger movers. Confirm sizes of mats with MCPS during design.******
   1. Provide all structural steel overhead framing members, anchorage, fasteners, and hardware, and other components as required by manufacturer for a complete assembly and for secure mounting to overhead structure.
   2. Winch/Operator: Electric hoist that raises or lowers mat mover with 208 V, 3 Phase, 60 Hz reduction drive motor with secondary chain and sprocket drive. Provide integral limit switches that provide automatic shut-off in both positions, and safety catch with emergency lowering manual override. Provide motor horsepower as required by manufacturer for mat mover size indicated.
      a. If manufacturer's standard hoist system requires two motors, include a monitoring controller to ensure the motors remain synchronized throughout the up/down cycle.
      b. Provide key switch control station, adjacent to other switches in the gymnasium. Coordinate switchplate covers with Division 26 electrical cover plates to match other cover plates in the space.
   3. Manufacturers:
      a. Draper, Inc; Sectional Mat Lifter - 502069.
      b. NGE Mat Hoist; Mat Hoist Model Maxi Mini.
      c. Porter Athletic; Stationary Mini Mat Mover; Model 91105100N.

2.06 EXERCISE EQUIPMENT

A. Ceiling Mounted Rings: Two rings on free hanging cables, mounted on ceiling beam with safety str; comply with International Gymnastics Federation (FIG) rules. ******High Schools only.******
   1. Rings: Wood.
   2. Cables: Plastic-coated steel cables, attached to nylon webbing for rings.

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3. Ring Height From Floor: Adjustable height; 48 inches to 102 inches.
4. Mounting: Building structure.
5. Manufacturers:
   a. Gibson Athletic; Model #RN85400. ******Basis of Design.******
   b. Gerstung International.
   c. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Climbing Ropes: Heavy duty rope, hung vertically from pipe beam secured to ceiling structure, unsecured at bottom. ******Elementary Schools only******
   1. Construction: Manufacturer's standard material; with top end securely clamped in a fitting specifically designed for attaching to supporting pipe beam structure.
      a. Provide four total ropes; two with knots distributed along rope as climbing aids, and two without knots.
   2. Diameter: 1-1/2 inches, nominal.
   3. Length: From ceiling attachment point to floor with extra 42 inches length to lie on floor.
   4. End: Provide knotted end on all ropes.
   5. Safety Cable Attachment: Provide attachment accessory fabricated of 3/16-inch chain or 1/8-inch diameter cable, with clamp and fittings, designed as backup attachment to pipe beam.
   6. Pipe Beam: Not less than 3-1/2-inch OD steel pipe or tubing beam, with not less than 2-3/8-inch OD drop pipes, and all bracing, connectors, and fasteners; designed to transfer loads and securely attach to overhead supporting structural elements.
   7. Rope Hoist: Manual hoist system to raise climbing ropes out of the way of other activities. Rope hoist shall be wall attached; consisting of #10 bell cord or 1/4-inch diameter synthetic polyfiber rope with snap swivel fittings, rope adjuster, rope weight, weight bag, pulley and rope cleat; and with clear-finished wood wall attachment pads for pulley and cleat attachment; provide with clamps and fasteners.
      a. Provide one rope hoist system per two climbing ropes.
      b. Include warning signage mounted adjacent to rope hoist that climbing equipment should only be used with proper supervision and with safety mats.

2.07 BATTING CAGES AND NETTING ******PROVIDE FOR HIGH SCHOOLS ONLY******

A. Basis-of-Design Product: Provide Porter #90900-00 or a comparable product by one of the following:
   1. AALCO Manufacturing.
   2. IPI by Bison.
   3. Performance Sports Systems.
   4. Progressive Sports Construction Group.

B. Indoor Retractable Batting Cage: Provide custom size netting, nominal size as indicated on Drawings.
   1. Provide integrally colored 2.5 mm braided polyester fiber netting with knotted construction. Twisted polyester fiber or nylon fiber netting is not acceptable.
   2. Provide welded framework of 1.75-inch by 14 gage square steel tube finished with black powder coat, and eyebolts for netting attachment.
   3. Provide retractable 3/4 HP, 115 V batting cage winch, cable and mounting accessories required for installation.
   4. Controls: Three-position wall switch; key operated. Provide two keys per switch.

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a. Coordinate switchplate cover with Division 26 electrical cover plates to match other cover plates in the space.

2.08 ARCHERY NETS ***PROVIDE FOR MIDDLE SCHOOLS AND HIGH SCHOOLS***

A. General: Provide heavy-duty closed nylon mesh, fold-up archery nets; size 42 feet long by 10 feet high; with bound edges, reinforced seams, and brass grommets at top.
   1. Color shall be selected from manufacturer's standard options.
   2. Provide retractable 3/4 HP, 115 V winch, including all cable and mounting accessories required for installation.
   3. Controls: Three-position wall switch; key operated. Provide two keys per switch.
      a. Coordinate switchplate cover with Division 26 electrical cover plates to match other cover plates in the space.

2.09 WALL PADDING

A. Wall Padding: **<<ASTM F2440>>** and **<<NFPA 286>>** compliant; fire-retardant foam filling bonded to backing board, wrapped in covering; each panel fabricated in one piece.
   1. Surface Burning Characteristics: Flame spread index (FSI) of 25 or less, smoke developed index (SDI) of 450 or less, Class A, when tested in accordance with **<<ASTM E84>>** as a complete panel.
   2. Flammability: Entire assembly shall be tested to **<<NFPA 286>>** and shall meet the following criteria:
      a. During the 40 kW exposure, flames shall not spread to the ceiling.
      b. During the 160 kW exposure:
         1) Flame shall not spread to the outer extremity of the sample on any wall or ceiling.
         2) Flashover, as defined in NFPA 286, shall not occur.
      c. The peak rate of heat release throughout the NFPA 286 test shall not exceed 800 kW.
      d. The total smoke released throughout the NFPA 286 test shall not exceed 1,000 m^2.
   3. Impact Resistance: Entire assembly shall be tested to and meet the impact resistance criteria of **<<ASTM F2440>>**.
   4. Covering: Vinyl-coated polyester fabric, mildew and rot resistant.
      a. Fire Resistance: Covering shall pass **<<NFPA 701>>**.
      b. Fabric Weight: 14 oz/sq yd, minimum.
      c. Color: To be selected by Architect from manufacturer's full range.
   5. Foam, Fire-Rated: Open cell polychloroprene (Neoprene), with 5.5 pcf nominal density.
   6. Foam Thickness: Not less than 2 inches.
   7. Backing Board: Plywood.
      a. Thickness: 3/8-inch, minimum.
   8. Mounting: Minimum three rows of Z-clips fixed to wall and to padding. Nailer strips are not acceptable.
   9. Manufacturers:
      a. IPI by Bison, Inc; Firewall Wall Padding.
      b. Performance Sports Systems, Inc; Model 4130 Fire Retardant Wall Padding.
      c. Porter Athletic, Inc; 575 FireSafe Wall Pad.

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B. Specially Shaped Padding: Same construction as standard padding; custom fabricate padding to fit irregularly shaped members, areas, and protrusions in gymnasium as indicated; provide padding for:
   1. I-beams.
   2. Wall corners.

C. Pad Cutout Accessories: Provide manufacturer's fire-retardant treated, molded rubber inserts as trim around field cutouts at outlets, switches, and other wall mounted elements. Secure molded inserts to back of wall pads.

2.10 SCOREBOARDS

A. Main Gymnasium: Provide the following interior scoreboards and accessories for main court only. All displays shall be LED. ******Provide this set of scoreboards for High School Main Gym only******
   1. (2) Interior Scoreboards: Approximately 8'-0" wide by 6'-0" high by 6 inches deep, with "double-bonus" foul indicator and "time-outs left" accessory features, and with 13 inch high digits. **<< Provide with customizable electronic team name message centers in lieu of "home" and "guest" captions. ; or None - N/A>>**Scoreboard shall also provide scoring for volleyball and wrestling. Provide 120 V (200W, 60 Hz, 1.7A) electrical configuration. Scoreboard color shall be selected by Architect from manufacturer's standard range.
      a. Manufacturers:
         1) Daktronics; Model # BB-2103-13. (10'-0"W x 6'-0"H x 6"D)
         2) Fair-Play; Model # BB-3660-4. (9'-0"W x 5'-6"H x 4"D)
         3) Nevco; Model # 2770. (8'-0"W x 6'-0"H x 8"D)
   2. (2) Stats Display Panels (Shall be provided at one main gym scoreboard only - mount to each side of scoreboard): Approximately 3'-0" wide; height and depth shall match scoreboard; with six (6) individual player numbers, points scored, and fouls committed. **<< Provide reversible / interchangeable plates to show "digs", "aces", and "kills" for volleyball scoring. ; or None - N/A>>**Provide 120 V (200W, 60 Hz, 1.6A) electrical configuration. Match color of primary scoreboard.
      a. Manufacturers:
         1) Daktronics; Model # SD-2102. (3'-6"W x 6'-0"H x 6"D)
         2) Fair-Play; Model # SP-3606-4. (3'-0"W x 5'-6"H x 4"D)
         3) Nevco; Model # SD7-5. (3'-0"W x 6'-0"H x 8"D)
   3. (2) Shot Clocks: Approximately 1'-10" wide by 1'-7" high by 6 inches deep, single-sided shot clock with 13 inch high digits. Provide unit compatible for mounting to top of basketball backstops; provide accessory mounting kit if required. Include built-in horn. Provide 120 V (40W, 60 Hz, 0.7A) electrical configuration. Manufacturer's standard black finish case. Include hand held shot clock controllers that are compatible with main wireless controller.
      a. Manufacturers:
         1) Daktronics; Model # BB-2114-13.
         2) Fair-Play; Model # ST-1405-4. (1'-8"W x 1'-5"H by 4"D)
         3) Nevco; Model # SCD-5 with SBSK-1 mounting kit. (1'-10"W x 1'-8.5"H by 7"D)
   4. (1) Controller: Manufacturer's standard multiple sport wireless controller with protective case. Provide 120 V (6W, 60 Hz) electrical configuration. Provide with minimum 25 foot power cord.
      a. Manufacturers:

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1) Daktronics; All Sport 5000.
2) Fair-Play; MP-80.
3) Nevco; MPCW-7.

B. Auxiliary Gym: Provide the following interior scoreboards and accessories in the auxiliary gym. All displays shall be LED. ******Provide this set of scoreboards for High School Aux gym only******

1. (1) Interior Scoreboard: Approximately 8'-0" wide by 6'-0" high by 6 inches deep, with "double-bonus" foul indicator and "time-outs left" accessory features, and with 13 inch high digits. **<< Provide with customizable electronic team name message centers in lieu of "home" and "guest" captions. ; or None - N/A>>**Scoreboard shall also provide scoring for volleyball and wrestling. Provide 120 V (200W, 60 Hz, 1.7A) electrical configuration. Scoreboard color shall be selected by Architect from manufacturer's standard range.
   a. Manufacturers:
      1) Daktronics; Model # BB-2103-13. (Basis-of-Design)
      2) Fair-Play; Model # BB-3660-4. (9'-0"W x 5'-6"H x 4"D)
      3) Nevco; Model # 2770-D. (8'-0"W x 6'-0"H x 8"D)
2. (1 Pair) Shot Clocks: Approximately 1'-10" wide by 1'-7" high by 6 inches deep, single-sided shot clock with 13 inch high digits. Provide unit compatible for mounting to top of basketball backstops; provide accessory mounting kit if required. Include built-in horn. Provide 120 V (40W, 60 Hz, 0.7A) electrical configuration. Manufacturer's standard black finish case. Include hand held shot clock controllers that are compatible with main wireless controller.
   a. Manufacturers:
      1) Daktronics; Model # BB-2114-13.
      2) Fair-Play; Model # ST-1405-4. (1'-8"W x 1'-5"H by 4"D)
      3) Nevco; Model # SCD-5 with SBSK-1 mounting kit. (1'-10"W x 1'-8.5"H by 7"D)
3. (1) Controller: Manufacturer's standard multiple sport wireless controller with protective case. Provide 120 V (6W, 60 Hz) electrical configuration. Provide with minimum 25 foot power cord.
   a. Manufacturers:
      1) Daktronics; All Sport 5000.
      2) Fair-Play; MP-80.
      3) Nevco; MPCW-5.

C. Main Gymnasium: Provide the following interior scoreboards and accessories for main court only. All displays shall be LED. ******Provide this scoreboard for Middle Schools only******

1. (1) Interior Scoreboard: Approximately 8'-0" wide by 6'-0" high by 6 inches deep, with "double-bonus" foul indicator and "time-outs left" accessory features, and with 13 inch high digits. **<< Provide with customizable electronic team name message centers in lieu of "home" and "guest" captions. ; or None - N/A>>**Scoreboard shall also provide scoring for volleyball and wrestling. Provide 120 V (200W, 60 Hz, 1.7A) electrical configuration. Scoreboard color shall be selected by Architect from manufacturer's standard range.
   a. Manufacturers:
      1) Daktronics; Model # BB-2103-13. (10'-0"W x 6'-0"H x 6"D)
      2) Fair-Play; Model # BB-3660-4. (9'-0"W x 5'-6"H x 4"D)
      3) Nevco; Model # 2770. (8'-0"W x 6'-0"H x 8"D)

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2. (1) Controller: Manufacturer's standard multiple sport wireless controller with protective case. Provide 120 V (6W, 60 Hz) electrical configuration. Provide with minimum 25 foot power cord.
    a. Manufacturers:
        1) Daktronics; All Sport 5000.
        2) Fair-Play; MP-80.
        3) Nevco; MPCW-7.

PART 3 EXECUTION

3.01 EXAMINATION

A. Take field measurements to ensure proper fitting of work. If taking field measurements before fabrication will delay work, allow for adjustments within recommended tolerances.

B. Inspect areas and conditions before installation, and notify Architect in writing of unsatisfactory or detrimental conditions.

C. Do not proceed with this work until conditions have been corrected; commencing installation constitutes acceptance of work site conditions.

D. Verify that electrical services are correctly located and have proper characteristics.

3.02 INSTALLATION

A. Install in accordance with Contract Documents and manufacturer's instructions.

B. Coordinate installation of inserts and anchors that must be built in to flooring or subflooring.

C. Install equipment rigid, straight, plumb, and level.

D. Secure equipment with manufacturer's recommended anchoring devices.

E. Install wall padding securely, with edges tight to wall and without wrinkles in fabric covering. Mount wall padding with bottom of pad assembly directly above top of resilient base product, not higher than 6 inches above finished floor level.

F. Separate dissimilar metals to prevent electrolytic corrosion.

3.03 ADJUSTING

A. Verify proper placement of equipment.

B. Verify proper placement of equipment anchors and sleeves, and use actual movable equipment to be anchored if available.

C. Adjust operating equipment for proper operation; remove and replace equipment causing noise or vibration; lubricate equipment as recommended by manufacturer.

3.04 CLEANING

A. Remove masking or protective covering from finished surfaces.

B. Clean equipment in accordance with manufacturer's recommendations.

3.05 PROTECTION

A. Protect installed products until Date of Substantial Completion.

B. Replace damaged products before Date of Substantial Completion.

END OF SECTION 116623

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SECTION 116843
EXTERIOR SCOREBOARDS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

C. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

D. ASTM C150/C150M - Standard Specification for Portland Cement.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

F. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.

G. AWS D1.1/D1.1M - Structural Welding Code - Steel.

H. NFPA 70 - National Electrical Code.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Large Components: Ensure that large components can be moved into final position without damage to other construction.

B. Electrically Operated Equipment: Coordinate location and electrical characteristics of service connection.

1. Coordinate requirements for electrical raceways, junction boxes, wiring, disconnects, connections with the electrical contractor.

1.03 SUBMITTALS

A. Product Data: Provide manufacturer's data showing configuration, sizes, materials, finishes, hardware, and accessories; include:

1. Electrical characteristics and connection and wiring locations.
2. Manufacturer's installation instructions.

B. Shop Drawings: Indicate locations, sizes and dimensions, face layouts, construction methods; method of attachment or installation; type and gauge of metal, hardware, and fittings; plan front elevation; elevations and dimensions; minimum one cross section.

1. Indicate utility requirements including electrical wiring diagrams.

C. Design Data: Provide structural and physical characteristics and engineering calculations for support structure framing and foundations/footings; identify dimensional limitations; include load calculations at points of attachment to building structure.

D. Samples: Provide color charts or chips indicating full range of manufacturer's available colors.

E. Erection Drawings: Detailed dimensional requirements for proper location of support structure and scoreboards.

F. Designer's Qualification Statement.

G. Operating and maintenance data for each operating equipment item.

H. Welders' Qualification Statement: Welders' certificates in accordance with **<<AWS B2.1/B2.1M>>** and dated no more than 12 months before start of scheduled welding work.

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I. Warranty: Submit manufacturer warranties and ensure that forms have been completed in **<<Owner>>**'s name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Designer Qualifications: Design steel support structures and concrete foundations under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in **<<the State in which the Project is located>>**.

B. Welder Qualifications: Welding processes and welding operators qualified in accordance with **<<AWS D1.1/D1.1M>>** and no more than 12 months before start of scheduled welding work.

C. Source Limitations: Provide all scoreboards, controllers, and accessories by a single manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to project site in manufacturer's original packaging with factory original labels attached.

B. Do not deliver until installation space is enclosed and conditioned.

C. Store products indoors and elevated above floor; prevent warping, twisting, or sagging.

D. Store products in accordance with manufacturer's instructions; protect from extremes of weather, temperature, moisture, and other damage.

1.06 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Exterior Scoreboards: Provide 5 year manufacturer warranty for scoreboards and accessories, from date of Substantial Completion.

1. Wireless Controls: Provide 2 year manufacturer warranty, from date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS & MATERIALS

A. Refer to drawings for sizes and locations, unless noted otherwise.

B. Provide mounting plates, brackets, and anchors of sufficient size and strength to securely attach scoreboards to support structure; comply with requirements of Contract Documents.

1. Mounting Brackets: Provide S and J brackets, fabricated of minimum 5/16-inch thickness steel plate; size and spacing recommended by manufacturer for secure attachment of scoreboards to support structure.
2. Provide bolts, anchors, and fasteners of non-corroding, tamper- and vandal-resistant materials; provide concealed anchorage to greatest extent possible.

C. Hardware: Heavy duty steel hardware, as recommended by manufacturer.

D. Electrical Wiring and Components: Comply with **<<NFPA 70>>**; provide UL-listed equipment.

1. Provide each scoreboard with all required control cable of length required, junction boxes, and other accessories for complete, functional installation. Coordinate with Division 26 electrical subcontractor for supply junction box location at base of each scoreboard.

E. Steel Support Structure and Foundations: Coordinate with Structural and Civil Drawings and as follows:

1. Concrete: **<<ASTM C150/C150M>>**; minimum 3,000 psi concrete.

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2. Structural Steel: **<<ASTM A36/A36M>>** steel sections or **<<ASTM A500/A500M>>** steel tubing, welded in accordance with **<<AWS D1.1/D1.1M>>**, using certified welders. Galvanize after fabrication to **<<ASTM A123/A123M>>**.

2.02 MULTI-SPORT SCOREBOARD

A. Football/Field Hockey/Lacrosse/Soccer Scoreboard: Provide the following multi-sport exterior scoreboard and accessories. All displays shall be LED.

1. (1) Exterior Scoreboard: Approximately 25'-0" wide by 10'-0" high by 8 inches deep, with integral horn and clock timer display to 1/100 second for track and when under one minute to play. Electrical: 120 V (60 Hz, 15A) electrical configuration.
    a. Provide with customizable LED electronic team name message centers in lieu of "home" and "guest" captions.
    b. Provide with LED electronic captions for all features; accessory features shall be changeable by sport from the control console. Captions shall allow for white or colored display.
        1) Electronic captions shall be included for at minimum the following accessory features: "Qtr", "Down", "To Go", "T.O.L.", "Ball On", and Possession Indicator (football), "Player", "Penalty", "Period", and Possession Indicator (lacrosse/field hockey), and "Saves", "S.O.G.", and "Half" (soccer).
    c. Digit Sizes: 24 inches (clock digits and team scores); 18 inches (accessory features).
    d. Scoreboard color shall be selected by Architect from manufacturer's standard range.
    e. Products:
        1) Daktronics; Model # MS-2009. (Basis-of-Design)
        2) Nevco; Model # 5685 (24'-0"W by 10'-0"H by 8"D).
2. (2) Delay-of-Game/Field Timers: Approximately 40 inch wide by 28 inch high by 8 inch deep, single-sided timer with 24 inch high digits. Include built-in horn. Provide 120 V (40W, 60 Hz, 0.7A) electrical configuration. Manufacturer's standard black finish case. Play clocks shall be controllable from main wireless controller. Install one at each end of field; verify final locations with Owner.
    a. Manufacturers:
        1) Daktronics; Model # TI-2015.
        2) Nevco; Model # FT-. (48"W x 48"H by 8"D)

2.03 BASEBALL/SOFTBALL SCOREBOARDS

A. Baseball/Softball Scoreboards: Provide the following exterior scoreboards and accessories. All displays shall be LED.

1. (1) Exterior Scoreboard (Baseball): Approximately 14'-0" wide by 5'-0" high by 8" deep. Electrical: 120 V (60 Hz, 8A) electrical configuration.
    a. Provide with permanent customized vinyl caption for home mascot (verify with Owner), and with manufacturer's standard "guest" caption.
    b. Provide with "H/E", "Ball", "Strike", and "Out", and ball possession indicator accessory features.
    c. Digit Sizes: 18 inches (Home and Guest scores and Inning). Ball, Strike, Out, and H/E indicators shall be 2-inch diameter circular indicators.
    d. Scoreboard color shall be selected by Architect from manufacturer's standard range.
    e. Products:
        1) Daktronics; Model # BA-618. (Basis-of-Design)
        2) Fair-Play; Model # BA-7100-2 (14'-0"W by 5'-0"H by 10"D).

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3) Nevco; Model # 1600 (16'-0"W by 5'-0"H by 8"D).

2. (1) Exterior Scoreboard (Softball): Approximately 9'-0" wide by 4'-0" high by 8" deep. Electrical: 120 V (60 Hz, 8A) electrical configuration.
   a. Provide with permanent customized vinyl caption for home mascot (verify with Owner), and with manufacturer's standard "guest" caption.
   b. Provide with "Inning", "Ball", "Strike", and "Out" indicator accessory features.
   c. Digit Sizes: 18 inches (Home and Guest scores and Inning). Ball, Strike, and Out indicators shall be 2-inch diameter circular indicators.
   d. Scoreboard color shall be selected by Architect from manufacturer's standard range.
   e. Products:
      1) Daktronics; Model # BA-2518. (Basis-of-Design)
      2) Fair-Play; Model # BA-7109-2 (9'-0"W by 4'-0"H by 10"D).
      3) Nevco; Model # 1610 (10'-0"W by 4'-0"H by 8"D).

2.04 CONTROL CENTERS

A. Controllers (provide one for each scoreboard): Manufacturer's standard multi-sport wireless controller with protective case. Provide 120 V (6W, 60 Hz) electrical configuration. Provide with minimum 25 foot power cord.
   1. Unit shall comply with FCC rules regarding interference.
   2. Receiver: Provide manufacturer's standard; approximately 6-inch by 4-inch nominal receiver box mounted at scoreboard.
   3. Range: Minimum 1,000 feet from control center to receiver.
   4. Adapter: Provide with adapter for each receiver for 120V input and 9V output.
   5. Products:
      a. Daktronics; All Sport 5000.
      b. Fair-Play; MP-80.
      c. Nevco; MPCW-7.

PART 3 EXECUTION

3.01 EXAMINATION

A. Take field measurements to ensure proper fitting of work. If taking field measurements before fabrication will delay work, allow for adjustments within recommended tolerances.

B. Inspect areas and conditions before installation, and notify **<<Architect>>** in writing of unsatisfactory or detrimental conditions.

C. Do not proceed with this work until conditions have been corrected; commencing installation constitutes acceptance of work site conditions.

D. Verify that electrical services are correctly located and have proper characteristics.

3.02 INSTALLATION

A. Install in accordance with Contract Documents and manufacturer's instructions.

B. Coordinate installation of inserts and anchors that must be built in to flooring or subflooring.

C. Install equipment rigid, straight, plumb, and level.

D. Clearances:

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1. Install scoreboards at height required to clear fence height or as indicated on Drawings, but with not less than 10 feet between grade level and bottom of scoreboard.
2. Provide a minimum of 36 inches clearance behind scoreboard to allow access to panel doors.

E. Secure equipment with manufacturer's recommended anchoring devices.

F. Separate dissimilar metals to prevent electrolytic corrosion.

3.03 ADJUSTING

A. Verify proper placement of equipment.

B. Verify proper placement of equipment anchors and sleeves, and use actual movable equipment to be anchored if available.

C. Adjust operating equipment for proper operation; remove and replace equipment causing noise or vibration; lubricate equipment as recommended by manufacturer.

D. Field Quality Control: Field test each scoreboard with manufacturer's representative; ensure that all scoreboard functions operate correctly. Provide adjustments as required.

3.04 DEMONSTRATION AND TRAINING

A. Demonstration and Training: Demonstrate and provide training on operation and maintenance of each type of scoreboard to **<<Owner>>**'s personnel.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of two hours training by manufacturer's authorized personnel at Project site using installed scoreboards.

3.05 CLEANING

A. Remove masking or protective covering from finished surfaces.

B. Clean equipment in accordance with manufacturer's recommendations.

3.06 PROTECTION

A. Protect installed products until Date of Substantial Completion.

B. Replace damaged products before Date of Substantial Completion.

END OF SECTION 116843

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SECTION 117300
PATIENT CARE EQUIPMENT

PART 1 GENERAL

1.01 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.02 SUBMITTALS

A. Product Data: Provide manufacturer's data sheets of **<< operating system components; track system components; track depth; track maneuverability systems; slings; accessories; and _____>>**. Indicate **<< dimensions; performance requirements; service requirements; materials; finishes; options; and _____>>**

B. Shop Drawings: Indicate **<< dimensions; reflected ceiling plan track layouts; above-ceiling support requirements; attachment-to-support details; point loads; power-supply connections; and _____>>**.

C. Operation Data: Include description of equipment operation and required adjusting and testing.

D. Maintenance Data: Identify system maintenance requirements, servicing cycles, lubrication types required and local **<< local; or None - N/A>>** spare part sources.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Package equipment to project site in protective packaging.

B. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.

PART 2 PRODUCTS

2.01 EXAM/TREATMENT/CHANGING TABLE

A. Exam / Treatment / Changing Table Manufacturers:
   1. Basis of Design Product: Midmark; Ritter 244 Barrier-Free Exam Table.
   2. Other Acceptable Manufacturers:
      a. Armedica Manufacturing.
      b. Clinton Industries, Inc.
      c. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Description: Freestanding mobile unit with locking casters, minimum 80 inches long by 30 inches wide, height adjustable, with multi-position adjustable-angle back and seat sections.
   1. Exam table shall be bariatric-grade and shall be engineered to support a minimum of 500-lb static load when opened.
   2. Conform to ADA accessibility requirements.
   3. Operation: Foot-operated electrical (120V); operates a pneumatic or hydraulic mechanism to raise and lower the entire unit and operate the back and seat sections.
   4. Material and Finish: Manufacturer's standard vinyl upholstered finish; color selected by Architect from manufacturer's standard range.

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2.02 SPECIAL NEEDS CHANGING TABLE

A. Special Needs Changing Table Manufacturers:
   1. Basis of Design Product: Koala Kare Products; KB3000-AHL Adult Changing Station
   2. Other Acceptable Manufacturers:
      a. Armedica Manufacturing.
      b. Clinton Industries, Inc.
      c. Midmark Corporation.
      d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Description: Wall mounted, motorized, height-adjustable changing station with safety rails and emergency stop feature.
   1. Operation: Unit shall have two sets of built-in electronic controls for height adjustment located at face of wall and on front of changing surface.
   2. Changing station shall be engineered to support a minimum of 500 pound static load.
   3. Unit shall have a protection system against electrical shock and beUL certified.
   4. Backup Battery: Unit shall have a built-in backup battery system that allows for continuous operation during power interruption
   5. Emergency Stop: Emergency stop to break power to actuator shall be wall-mounted.
   6. Safety Requirements: Unit shall withstand significant exposure to water without damage to electrical components. It shall include a grounded power cord and have a splash-proof control system. Electrical components and wiring shall not come in contact with station users or caregivers.
   7. Frame: 2 inch powder coat.
   8. Changing Surface Material: HDPE.

2.03 MOUNTING HARDWARE FOR SPECIAL NEEDS SWING

A. Lay-In Ceiling Installation Kit: Provide prefabricated hardware kit for mounting eyebolt below suspended ceiling, braced to joist structure above. Basis-of-Design Product is www.eSpecialNeeds.com; “Prefab Joist Installation Kit."
   1. Accessories: Provide eyebolt and additional accessories required for installation below lay-in ceiling at height indicated. Provide accessories compatible with both prefabricated mounting kit and safety rotational device.

B. Safety Rotational Device: Heavy-Duty, swivel device with minimum working load of 1000 lbs. Basis-of-Design Product is www.eSpecialNeeds.com; “Heavy Duty Swing Rotational Device."
   1. Accessories: Provide one compatible carabiner for each end of safety rotational device, to provide for attachment to eyebolt hardware above and for future installation of Owner’s swing below (swing is NIC). Working load of carabiner shall meet that of safety rotational device.

2.04 ACCESSORIES

A. Installation Accessories: Provide necessary accessories and closure trim as required for complete installation.

B. Fasteners: Manufacturer's standard inserts, anchors, bolts, rivets, and screws appropriate for project conditions; corrosion-resistant.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Examine areas and conditions, with installer present, for compliance with requirements of supporting structural members, installation tolerances, and other conditions that may impact performance of equipment.
   1. Do not install equipment until finishes in the space are complete and space is conditioned at occupancy conditions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions and approved shop drawings.

B. Set components plumb, level, and rigid.

C. Install anchors in accordance with anchor manufacturer's installation guidelines.

D. Interface With Other Work: Use pop rivets or screws to attach L-shaped perimeter moldings of ceiling to lift equipment track.

3.03 ADJUSTING

A. Adjust operating equipment for smooth and efficient operation throughout full operating cycle.

3.04 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate operation of equipment to **<<Owner>>**'s personnel.
   1. Use operation and maintenance data as reference during demonstration.
   2. Briefly describe function, operation, and maintenance of each component.

B. Training: Train **<<Owner>>**'s personnel on operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of **<< two hours; one day; or _____>>** of training.
   3. Location: At project site.

3.05 CLEANING AND PROTECTION

A. Remove labels, fingerprints; clean surfaces. Repair any marred or damaged surfaces that effect appearance in manner not acceptable to **<<Owner>>**. Replace any parts that cannot be repaired in such a manner.

B. Protect installed equipment from subsequent construction operations.

END OF SECTION 117300

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SECTION 118129
FACILITY FALL PROTECTION

PART 1 GENERAL

1.01 DEFINITIONS

A. Anchorage: A secure connecting point or a terminating component of a fall protection system or rescue system capable of safely supporting the impact forces applied by a fall protection system or anchorage subsystem.

B. Lifeline: A component of a fall protection system consisting of a flexible line designed to hang vertically, a vertical lifeline, or connecting to anchorages or anchorage connectors at both ends to span horizontally, a horizontal lifeline.

1.02 REFERENCE STANDARDS

A. 29 CFR 1910 - Occupational Safety and Health Standards.

B. 29 CFR 1910.27 - Scaffolds and Rope Descent Systems.

C. 29 CFR 1910.66 - Powered Platforms for Building Maintenance.

D. 29 CFR 1910.140 - Personal fall protection systems.

E. 29 CFR 1926 - Safety and Health Regulations for Construction.

F. 29 CFR 1926.502 - Fall protection systems criteria and practices.

G. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary.

H. AISC 360 - Specification for Structural Steel Buildings.

I. ANSI/ASSP Z359.7 - Qualification and Verification Testing of Fall Protection Products.

J. ANSI/ASSP Z359.12 - Connecting Components for Personal Fall Arrest Systems.

K. ANSI/ASSP Z359.15 - Safety Requirements for Single Anchor Lifelines and Fall Arresters for Personal Fall Arrest Systems.

L. ANSI/ASSP Z359.18 - Safety Requirements for Anchorage Connectors for Active Fall Protection Systems.

M. ANSI/IWCA I-14 - Window Cleaning Safety Standard.

N. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

O. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.

P. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

Q. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

R. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

S. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.

T. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

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U. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

V. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

W. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

X. ASTM A1023/A1023M - Standard Specification for Carbon Steel Wire Ropes for General Purposes.

Y. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi, 144 ksi, and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.

Z. AWS D1.1/D1.1M - Structural Welding Code - Steel.

AA. ICC (IBC) - International Building Code.

BB. ISO/IEC 17025 - General Requirements for the Competence of Testing and Calibration Laboratories.

CC. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate installation of roof anchors with Division 7 roofing manufacturer to verify anchors are compatible in a warrantable roof assembly.
   2. Coordinate with Division 5 steel fabricator for installation to steel structure/roof deck.

1.04 SUBMITTALS

A. Product Data: Material, equipment, and fixture lists. Manufacturer’s catalog data indicating the sizes, descriptions, capacities, test certifications, and other descriptive data showing in sufficient detail that product complies with contract requirements.

B. Shop Drawings: Installation details: plan showing locations and types of anchorage points for personal fall protection systems and building maintenance equipment.
   1. Detail mounting, securing, and flashing of roof-mounted items to roof structure. Indicate coordinating requirements with roof membrane system.
   2. Indicate anchorage details and quantity, diameter, and depth of penetration of anchors.

C. Delegated Design Documents: Drawings and calculations sealed by Designer for fall protection system, indicating compliance with performance requirements and design criteria.

D. Test Report: Indicating completion of proof load testing on installed systems.

E. Manufacturer's Installation Instructions: Instructions indicating recommended method and sequence of installation for lifeline anchors, safety tieback anchors, energy-absorbing devices, and lifeline cable.

F. Designer's qualification statement.

G. Installer's qualification statement.

H. Testing agency's qualification statement.

I. Operation Data: Provide operating instructions and identify unit limitations.

J. Maintenance Data: Include parts list and maintenance requirements for equipment.

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1.05 QUALITY ASSURANCE

A. Designer Qualifications: Perform design under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in **<<the State in which the Project is located>>**.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.

1.06 WARRANTY

A. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 ROOF ANCHORS

A. Manufacturers - Penetrating Anchors:
   1. 3M.
   2. Guardian Fall Protection.
   3. Pro-Bel Enterprises Ltd.
   4. Summit Anchor Company.
   5. Tractel.
   6. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Manufacturers - Clamping, Non-Penetrating Anchors:
   1. 3M.
   2. Diversified Fall Protection.
   3. Kee Safety.
   4. Hy-Safe.
   5. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

C. Application:
   1. OSHA and ANSI one person PPE anchor.

D. Description:
   1. Roof anchorage points for personal fall protection systems; used exclusively for employee fall protection and independent of any anchorage used to suspend employees or platforms on which employees work.
      a. Anchor Type per **<<ANSI/ASSP Z359.18>>**: Type A.

E. Structural Performance: Provide safety tieback anchors capable of withstanding design loads as required by governing regulations and codes.

F. Design Criteria: Fall protection anchors.
   1. Comply with **<<29 CFR 1910.140>>** and **<<29 CFR 1926.502>>** for personal fall protection systems and anchorage.
   2. Comply with **<<29 CFR 1926>>**, Subpart M-Fall Protection.
   3. Comply with **<<ANSI/ASSP Z359.18>>** test requirements for static strength, dynamic strength, residual strength, serviceability, and corrosion of anchorage.

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a. Testing Labs: Meet requirements of **<<ANSI/ASSP Z359.7>>** and **<<ISO/IEC 17025>>**.

G. Provide permanent labels with **<< manufacturer's name; serial number; manufacturing date; rated load; and _____>>** on commercial roof anchors.

H. Anchors - Membrane Roof:
1. Basis-of-Design: Guardian Fall Protection; CB-18 Anchor; 00657.
2. Type: **<< Vertical foam-filled steel pier and baseplate; Vertical steel pier; or _____>>** and baseplate with **<< cast iron loop; galvanized forged steel loop; forged stainless steel loop; threaded top for PPE bolt-attached components; galvanized 4-way HLL top anchor; galvanized pass-through top; swivel head U-bar; fixed U-bar; eyelet; or _____>>**; galvanized finish.
a. Pier:
1) Height: 18 inches.
2) Material: Hot-dip galvanized steel pipe.
3) Threaded vent hole with stainless steel plug.
b. Flat baseplate, factory-welded.
1) Size: 16 inches square.
2) Thickness: 1/2 inch.
3) Material: Hot-dip galvanized steel.

I. Anchors - Standing Seam Metal Roof:
1. Type: Non-penetrating clamp and baseplate with galvanized forged steel loop; galvanized finish.
a. Pier:
1) Height: 12 inches.
2) Material: Stainless steel.
3) Threaded vent hole with stainless steel plug.
b. Flat baseplate, factory-welded.
1) Size: 14 inches by 18 inches.
2) Thickness: 1/2 inch.
3) Material: Stainless steel.

J. Anchor Installation:
1. Type: Through-bolted for membrane roof. Non-penetrating clamp for standing seam metal roof.
2. Anchor Substrate: Metal decking for membrane roof. Standing seam metal for metal roof.
3. Roofing Assembly: As indicated on drawings.
4. Flashing Material: Premolded pipe flashing, membrane flashing, or sealant acceptable to roof manufacturer.

2.02 HORIZONTAL LIFELINE SYSTEMS

A. Manufacturers:
1. 3M Personal Safety Division.
2. Guardian Fall Protection.
3. Pro-Bel Enterprises Ltd.
4. Super Anchor Safety.
5. Tractel.

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6. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Description: A system comprised of a flexible line such as wire rope or cable, with connectors at both ends to secure it horizontally between two anchorages or anchorage connectors.

C. Structural Performance: Provide fall-arresting lifeline systems capable of withstanding design loads as required by governing regulations and codes.

D. Design Criteria:
1. Comply with **<<ANSI/ASSP Z359.12>>**.
2. Comply with **<<ANSI/ASSP Z359.15>>**.
3. Comply with **<<29 CFR 1926.502>>**.

E. Wire Rope: **<<ASTM A1023/A1023M>>**, **<< 7x7; 7x19; or _____>> << galvanized wire; stainless steel wire; or _____>>** , **<< 5/16 inch; 3/8 inch; or _____ inch>>** diameter.
1. **<< Galvanized ; Stainless Steel; or _____>>** Rigging Components: Consisting of **<< turnbuckles; cable clamps; spring energy absorbers; absorber couplers; eye thimbles; bolts; connector O-rings; and _____>>** as required to make a complete and functional HLL system compatible with installed anchors.

2.03 MATERIALS - STEEL

A. Steel Plates, Shapes, and Bars: **<<ASTM A6/A6M>>** or **<<ASTM A283/A283M>>**.

B. Steel Pipe: **<< ASTM A53/A53M Grade B Schedule 40; ASTM A53/A53M Grade B Schedule 80; ASTM A53/A53M Grade ____ Schedule 40; ASTM A53/A53M Grade ____ Schedule ____; or _____>>**, **<< black finish; galvanized finish; or black and galvanized finish, as indicated>>**.

C. Steel Tubing: **<<ASTM A500/A500M>>** or **<<ASTM A501/A501M>>** structural tubing, round and shapes as indicated.

D. Welding Materials: **<<AWS D1.1/D1.1M>>**; type required for materials being welded.

E. Steel Bolts, Nuts, and Washers: **<<ASTM F3125/F3125M>><< , Type 1; , Type 3; , _____; or None - N/A>><< , and galvanized in accordance with ASTM A153/A153M where connecting galvanized hardware components; , plain; , _____; or None - N/A>>**.

F. Touch-Up Primer for Galvanized Surfaces: **<< SSPC-Paint 20, Type I - Inorganic; SSPC-Paint 20 Type II - Organic; or _____>>**, complying with VOC limitations of authorities having jurisdiction.

2.04 MATERIALS - STAINLESS STEEL

A. Stainless Steel, General: **<<ASTM A666/A666M>>**, **<< Type 304; Type 316; or _____>>**.

2.05 FABRICATION

A. Fabricate work true to dimension, square, plumb, level, and free from distortion or defects detrimental to appearance and performance.

B. Grind off surplus welding material and ensure exposed internal corners have smooth lines.

C. Fabricate system components of the same material unless otherwise indicated.

D. Fabricate anchoring devices as recommended by the manufacturer to provide adequate support for intended use.

E. Fabricate joints in a manner to discourage water accumulation. Provide weep holes to drain all water that could accumulate in the exposed joints.

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2.06 FINISHES

A. Galvanizing: Hot-dip galvanize to minimum requirements of **<<ASTM A123/A123M>>**.
   1. Touch up abraded areas after fabrication using specified touch-up primer for galvanized surfaces.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine area for compliance with requirements for installation tolerances and other conditions related to this work.

B. Proceed with installation after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Coordinate location of fall protection equipment indicated to be attached to structural substrate or surface of roofing system and provide anchoring devices with templates, diagrams, and installation instructions.

3.03 INSTALLATION

A. Install anchorage and fasteners in accordance with shop drawings and manufacturer's recommendations to obtain allowable working loads published in product literature and in accordance with this specification.

B. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous coating or by other permanent separation as recommended by fall protection system manufacturer.

C. Deform threads of tail end of anchor studs after nuts have been tightened to prevent accidental removal or vandalism.

D. Do not load or stress anchors until all materials and fasteners are properly installed and ready for service.

E. Seal roof penetrations at anchors with pre-molded pipe flashing, membrane flashing, or sealant acceptable to roof manufacturer.

3.04 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

B. Test anchorage systems using only chemical adhesive fasteners on-site using load cell test apparatus in accordance with manufacturer's recommendations.

C. Load test anchors under the direct supervision of a licensed engineer in accordance with **<< ACI CODE-318; AISC 360; ASCE 7; ICC (IBC); 29 CFR 1910.27; 29 CFR 1910.66; and _____>>** requirements.

D. Inspect each anchor for conformance to manufacturer requirements, building envelope, looseness, and signs of permanent deflection during load testing.

3.05 ADJUSTING

A. Adjust fall protection components to function smoothly and safely.

3.06 CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing in accordance with **<<ASTM A780/A780M>>**.

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B. Clean exposed surfaces in accordance with fall protection system manufacturer's written instructions.

3.07 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate operation of system to **<<Owner>>**'s personnel.
   1. Use operation and maintenance data as reference during demonstration.
   2. Briefly describe function, operation, and maintenance of each component.

B. Training: Train **<<Owner>>**'s personnel on operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of **<< two hours; one day; or _____>>** of training.
   3. Instructor: Manufacturer's training personnel.
   4. Location: At project site.

3.08 MAINTENANCE

A. **<<29 CFR 1910>>** and **<<ANSI/IWCA I-14>>** require that anchors first be certified and subsequently inspected on an annual basis. Coordinate with manufacturer and local inspectors as required to maintain compliance.

B. Provide a separate maintenance contract for specified maintenance service.

END OF SECTION 118129

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SECTION 119513
KILNS

PART 1 GENERAL

1.01 SUBMITTALS

A. Product Data: For kilns, ventilation systems, and accessories. Include product data, installation instructions, and manufacturer's recommendations.

B. Shop Drawings: Indicate space required, clearances, and relationship to adjacent construction. Provide ventilation duct layout and routing.

C. Operation and Maintenance Data: For kilns, kiln controls, and ventilation systems, to include in operation and maintenance manual.

D. Specimen warranty.

E. Software: Copy of software required in this section, associated licensing documentation, and support contact information. Indicate that licensing is in the Owner's name.

1.02 DELIVERY, STORAGE, AND HANDLING

A. Deliver kilns, ventilation systems, and accessories to project site in manufacturer's original packaging, with protective coverings intact.

B. Store under cover and elevated above grade. Do not stack items on top of kilns.

C. Protect from damage due to weather, excessive temperature, and construction operations.

1.03 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Manufacturer Warranty: Provide two-year manufacturer warranty for kiln systems, including kiln, ventilation, accessories, and workmanship.

PART 2 PRODUCTS

2.01 ELECTRIC KILNS

A. ******MCPS prefers for Elementary Schools.****** Basis of Design: Paragon Kilns; ~~TNF-82-3~~ CT81722.

B. ******MCPS prefers for Middle and High Schools.****** Basis of Design : L&L Manufacturing, Inc.; ~~JD230EZ~~ e23T-3.

C. Acceptable Manufacturers:
   1. L&L Kiln Manufacturing, Inc. ******Delete this paragraph if L&L is the Basis of Design.******
   2. Paragon Kilns. ******Delete this paragraph if Paragon is the Basis of Design.******
   3. Skutt Kilns.
   4. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
   5. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.

D. Electric Kilns: Provide **<< 8-sided; 10-sided; or None - N/A>>** electric kilns with components, options and accessories for a complete kiln system, including the following: ******Select 8-sided if Paragron is the Basis of Design. Select 10-sided if L&L is the Basis of Design.******
   1. Kiln stand (minimum 8 inch high).

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2. Kiln floor or slab.
3. Fire brick.
4. Kiln elements.
5. Ring latch.
6. Chest handle.
7. Lid with latch and easy-lift device for assisted lifting and closing.
8. Control box.
9. Thermocouple.
10. Controller touch pad
11. Peep plugs.

E. Factory prewire kilns for electrical switching devices and computer interface system. Factory predrill holes in the kiln lid and floor for the downdraft ventilation system.

F. Electrical Components and Devices: Shall be listed and labeled by UL or other qualified testing agency, and as required by NFPA 70.

1. Electrical Requirements: **<< 208 V, 1 Ph, 48 A ; 240 V, 1 Ph, 48 A; 208 V, 3 Ph, 32 A; or 240 V, 3 Ph, 32 A>>**. ******Use 240V; 1Ph; 32A if Paragon is Basis of Design. Use 240V; 1Ph; 48A if L&L is Basis of Design.******

2.02 DOWNDRAFT VENTILATION SYSTEM

A. Downdraft Ventilation System: Negative-pressure downdraft ventilation system; capable of removing hazardous fumes only, not heat. System shall consist of the following components:

1. Blower motor with six-foot power cord and in-line switch.
2. 8- x 12-inch mounting plate.
3. 3-inch diameter flexible aluminum duct. Provide additional lengths of duct beyond what is provided standard, as required to vent the system to exterior as indicated.
4. Spring-loaded plenum cap assembly.
5. Blower inlet and discharge tubes.
6. Plenum spring.
7. Three to four inch connector/adaptor.
8. Floor mounting plate and mou.

B. System shall fit top-loading, multi-sided electric kiln specified. Provide a dual intake kit as required for larger kiln, or if multiple kilns are indicated.

C. Electrical Switching Device: Provide electrical switching device utilizing a programmable power output in the controller to turn the downdraft ventilation system on or off.

2.03 OVERHEAD VENTILATION SYSTEM

A. Overhead Ventilation System: Negative-pressure system capable of removing heat in addition to fumes and odors. Provide properly sized system for specified kiln. System shall consist of the following components:

1. Blower motor with six-foot power cord and in-line switch.
2. Wall bracket, sized to blower motor, for motor mounting.
3. Aluminum hood, sized for kiln.
4. Overhead mounting bar of 1 inch square structural steel tube, and counter-weighted pulley lifting system, with 3/16" plastic-coated steel cable and 3" diameter steel counterweight.

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5. Flexible aluminum duct. Provide additional lengths of duct beyond what is provided standard, as required to vent the system to exterior as indicated.

2.04 ACCESSORIES

A. Angled Touchpad Mount: Provide angled touchpad mount for easier viewing and programming of kiln controls.

B. Computer Interface System (CIS): Computer interface system including required software and hardware to connect a computer to kiln controller.

C. Furniture Kit: Provide manufacturer's accessory furniture kit, compatible with specified kiln size, including shelves and one or more posts. Kits shall be designed to fire to kiln temperature.

D. Fasteners and Anchors: Provide mechanical fasteners and anchors in type and quantity as required by manufacturer's installation instructions to provide secure attachment to in-place construction.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Verify that all finishes have been completed in installation locations, and verify that clearances to adjacent construction are adequate for proper and safe operation of equipment.

B. Examine roughing-in of electrical and ventilation systems to verify location of connections is acceptable prior to installation of kilns.

3.02 PREPARATION

A. Protection of In-Place Conditions: Protect adjacent finishes from damage or wear due to handling and installation of kilns and accessories.

B. Downdraft Ventilation System:

1. Ensure that kiln stand is a minimum of 8 inches high. If stand is lower than 8 inches high, either shim legs to increase distance from floor to a minimum of 8 inches, or replace kiln stand with one that is 8 inches high.
2. If kiln does not have factory drilled holes, field drill holes in number, size, and location as recommended by manufacturer for the specific kiln model provided.

3.03 INSTALLATION

A. Install kilns and accessories in accordance with manufacturer's written instructions.

B. Coordinate installation with adjacent construction to ensure proper clearances.

C. Install units in final locations after finishes have been completed in each area.

D. Install units level, plumb, properly aligned, and securely in place, with control units facing toward clear, open floor space.

E. Verify that final installation clearances are adeqate to properly and safely operate equipment.

F. Refer to Division 26 for electrical requirements.

G. Downdraft Ventilation System:

1. Assemble and install system components on kiln in accordance with manufacturer's written instructions.

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2. Install the blower and motor assembly on the wall in a location that is close enough for the flexible aluminum duct to reach the kiln without overstretching the duct. Where wall-mounting is not possible, mount the vent motor on the floor or above the ceiling.

H. Overhead Ventilation System:
   1. Assemble and install system components centered above kiln, in accordance with manufacturer's written instructions.
   2. Secure assembled pulley and counterweight system to building structure. Do not fasten overhead mounting bar/pulley counterweight system directly to the ceiling.

3.04 STARTUP, DEMONSTRATION, AND TRAINING

A. See Section **<< 017900 - Demonstration and Training>>** for additional requirements.

B. Manufacturer Services: Provide services of manufacturer's field representative to ensure proper operation of kilns and to provide demonstration and training.

C. Demonstrate proper operation of equipment to **<<Owner>>**'s designated personnel.

D. Training: Train **<<Owner>>**'s personnel on operation and maintenance of system.
   1. Software: Coordinate with Owner's personnel to ensure that kiln control software is properly installed on Owner's computer hardware. Training shall include the use of control software.

3.05 ADJUSTING, CLEANING, AND PROTECTION

A. After startup and demonstration, verify proper operation and make any necessary adjustments.

B. Protect installed kilns from subsequent construction operations. Do not stack or place any materials on or against kilns.

C. Provide final cleaning of kiln and leave kiln ready for operation.

END OF SECTION 119513

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SECTION 122400
WINDOW SHADES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

B. NFPA 70 - National Electrical Code.

C. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.

D. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.

E. WCMA A100.1 - Standard for Safety of Window Covering Products.

1.02 ADMINISTRATIVE REQUIREMENTS

******Specifiers: Coordinate with MCPS shade shop for standards.******

A. Coordination:

1. Where motorized shades are to be controlled by control systems provided under other sections, coordinate the work with other trades to provide compatible products.
2. Coordinate the work with other trades to provide rough-in of electrical wiring as required for installation of hardwired motorized shades.

B. Preinstallation Meeting: Convene one week**<< one week; or _____>>** prior to commencing work related to products of this section; require attendance of affected installers.

C. Sequencing:

1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
2. Do not install shades until final surface finishes and painting are complete.

1.03 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.

1. Motorized Shades: Include power requirements and standard wiring diagrams for specified products.

B. Shop Drawings: Include **<< shade schedule indicating size, location and keys to details; head, jamb and sill details; mounting dimension requirements for each product and condition; operation direction; and _____>>**.

1. Motorized Shades: Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.

C. Certificates: Manufacturer's documentation that line voltage components are UL listed or UL recognized.

D. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.

E. Selection Samples: Include fabric samples in full range of available colors and patter **<< fabric samples in full range of available colors and patterns; and _____>>**.

1. Motorized Shades: Include finish selections for controls.

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F. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.

G. Project Record Documents: Record actual locations of control systems and show interconnecting wiring.

H. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.

I. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in **<<Owner>>**'s name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Authorized installation representative of fabricator/manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

B. Handle and store shades in accordance with manufacturer's recommendations.

1.06 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.07 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following minimum terms:

1. Electric Motors and Components: 5 years, minimum.
2. Manual Operating Mechanism / Clutch: 10 years, minimum (excludes bead chain).
3. Fabric: 10 years, minimum.
4. Balance of Shade Hardware and Non-Operating Materials and Components: 25 years, minimum.

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PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Interior Manually Operated Roller Shades:

1. Crown Shade Company; Manual Roller Shades.
2. Draper, Inc; Clutch Operated FlexShade N.
3. Hunter Douglas Architectural; RB500 Manual Rollder Shades.
4. Lutron Electronics Co., Inc; Contract Roller Manual Roller Shades.
5. MechoShade Systems LLC; Mecho/5 System.
6. SWFcontract, a division of Springs Window Fashions, LLC.; Pro Series Manual Solar Shade System.
7. WT Shade, an InPro Company; HeliaRise.
8. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Interior Motorized Roller Shades, Motors and Motor Controls:

1. Crown Shade Company; Motorized Skylight Roller Shades.
2. Draper, Inc; Motorized FlexShade.

3. Hunter Douglas Architectural; RB500 Motorized Roller Shades.
4. Lutron Electronics Co., Inc; Contract Roller Motorized Roller Shades.
5. MechoShade Systems LLC; Electroshade.
6. SWFcontract, a division of Springs Window Fashions, LLC.; Standard Motorized Solar Shades.
7. WT Shade, an InPro Company; MotoRise.
8. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

C. Source Limitations: Provide products produced by a single manufacturer and obtained from a single supplier.

2.02 ROLLER SHADES

******Specify roller shades only. MCPS does not want horizontal louver blinds.******

A. General:
1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
2. Provide shade system that operates smoothly when shades are raised or lowered.
3. Motorized Shades: Motor system housed inside roller tube, controlling shade movement via motor controls indicated; listed or recognized to **<<UL 325>>**.
   a. Comply with **<<NFPA 70>>**.
   b. Electrical Components: Listed, classified, and labeled as suitable for the purpose intended. Where applicable, system components to be FCC compliant.
   c. Motors: Size and configuration as recommended by manufacturer for the type, size, and arrangement of shades to be operated; integrated into shade operating components and concealed from view; fully compatible with controls to be installed.

******Use this option for single manual roller shades located at: exterior windows at grade, interior side lites and door lites to corridors, windows facing courtyards, exterior windows above first floor. Refer to MCPS Design Guidelines.******

B. Roller Shades:
1. Description - Interior Roller Shades: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
   a. Drop Position: Regular roll.
   b. Roll Direction: Roll down, closed position is at window sill.
   c. Mounting: Surface mounted on steel lintel or CMU, unless otherwise indicated. ******MCPS preferred mounting methods. Coordinate with MCPS for approval of other mounting options.******
      1) Where length exceeds maximum of a single shade section and jamb mounting is not feasible, provide for mounting to overhead/lintel construction.
      2) Secure to the structural building construction at jambs or overhead as indicated (masonry, cold-formed steel framing). Shades shall not be mounted directly to window frames or mullions.
   d. Size: As indicated on drawings for rough opening sizes; field verify rough openings prior to fabrication.
2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
   a. Material: Stamped steel.

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3. Roller Tubes: As required for type of shade operation.
   a. Material: Extruded aluminum, clear anodized finish or electrogalvanized/epoxy primed steel, as standard with manufacturer.
   b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
   c. Fabric Attachment: Utilize manufacturer's standard method for attaching shade fabric material to rollers.
4. Hembars: Designed to maintain bottom of shade straight and flat.
   a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed.
5. Manual Operation for Interior Shades:
   a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
   b. Drive Chain: Continuous loop beaded ball chain, 95 pounds minimum breaking strength. Provide upper and lower limit stops.
   c. Safety Device: At all chain/loop operators, provide a **<<WCMA A100.1>>** compliant chain tensioning hold-down device/retainer.
6. Accessories:
   a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; white powder-coated finish.
   b. End Caps: Provide manufacturer's standard end caps to cover exposed ends of brackets.
   c. Fasteners: Noncorrosive, and as recommended by shade manufacturer.

******Use this option for dual manual roller shades located at: admin offices. Refer to MCPS Design Guidelines.******

C. Roller Shades:
   1. Description - Interior Roller Shades: Double roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
      a. Drop Position: Regular roll.
      b. Roll Direction: Roll down, closed position is at window sill.
      c. Mounting: Surface mounted on steel lintel or CMU, unless otherwise indicated. ******MCPS preferred mounting methods. Coordinate with MCPS for approval of other mounting options.******
         1) Where length exceeds maximum of a single shade section and jamb mounting is not feasible, provide for mounting to overhead/lintel construction.
         2) Secure to the structural building construction at jambs or overhead as indicated (masonry, cold-formed steel framing). Shades shall not be mounted directly to window frames or mullions.
      d. Size: As indicated on drawings for rough opening sizes; field verify rough openings prior to fabrication.
   2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
      a. Material: Stamped steel.
      b. Double Roller Brackets: Configured for light-filtering and room-darkening shades in one opening.
         1) Light-Filtering Fabric: Room-side of opening.
         2) Room-Darkening Fabric: Glass-side of opening.

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3. Roller Tubes: As required for type of shade operation.
   a. Material: Extruded aluminum, clear anodized finish or electrogalvanized/epoxy primed steel, as standard with manufacturer.
   b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
   c. Fabric Attachment: Utilize manufacturer's standard method for attaching shade fabric material to rollers.
4. Hembars: Designed to maintain bottom of shade straight and flat.
   a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed.
5. Manual Operation for Interior Shades:
   a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
   b. Drive Chain: Continuous loop beaded ball chain, 95 pounds minimum breaking strength. Provide upper and lower limit stops.
   c. Safety Device: At all chain/loop operators, provide a **<<WCMA A100.1>>** compliant chain tensioning hold-down device/retainer.
6. Accessories:
   a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; white powder-coated finish.
   b. End Caps: Provide manufacturer's standard end caps to cover exposed ends of brackets.
   c. Fasteners: Noncorrosive, and as recommended by shade manufacturer.

******Use this option for dual motorized roller shades located at: exterior high-volume glazing and celerestory windows. Refer to MCPS Design Guidelines.******

D. Roller Shades:
   1. Description - Interior Roller Shades: Double roller, motor operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
      a. Drop Position: Regular roll.
      b. Roll Direction: Roll down, closed position is at window sill.
      c. Mounting: Surface mounted on steel lintel or CMU, unless otherwise indicated. ******MCPS preferred mounting methods. Coordinate with MCPS for approval of other mounting options.******
         1) Where length exceeds maximum of a single shade section and jamb mounting is not feasible, provide for mounting to overhead/lintel construction.
         2) Secure to the structural building construction at jambs or overhead as indicated (masonry, cold-formed steel framing). Shades shall not be mounted directly to window frames or mullions.
      d. Size: As indicated on drawings for rough opening sizes; field verify rough openings prior to fabrication.
   2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
      a. Material: Stamped steel.
      b. Double Roller Brackets: Configured for light-filtering and room-darkening shades in one opening.
         1) Light-Filtering Fabric: Room-side of opening.
         2) Room-Darkening Fabric: Glass-side of opening.

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3. Roller Tubes: As required for type of shade operation.
   a. Material: Extruded aluminum, clear anodized finish or electrogalvanized/epoxy primed steel, as standard with manufacturer.
   b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
   c. Fabric Attachment: Utilize manufacturer's standard method for attaching shade fabric material to rollers.
4. Hembars: Designed to maintain bottom of shade straight and flat.
   a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed.
5. Manual Operation for Interior Shades:
   a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
   b. Drive Chain: Continuous loop beaded ball chain, **<< 95 pounds; or _____ pounds>>** minimum breaking strength. Provide upper and lower limit stops.
   c. Safety Device: At all chain/loop operators, provide a **<<WCMA A100.1>>** compliant chain tensioning hold-down device/retainer.
6. Accessories:
   a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; white powder-coated finish.
   b. End Caps: Provide manufacturer's standard end caps to cover exposed ends of brackets.
   c. Fasteners: Noncorrosive, and as recommended by shade manufacturer.

2.03 SHADE FABRIC

A. Fabric: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
   1. Products (Light-filtering - 5%): Vinyl coated fiberglass. ****** Use light-filtering fabrics for windows exterior windows above first floor, windows facing courtyards that are corridors, admin offices, exterior high volume glazing, clerestory windows.******
      a. Lutron Electronics Co., Inc; Basketweave 27 - 5%.
      b. Mermet Corporation; E-Screen - 5%.
      c. Phifer, Inc; SheerWeave 2390 - 5%.
      d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
   2. Products (Blackout): 100% polyester with acyrlic flocked backing (PVC free). ******Use blackout fabrics for exterior windows at grade, interior side lites and door lites to corridors, windows facing courtyards that are not corridors, admin offices, exterior high volume glazing, and celerestory windows.******
      a. Lutron Electronics Co., Inc; Value Premiere Blackout.
      b. Mermet Corporation; Sparta Twilight.
      c. Phifer, Inc; Style 7000 Blackout.
      d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
   3. Performance Requirements:
      a. Flammability: Pass **<<NFPA 701>>** large and small tests.
      b. Fungal Resistance: No growth when tested according to **<<ASTM G21>>**.

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4. Color: To be selected by **<<Architect>>** from manufacturer's **<< full; or standard>>** range.
5. Fabrication:
   a. Fabric Orientation: Railroaded, fabric is turned 90 degrees off the roll.
   b. If height of opening requires multiple panels of railroaded fabric, use **<< battens at seams; manufacturer's standard sewn seams; or _____>>**.

2.04 MOTOR CONTROLS

A. Provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the control intent indicated. ******MCPS prefers a singular key switch for the same area.******

B. Provide all components and connections necessary to interface with other systems as indicated.

2.05 ROLLER SHADE FABRICATION

A. Field measure finished openings prior to ordering or fabrication.

B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
   1. Vertical Dimensions: Fill openings from head to sill with **<< 1/2 inch; or 1/4 inch>>** maximum space between bottom bar and **<< window sill; finished floor; window stool; or _____>>**.
   2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb, with maximum 1/4 inch gap at each edge of jamb.

C. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.

B. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.

B. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

C. Jamb mount shades at each end within the rough opening unless otherwise indicated. At large openings where multiple shades are required and jamb mount is not feasible, overhead mount shade to overhead/lintel construction. Do not mount to window framing.

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3.04 SYSTEM STARTUP

A. Motorized Shade System: Provide services of a manufacturer's authorized representative to perform system startup.

3.05 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

C. See Section **<< 017419 - Construction Waste Management and Disposal>>** for additional requirements.

3.06 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate operation and maintenance of window shade system to **<<Owner>>**'s personnel.

3.07 PROTECTION

A. Protect installed products from subsequent construction operations.

B. Touch-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION 122400

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SECTION 123553.19
WOOD LABORATORY CASEWORK

PART 1 GENERAL

1.01 DEFINITIONS

A. Exposed: Portions of casework visible when drawers and cabinet doors are closed, including end panels, bottoms of cases more than **<< 42 inches>>** above finished floor, tops of cases less than **<< 72 inches>>** above finished floor and all members visible in open cases or behind glass doors.

B. Semi-Exposed: Portions of casework and surfaces behind solid doors, tops of cases more than **<< 72 inches>>** above finished floor and bottoms of cabinets more than **<< 30 inches>>** but less than **<< 42 inches>>** above finished floor.

C. Concealed: Sleepers, web frames, dust panels and other surfaces not generally visible after installation and cabinets less than **<< 30 inches>>** above finished floor.

1.02 REFERENCE STANDARDS

A. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.

B. ASHRAE Std 110 - Methods of Testing Performance of Laboratory Fume Hoods.

C. ASTM C1036 - Standard Specification for Flat Glass.

D. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.

E. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

F. BHMA A156.9 - Cabinet Hardware.

G. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood.

H. ICC (IFC) - International Fire Code.

I. NFPA 1 - Fire Code.

J. NFPA 30 - Flammable and Combustible Liquids Code.

K. SEFA 1 - Laboratory Fume Hoods.

L. SEFA 2 - Installations.

M. SEFA 8W - Laboratory Grade Wood Casework.

N. UL 1805 - Standard for Safety Laboratory Fume Hoods and Cabinets.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate installation of casework with related items.

1. Service Fixtures: Coordinate location and characteristics of service connections.
2. Equipment and Instruments: Coordinate installation of casework with **<< equipment; scientific instruments; fume hoods; biological safety cabinets; and _____>>**.

B. Preinstallation Meeting: Conduct a preinstallation meeting**<< one week; at least one week; _____; or None - N/A>>** prior to the start of the work of this section; require attendance by all affected installers.

C. Keying Conference: Conduct conference prior to ordering keys. Incorporate conference decisions into keying submittal.

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1.04 SUBMITTALS

A. Product Data: Component dimensions, configurations, construction details, joint details, attachments; manufacturer's catalog literature on hardware, accessories, and service fittings, if any.

B. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include rough-in and **<< anchors; reinforcements; blocking; and _____>>** placement dimensions and tolerances, clearances required, and utility locations, if any. **<< Include coordinated information for laboratory equipment specified in another section and/or furnished by Owner.; or None - N/A>>**

C. Sustainable Design Submittals: Refer to Division 1 Section "Sustainable Design Requirements."

D. Test Reports: From independent laboratory indicating compliance with referenced chemical-resistance standards for cabinet finish and liner materials.

E. Maintenance Data: Manufacturer's recommendations for care and cleaning.

F. Finish touch-up kit for each type and color of materials provided.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section**<< with SEFA 8W certification for wood casework; or None - N/A>>**.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation. For metal surfaces, use polyethylene film or other protective material standard with the manufacturer.

B. Acceptance at Site:

1. Do not deliver or install casework until the conditions specified under Part 3, Examination Article of this section have been met. Products delivered to sites that are not enclosed and/or improperly conditioned will not be accepted if warping or damage due to unsatisfactory conditions occurs.

C. Storage:

1. Store casework in the area of installation. If necessary, prior to installation, temporarily store in another area, meeting the environmental requirements specified under Part 3, "Site Verification of Conditions" paragraph of this section.

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PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wood Laboratory Casework:

1. Stevens Advantage. ******MCPS prefers Stevens Advantage as the Basis of Design manufacturer.******
2. CiF Lab Solutions LP.
3. Diversified Woodcrafts.
4. Institutional Casework Inc (ICI Scientific).
5. Kewaunee Scientific Corp.
6. Leonard Peterson & Co., Inc.
7. Mott Manufacturing
8. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Countertops:
   1. Durcon (Epoxy resin, Solid phenolic).
   2. Panolam Industries International, Inc.
   3. Trespa (Solid phenolic).
   4. WilsonArt (Solid phenolic).
   5. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.02 WOOD LABORATORY CASEWORK

A. Wood Laboratory Casework: Solid wood and wood panel construction; each unit self-contained and not dependent on adjacent units or building structure for rigidity; in sizes necessary to avoid field cutting except for scribes and filler panels. Include adjustable levelers for base**<< and tall; or None - N/A>>** cabinets.
   1. Style: **<< Flush overlay; Lipped overlay; or _____>>**. Ease doors and drawer fronts slightly at edges.
   2. Cabinet Nominal Dimensions: Unless otherwise indicated, provide cabinets of widths and heights indicated on drawings, and with following front-to-back dimensions:
      a. Base Cabinets: **<< 22 inches; or _____ inches>>**.
      b. Tall Cabinets: **<< 13 inches; 16 inches; 22 inches; or _____ inches>>**.
      c. Upper Cabinets: **<< 13 inches; 16 inches; or _____ inches>>**.
   3. Construction: Joints doweled, glued and screwed, except drawers may be lock-shoulder jointed; with interior of units smooth and flush; cabinet bottom flush with top of face frame; without gaps or inaccessible spaces or areas where dirt or moisture could accumulate.
   4. Fittings and Fixture Locations: Cut and drill counter tops, backs, and other components for service outlets and fixtures.
   5. Access Panels: Where indicated, for maintenance of utility service and mechanical and electrical components.
   6. **<< Fixed; Removable; or _____>>** panels at backs of open spaces between base cabinets**<< and at ends of utility spaces not otherwise enclosed; _____; or None - N/A>>**.
   7. Scribes and Fillers: Panels of matching construction and finish, for locations where cabinets do not fit tight to adjacent construction.
   8. Base: Coordinate with Division 9 Section "Resilient Base & Accessories", provide continuous resilient base around all fixed cabinet bases.
   9. Factory-finish all exposed and semi-exposed surfaces with the same finish.
      a. Finish Performance: Provide finish on all surfaces having chemical resistance of Level 0 (no change) or Level 1 (slight change of gloss or slight discoloration) according to **<<SEFA 8W>>** and no visible effect when surface is exposed to:
         1) Hot water at temperature between **<< 190 degrees F>>** and **<< 205 degrees F>>** trickled down the test surface at 45 degree angle for 5 minutes.
         2) Constant moisture in the form of **<< 2 by 3 by 1 inch>>** thick cellulose sponge kept continually saturated with water and in contact with test surface for 100 hours.
      b. Preparation: Wood sanded smooth, free from dust and mill marks.
      c. Coating: Clear, superior-quality, chemical-resistant acyclic urethane; applied in accordance with manufacturer instructions, force-dried, sanded and wiped clean.
      d. Coats: Multiple coats as required to achieve minimum **<< 1.5 mil>>** dry film thickness.
      e. Appearance: Clear satin gloss; not cloudy or muddy.

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B. Solvent (Flammable and Combustible Liquids) Storage Cabinets: Pre-fabricated steel cabinets, complying with the following:
   1. Construct to **<<NFPA 30>>** and applicable OSHA requirements.
   2. Fire Resistance: Maximum internal temperature of **<< 325 degrees F>>** at the center, and **<< 1 inch>>** from top of the cabinet when cabinet is subjected to a ten minute fire test that simulates fire exposure of a standard time-temperature curve specified in **<<ASTM E119>>**.
   3. Shelves: Full depth, adjustable.
   4. Bottom Pan: **<< 2 inches>>** deep, corrosion-resistant, liquid-tight pan covering entire bottom of cabinet.
   5. Cabinet Hardware: UL-listed.
      a. Hinges: Full-length stainless steel continuous (piano) hinges.
      b. Self-closing Doors: Comply with requirements of **<<NFPA 1>>** and **<<ICC (IFC)>>**. Minimum 90 degree opening. Three-point latch arrangement, door(s) shutting and latching automatically when hold-open device's fusible link melts at **<< 165 degrees F>>** under fire conditions outside the cabinet. At pair of doors, synchronize latching so that both doors always fully close.
      c. Door Handles: Manufacturer's standard**<< , with slip-resistant grip; or None - N/A>>**.
         1) Provide manufacturer's standard cylinder lock and key set.
   6. Signage: Provide manufacturer's standard signage reading "FLAMMABLE - KEEP FIRE AWAY" or similar message in bright red color.

C. Tables: With standard aprons manufactured of not less than 3/4 by 3 1/2 inch solid hardwood lumber, machined to receive corner blocks, and bolted to 2 1/8 by 2 1/2 inch solid hardwood legs. 3/8 inch **<< 3/8 inch; or _____ inch>>** leveling devices, and slip-on type black PVC or rubber shoes.
   1. Provide 30 inch standard table height unless otherwise indicated.
   2. Provide manufacturer's power and data receptacles. ******MCPS preferred for demonstration table adjacent to teacher's desk.******

2.03 CABINET HARDWARE

A. Comply with **<<BHMA A156.9>>** requirements.

B. Locks: Provide locks on casework drawers and doors where indicated. **<< Lock with 5 pin cylinder and 2 keys per lock; Lock with 5 pin cylinder and ____ keys per lock; Lock with ____ pin cylinder and 2 keys per lock; Lock with ____ pin cylinder and ____ keys per lock; Lock with padlock hasps; or _____>>**.
   1. Hinged Doors: Cam type lock**<< , bright chromium plated over nickel on base material; , satin chromium plated over nickel on base material; , _____; or None - N/A>>**.
   2. Tall Hinged Doors: Three-point latching system.
   3. Keying: Key **<< locks alike within a space; key each room separately; each lock separately; or locks as directed>>**.
   4. Master Key System: All locks operable by master key.

C. Shelves in Cabinets:
   1. Shelf Standards and Rests: **<< Vertical standards with rubber button fitted rests; or _____>><< , bright chromium plated over nickel on base material; , satin chromium plated over nickel on base material; , _____; or None - N/A>>**.

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D. Swinging Doors:
   1. Hinges: **<< Offset pin; Butt; Continuous; or _____>>**, number as required by referenced standards for width, height, and weight of door.
      a. European-Style Hinges: **<< For overlay doors, semi-concealed.; For overlay doors, concealed; or For inset door, concealed>>**. **<< Steel, nickel-plated; Stainless Steel, No.4 finish; or _____>>**, **<< 170; 155; 120; 110; 100; 95; or _____>>** degree opening angle.
   2. Catches: **<< Magnetic; Mechanical catch; or _____>>**.
   3. Pulls: **<< Chrome; Brass; or _____>><< wire pulls; or _____>>**, **<< 4 inches; or ___ inches>>** wide.

E. Drawers:
   1. Pulls: **<< Chrome; Brass; or _____>> << wire pulls; or _____>>**, **<< 4 inches; or ___ inches>>** wide.
   2. Slides: Steel, full extension arms, ball bearings; **<< self-closing; ; or None - N/A>>**capacity as recommended by manufacturer for drawer height and width.

2.04 COUNTERTOPS

A. Countertops:
   1. Epoxy Resin Countertops: Filled epoxy resin molded into homogenous, non-porous sheets; no surface coating and color and pattern consistent throughout thickness; with integral or adhesively seamed components.
      a. Flat Surface Thickness: **<< 1 inch; 3/4 inch; 5/8 inch; or ___ inch>>**, nominal.
      b. Surface Finish: Smooth, non-glare.
      c. Color: **<< Black; Gray; White; or _____>>**.
      d. Exposed Edges and Corners: Beveled or radiused approximately 3/16 inch.
      e. Drip Edge: Drip groove **<< 1/8 inch; or ___ inch>>** wide and deep, located **<< 1/2 inch; or ___ inch>>** back from edge on underside of each exposed edge.
      f. Back and End Splashes: Same material, same thickness; **<< separate for field attachment; integrally molded; or _____>>**.

2.05 MISCELLANEOUS LAB CASEWORK AND ACCESSORIES

A. Demonstration Station: Prefabricated unit with locking base cabinets and drawers, constructed of veneered plywood of species and finish matching built in wood casework; with 1 inch thick epoxy top. Provide in configuration and dimensions as indicated on Drawings, and with the following features:
   1. Mobile Unit: Provide with heavy duty, locking, 4-inch ball-bearing casters.
   2. Sink: Stainless steel sink with galley-type pump. Provide with molded plastic containers in base cabinet for both fresh water and waste water.
   3. Apparatus Rod/Greenlaw Arm Assembly: Adjustable aluminum assembly with either one or two vertical rods and corresponding sockets in epoxy top, per manufacturer's standard assembly, and with horizontal crossrod and clamping hardware.
   4. Power: 120V duplex outlet, with a minimum 9 foot long extension cord.

B. Pegboards: **<< Epoxy; Stainless steel; Polypropylene; Phenolic; Acrylic; or _____>>** pegboards with pre-drilled or punched holes in a staggered pattern, designed to accept removable **<< black ; gray; white ; or None - N/A>>**polypropylene pegs. With each pegboard include a stainless steel drip-trough with drain outlet and matching diameter **<< 36 inches; or _____ inches>>** long **<< PVC; or _____>>** drain hose.

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1. Size: **<< 24 inches wide by 30 inches high; 30 inches wide by 30 inches high; _____ inches wide by _____ inches high; or As indicated on drawings>>**.

C. Goggle Cabinet: Wall-mounted steel reinforced cabinet designed to store and sanitize protective goggles. Unit shall have automatic timer control that operates a germicidal lamp to sanitize goggles. Unit shall be fully factory assembled and pre-wired and doors shall be equipped with locks. Unit shall measure 24-1/2 inches wide by 32 inches high by 9-1/2 inches deep and have manufacturer's standard baked enamel finish.

D. Fire Blanket and Cabinet: Pre-fabricated steel cabinet with baked enamel finish and the lettering "FIRE BLANKET". Cabinet shall contain a minimum 62-inch by 80-inch woven blanket treated with fire-resistant chemicals to conform to Federal Specification #CS-191-53. Cabinet shall be drop type with hinged bottom panel and manual release. Mount cabinet such that release mechanism is less than 48 inches above floor.

2.06 FUME HOODS

A. General Requirements: Provide manufacturer's standard complete fume hood assembly, fabricated of steel internal structure and sheet steel cladding with manufacturer's standard chemical-resistant finish.

1. Comply with **<<SEFA 1>>**; and provide fume hoods UL listed and labeled for compliance with **<<UL 1805>>**; include labeling on the face of fume hood.
2. Configuration: Bench top type, with 36 inch height to work surface. Provide integral lockable base cabinets constructed of corrosion-resistant steel for storage of flammables and acids. Provide "ceiling skirt" finished to match steel sheet cladding to close fume hood to ceiling, with hinged access panel.
3. Interior Construction: Provide epoxy resin internal countertop work surface and manufacturer's standard lining of epoxy-coated steel sheet or glass-fiber-reinforced epoxy.
4. Sash: Provide vertical operating sash fabricated of steel sheet and 1/4 inch tempered safety glass, with counter-balance system designed to allow operation at a maximum 7 pounds of force over complete travel height; counter-balance shall be capable of holding sash open at any position without creep. Provide rubber bumpers at limit of travel horizontally and vertically.
5. Fittings: Provide gooseneck faucet, epoxy resin cup sink, and gas turret with ball valve within the fume hood. Provide a recessed duplex outlet on hood face.
6. Pre-wire fume hoods for service fittings, **<< light fixtures; receptacles; other electrical devices; fan switches; and _____>>**. Coordinate with Division 22, 23, and 26 contractors to ensure utility services are properly sized and located.
    a. Terminate all wiring in a junction box on top of hood.

B. Restricted-Bypass Fume Hoods:

1. Standard Performance: Fume hood shall be tested per **<<ASHRAE Std 110>>** and shall provide an average face velocity of 100 fpm with sash fully open, with no more than 10 percent variation.
2. Bypass: Provide a compensating bypass arrangement above the sash to open after sash is closed to less than **<< 20; or 40>>** percent open. Bypass to maintain exhaust capacity of at least **<< 25 CFM per square foot>>** of work surface regardless of sash position.
3. Provide an electronic control unit designed to use input from a sensor that monitors face velocity or sash position to modulate a dedicated exhaust damper in order to maintain a near-constant fume hood face velocity.
    a. Provide with safety monitor/alarm system that monitors face velocity and provides audible and visual alarm if face velocity drops below safe levels.

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b. Provide control unit with a manual-override switch that allows the operator to fully open the exhaust damper.

c. Provide control unit with outputs for interfacing with **<< building's HVAC control system; laboratory fume hood control system; or _____>>**.

2.07 MATERIALS

A. Wood-Based Materials:

1. Solid Wood: Air-dried to 4.5 percent moisture content, then tempered to 6 percent moisture content before use.
2. Composite Wood Panels: Containing no urea-formaldehyde resin binders.

B. Exposed Solid Wood: Clear, dry, sound, selected for compatible grain and color, no defects.

1. Wood Species: **<< White maple; Red oak; or _____>>**; **<< plain sliced; or _____>>**.

C. Exposed Hardwood Plywood: **<< Veneer; Lumber; or Particleboard>>** core; **<< HPVA HP-1 Grade A; HPVA HP-1 Grade ___; or None - N/A>>**, same species as exposed solid wood, clear, compatible grain and color, no defects; minimum 1/50 inch thick. Band exposed edges with Grade J solid wood of same species as veneer.

D. Semi-Exposed Hardwood Plywood: **<< Veneer; Lumber; or Particleboard>>** core; **<< HPVA HP-1 Grade B or C; HPVA HP-1 Grade ____; or None - N/A>>**, any species similar in color and grain to exposed portions. Band exposed edges with Grade J solid wood of same species as veneer.

E. Concealed Solid Wood or Plywood: Any species and without defects affecting strength or utility.

F. Solid Epoxy Resin: Modified epoxy resin and non-asbestos inert fillers cast into sheets.

G. Glass: Fully tempered float; **<<ASTM C1036>>**, Type 1, Quality **<< Q3; or ___>>**; **<<ASTM C1048>>**, tempered**<< using horizontal tempering; or None - N/A>><< and complying with ANSI Z97.1; or None - N/A>>**; **<< 3/16 inch; 1/4 inch; ___; or 3/16 inch>>** thick**<< minimum; or None - N/A>><< ; exposed edges ground, and cut or drilled to receive hardware; or None - N/A>>**; **<< clear; tinted; or _____>>**.

PART 3 EXECUTION

3.01 EXAMINATION

A. Site Verification of Environmental Conditions:

1. Do not deliver casework until the following conditions have been met:
   a. Building has been enclosed (windows and doors sealed and weather-tight).
   b. An operational HVAC system that maintains temperature and humidity at occupancy levels has been put in place.
   c. Ceiling, overhead ductwork, piping, and lighting have been installed.
   d. Installation areas do not require further “wet work” construction.

B. Verify adequacy of support framing and anchors.

C. Verify that service connections are correctly located and of proper characteristics.

3.02 INSTALLATION

A. Perform installation in accordance with manufacturer's instructions and with **<<SEFA 2>>**.

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B. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.

C. Set casework items plumb and square, securely anchored to building structure.
   1. Base Cabinets: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than **<< 3/4 inch>>** leveling adjustment. When installation conditions are acceptable, for each space, establish the high point of the floor. Set and make level and plumb first cabinet in relation to this high point.
   2. Wall Cabinets: Examine wall surfaces in installation space. Do not proceed with installation if the following conditions are encountered:
      a. Maximum variation from plane of masonry wall exceeds **<< 1/4 inch in 10 ft>>** and **<< 1/2 inch in 20 ft>>** or more, and/or maximum variation from plumb exceeds **<< 1/4 inch>>** per story.
      b. Maximum Variation of finished gypsum board surface from true flatness exceeds **<< 1/8 inch in 10 feet; or ____ inch in 10 feet>>** in any direction.

D. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.

E. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed **<< 1/16 inch>>**. In addition, do not exceed the following tolerances:
   1. Variation of Tops of Base Cabinets from Level: **<< 1/16 inch>>** in **<< 10 feet>>**.
   2. Variation of Bottoms of Upper Cabinets from Level: **<< 1/8 inch>>** in **<< 10 feet; or 10 feet>>**.
   3. Variation of Faces of Cabinets from a True Plane: **<< 1/8 inch>>** in **<< 10 feet; 10 feet; or 10 feet>>**.
   4. Variation of Adjacent Surfaces from a True Plane (Lippage): **<< 1/32 inch>>**.
   5. Variation in Alignment of Adjacent Door and Drawer Edges: **<< 1/16 inch>>**.

F. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than **<< 16 inches; or _____ inch>>** on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.

G. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.

H. Vented Cabinets: Install in strict compliance with manufacturer's written installation instructions.
   1. Install vent kits and connect to fume hood exhaust system.
   2. Use only rigid materials for venting. No flexible materials permitted.

I. Countertops: Install countertops in one true plane, with ends abutting at hairline joints, and no raised edges.

J. Replace units that are damaged, including those that have damaged finishes.

3.03 ADJUSTING

A. Adjust operating parts, including doors, drawers, hardware, and fixtures to function smoothly.

3.04 CLEANING

A. Clean casework and other installed surfaces thoroughly.

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3.05 PROTECTION

A. Do not permit finished casework to be exposed to continued construction activity.

B. Protect casework and countertops from ongoing construction activities. Prevent installers from standing on or storing tools and materials on casework or countertops.

C. Repair damage that occurs prior to Date of Substantial Completion, including finishes, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

END OF SECTION 123553.19

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SECTION 123583
MUSIC EQUIPMENT STORAGE CASEWORK & ACCESSORIES

PART 1 GENERAL

1.01 DEFINITIONS

A. Exposed: Portions of casework visible when drawers and cabinet doors are closed, including end panels, bottoms of cases more than **<< 42 inches>>** above finished floor, tops of cases less than **<< 72 inches>>** above finished floor and all members visible in open cases or behind glass doors.

B. Semi-Exposed: Portions of casework and surfaces behind solid doors, tops of cases more than **<< 72 inches>>** above finished floor and bottoms of cabinets more than **<< 30 inches>>** but less than **<< 42 inches>>** above finished floor.

C. Concealed: Sleepers, web frames, dust panels and other surfaces not generally visible after installation and cabinets less than **<< 30 inches>>** above finished floor.

1.02 REFERENCE STANDARDS

A. BHMA A156.9 - Cabinet Hardware.

B. CARB (ATCM) - Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products.

C. NEMA LD 3 - High-Pressure Decorative Laminates.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting a minimum of two weeks prior to the start of the work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

A. Product Data: Component dimensions, configurations, construction details, joint details, attachments.

B. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include rough-in and **<< anchors; reinforcements; and blocking>>**, **<< placement dimensions and tolerances; clearances required; keying information; and _____>>**.

1. Include utility locations and connection requirements.

C. Samples for Finish Selection: Fully finished, for color selection. Minimum sample size: **<< 2 inches by 3 inches; 6 inches by 6 inches; or _____ inches by _____ inches>>**.

1. Wood samples for color and species selection.
2. Solid phenolic or epoxy samples, for color, texture, and finish selection.

D. Maintenance Data: Manufacturer's recommendations for care and cleaning.

E. Finish touch-up kit for each type and color of materials provided.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation. For metal surfaces, use polyethylene film or other protective material standard with the manufacturer.

B. Acceptance at Site:

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1. Do not deliver or install casework until the conditions specified under Part 3, Examination Article of this section have been met. Products delivered to sites that are not enclosed and/or improperly conditioned will not be accepted if warping or damage due to unsatisfactory conditions occurs.

C. Storage:
1. Store casework in the area of installation. If necessary, prior to installation, temporarily store in another area, meeting the environmental requirements specified under Part 3, "Site Verification of Conditions" Article of this section.

1.06 WARRANTY

A. Instrument cabinetry and shelving shall have a ten year factory warranty from Date of Substantial Completion. Cover defects in materials and workmanship. Defects include, but are not limited to:
1. Ruptured, cracked, or stained finish coating.
2. Discoloration or lack of finish integrity.
3. Cracking or peeling of finish.
4. Delamination of components.
5. Failure of adhesives.
6. Failure of hardware.

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PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Manufacturer: Wenger Corp.; **<< AcoustiCabinets; and UltraStor>>** cabinets; models as indicated on Music Casework Schedule.

B. Subject to conformance with specifications, including features not standard to the manufacturer, the following manufacturers may provide products for this project, subject to submittal and approval by Owner and Architect of samples of materials, construction features, and finishes as stipulated in the Design Requirements paragraph below.
1. Corilam.
2. Melhart Storage Solutions.
3. Stevens Industries, Inc.
4. TMI Systems Corporation.

C. Obtain casework from single source and manufacturer, unless otherwise indicated.

2.02 THERMALLY FUSED LAMINATE MUSIC CASEWORK

A. Quality Standard: **<< AWI/AWMAC/WI (AWS); AWMAC/WI (NAAWS); or _____>>**, unless noted otherwise.

B. Thermally Fused Laminate Music Casework: Custom Grade.

C. Design Requirements:
1. Provide music storage cabinets specifically designed and intended for use with musical instruments. Storage units shall be chip and abrasion resistant under heavy usage and shall protect instruments and cases from damage under normal use.
2. Construction, General: Thermally fused laminate panel construction; each unit self-contained and not dependent on adjacent units or building structure for rigidity; in sizes necessary to avoid field cutting except for scribes and filler panels. Include adjustable

levelers for base and tall cabinets. Include integral toe-kick, finished to match adjacent paneling.

a. Cabinet Nominal Dimensions: Unless otherwise indicated, provide cabinets of widths and heights indicated on Drawings and Music Casework Schedule, and per Basis-of-Design models indicated.

3. Shelving: Provide minimum 3/4-inch thick high strength instrument shelving with scuff-resistant plastic surface, with integral profiled surface for ventilation, with radiused (bullnose) front edge, designed and engineered to withstand continuous use without surface or front edge breakdown.
   a. Loading: Each shelf shall be able to independently and safely support 200 lbs minimum, uniformly distributed, with maximum deflection of L/144.
4. Paneling: Manufacture instrument cabinet with 3/4-inch composite panels finished with thermally-fused laminate (melamine) or polyester laminate, meeting performance requirements of **<<NEMA LD 3>>** for VGS grade, both faces; and edge banded with 3 mm radiused PVC. Factory jig and drill end panels to accept unit-to-unit through bolting; wood screw attachment is not acceptable.
   a. Rear Panels: Provide rear panels fabricated of minimum 1/4-inch MDF, fully captured all four sides, or 1/2-inch particleboard full overlay. For all cabinets with wire grille doors or open interior (no doors), provide acoustically absorptive material on inside face of rear panels.
   b. Panel Colors: Exterior panel colors and edge bandings shall be selected from manufacturer's full range. Interior panel shall be manufacturer's standard white melamine.
5. Wire Grille Doors: Provide inset style, **<< wire grille; and solid wood composite>>** doors as indicated; reveal or full overlay style doors are not acceptable. All hinges shall be structurally attached to vertical cabinet panels with engineered and tested through-bolt hardware, and integrally welded to wire grille doors. Screw mounted hinges are not acceptable.
   a. Loading: Wire-grille door hinge welded connections shall be tested and shall resist 400 lbf pull test without visible damage or permanent deformation.
6. Panel Doors: Provide inset style doors, fabricated of 3/4-inch composite panels, finished with thermally-fused laminate (melamine) or polyester laminate. Finish edges with 3 mm radiused PVC edge banding. Finish colors to match adjacent cabinet panels. Factory jig and drill for through bolt hinge attachment.

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2.03 FABRICATION

A. Assembly: Shop assemble casework items for delivery to site in units easily handled and to permit passage through building openings.

B. Construction: As required for selected grade.

C. Hardware Application: Factory-machine casework members for hardware.

D. Edging: Fit shelves, doors, and exposed edges with**<< specified; or specified and detailed>>** edging. Do not use more than one piece for any single length.

E. Scribes and Fillers: Panels of matching construction and finish, for locations where cabinets do not fit tight to adjacent construction.

F. Mobile Cabinets: Same construction as fixed base cabinets, with modifications.
   1. Toe kick space eliminated.
   2. Cabinet underside reinforced as is standard with the manufacturer to provide caster mounting points.

3. Four casters, each with a load rating of 165 pounds.
4. For cabinets with drawers, include a counterweight to prevent the cabinet from tipping when one drawer is opened.
   a. Rate drawers at 50 pounds maximum.

2.04 SPECIAL PURPOSE UNITS

A. Music Library (Sheet Music) Storage: Manufacturer's standard, high-density, slide out type. Fabricate with 1-inch tube steel framing, powder-coated black color, with polyester laminate faced front and end panels, and with manufacturer's standard white melamine interior finish. Provide with manufacturer's standard casters. Provide **<< 6-shelf units, with four adjustable shelves and two fixed shelves.; or 7-shelf units, with four adjustable shelves and three fixed shelves.>>** Basis-of-Design is Wenger; Music Library System.

2.05 CABINET HARDWARE

A. Comply with **<<BHMA A156.9>>** requirements.

B. Label Holders: Manufacturer's standard, sized to hold standard label cards**<< , bright chromium plated over nickel on base material; , satin chromium plated over nickel on base material; , _____; or None - N/A>>**.

C. Swinging Doors: Hinges, latches, and joinery.
   1. Hinges: Number as required by manufacturer and by referenced standards for width, height, and weight of door.
      a. Hinges: **<<BHMA A156.9>>**, Grade 1 butt hinges; powder coated to match grille door.
         1) Hinges shall be installed with through-bolts to cabinet side panels; five-knuckle, projecting barrel, minimum 2-1/2 inches long.
         2) At wire-grille doors, weld hinges to door panels.
         3) At solid composite wood doors, through-bolt hinges to door panels.
   2. Latch and Locks: Provide manufacturer's standard slide or gravity latch, steel construction, with integral padlock eye and powder-coat finish. All doors shall latch securely without padlock; doors with padlock hasp only are not acceptable.
      a. Padlocks: NIC. Shall be provided by Owner.

2.06 MATERIALS

A. Composite Wood: Tested and certified to **<<CARB (ATCM)>>** requirements for ultra-low emitting formaldehyde (ULEF) resins.

B. Thermally Fused Laminate (TFL): Melamine or polyester resin, **<<NEMA LD 3>>**, Type VGS laminate panels.

2.07 ACCESSORIES

A. Plastic Edge Banding: Extruded 3mm PVC, **<< convex; flat; or _____>>** shaped; **<< smooth; ridged; or _____>>** finish; self locking serrated tongue; of width to match component thickness.
   1. Color: Match adjacent laminate.
   2. Use at exposed edges.

B. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.

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C. Concealed Joint Fasteners: Corrosion-resistant, standard with manufacturer.

PART 3 EXECUTION

3.01 PREPARATION

A. Large Components: Ensure that large components can be moved into final position without damage to other construction.

3.02 EXAMINATION

A. Site Verification of Environmental Conditions:
   1. Do not deliver casework until the following conditions have been met:
      a. Building has been enclosed (windows and doors sealed and weather-tight).
      b. An operational HVAC system that maintains temperature and humidity at occupancy levels has been put in place.
      c. Ceiling, overhead ductwork, piping, and lighting have been installed.
      d. Installation areas do not require further “wet work” construction.

B. For Cabinet Installation: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than **<< 1/2 inch>>** leveling adjustment. When installation conditions are acceptable, for each space, establish the high point of the floor. Set and make level and plumb first cabinet in relation to this high point.

C. Verify adequacy of support framing and anchors.

D. Verify that service connections are correctly located and of proper characteristics.

3.03 INSTALLATION

A. Perform installation in accordance with manufacturer's instructions.

B. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.

C. Set casework items plumb and square, securely anchored to building structure.

D. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.

E. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed **<< 1/16 inch>>**. In addition, do not exceed the following tolerances:
   1. Variation of Tops of Cabinets from Level: **<< 1/16 inch>>** in 10 feet.
   2. Variation of Faces of Cabinets from a True Plane: **<< 1/8 inch>>** in 10 feet.
   3. Variation of Adjacent Surfaces from a True Plane (Lippage): **<< 1/32 inch>>**.
   4. Variation in Alignment of Adjacent Door and Drawer Edges: **<< 1/16 inch>>**.

F. Secure cabinets to concealed reinforcement and blocking where installed to gypsum board partition assemblies.

G. Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.
   1. Where base cabinets are installed away from walls or service space framing, anchor to floor at toe space at not more than 24 inches on center, and at sides of cabinets with not less than two fasteners per side.

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H. Install hardware uniformly and precisely.

I. Countertops: Install countertops intended and furnished for field installation in one true plane, with ends abutting at hairline joints, and no raised edges.

J. Replace units that are damaged, including those that have damaged finishes.

3.04 ADJUSTING

A. Adjust operating parts, including doors, drawers, hardware, and fixtures to function smoothly.

3.05 CLEANING

A. See Section **<< 017419 - Construction Waste Management and Disposal>>** for additional requirements.

B. Clean casework and other installed surfaces thoroughly.

3.06 PROTECTION

A. Do not permit finished casework to be exposed to continued construction activity.

B. Protect casework and countertops from ongoing construction activities. Prevent workmen from standing on, or storing tools and materials on casework or countertops.

C. Repair damage, including to finishes, that occurs prior to Date of Substantial Completion, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

END OF SECTION 123583

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SECTION 124813
ENTRANCE FLOOR MATS AND FRAMES

PART 1 GENERAL

1.01 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate with Division 03 "Cast-in-Place Concrete" to provide properly sized recess to accommodate recessed entrance mat and frame.

1.02 SUBMITTALS

A. Product Data: Provide data indicating properties of walk-off surface, **<< component dimensions; recessed frame characteristics; and _____>>**.

B. Shop Drawings: Indicate **<< dimensions; details for recessed frame; and _____>>**.

1. For recessed frames located within a dimensionally restricted area, show dimensions of space within which the frame will be installed.

C. Selection Samples: Manufacturer's color charts for mat finishes, indicating full range of available colors.

1.03 QUALITY ASSURANCE

A. Critical Radiant Flux: All carpet shall be Class I rated, with a minimum CRF of 0.45 watts/sq cm, when tested by an independent testing agency in accordance with ASTM E648 or NFPA 253.

B. Rolling Loads: Permanent deformation not to exceed 1/8-inch after 1,000 cycles, when tested with a 350 lb wheel load.

1.04 WARRANTY

A. Entrance Mat Warranty: Provide a two (2) year manufacturer warranty, covering defective material and faulty installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Entrance Floor Grilles and Gratings:

1. Activar Construction Products Group - JL Industries
2. Babcock-Davis
3. Construction Specialties, Inc.
4. Nystrom, Inc.
5. Pawling Corporation.
6. Reese Enterprises, Inc.

B. Floor Mats:

1. Activar Construction Products Group - JL Industries.
2. American Floor Products Company, Inc.
3. Babcock-Davis.
4. Construction Specialties, Inc.
5. Nystrom, Inc
6. R.C. Musson Rubber Co.
7. Pawling Corporation.

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8. Reese Enterprises, Inc.

2.02 ENTRANCE FLOOR GRILLES AND GRATINGS

A. Entrance Floor Grilles: Recessed extruded aluminum grille assembly with nominal 1 inch wide tread strips running perpendicular to traffic flow, slots between treads, and perimeter frame forming sides of recess; grille hinged for access to recess.

1. Recess Depth: **<< 3/4 inches; 1 inches; 1-1/4 inches; 1-1/2 inches; 1-3/4 inches; 2 inches; 2-1/2 inches; 3 inches; 4 inches; 4-1/4 inches; or ____ inches>>**.
2. Tread Surfaces: Alternating **<< serrated anodized aluminum; rigid serrated rubber; rigid serrated vinyl; polypropylene brush; nylon carpet; and _____>>**.
3. Tread Surfaces: **<< Serrated anodized aluminum; Rigid serrated rubber; Rigid serrated vinyl; Polypropylene brush; Nylon carpet; or _____>>**.
4. Colors: To be selected by **<<Architect>>** from manufacturer's full range.
5. Length in Direction of Traffic Flow: 72 inches.
6. Width Perpendicular to Traffic Flow: Full width of entrance door opening.
7. Frame: Anodized aluminum for embedding in concrete; minimal exposed trim; stud or hook concrete anchors.
8. Pan: Anodized aluminum bottom pan with drain, sealed to frame.

B. Mounting: Top of non-resilient members level with adjacent floor.

C. Structural Capacity: Capable of supporting rolling load of **<< 300 lb; 350 lb; 500 lb; 1,000 lb; or ____ lb>>** without permanent deformation or noticeable deflection.

D. Vibration Resistant Fabrication: Welded, riveted, or bolted members; no snap or friction connections.

2.03 FLOOR MATS

A. Carpet Mat: Roll-up type; cut nylon pile permanently bonded to **<< vinyl; or rubber>>** backing; **<< one inch>>** black matching **<< vinyl; or rubber>>** border on all edges.

1. Tread Size: 2 inches wide on center, by 3/8 inch thick.
   a. Tread Hinges: Aluminum.
2. Mat Size: As indicated on Drawings; if not indicated, provide width not less than the width of adjacent entrance plus an additional 12 inches on each side of entrance, and not less than 10 feet in length.
3. Colors: To be selected by **<<Architect>>** from manufacturer's **<< standard; full; custom; or _____>>** range.

B. Recessed Frame: Extruded anodized aluminum, with anchoring features for fastening to concrete slab. Provide each edge as a single piece, or where length exceeds maximum length available, provide in the least number of pieces possible, with hairline joint splices connected with straight pins.

2.04 FABRICATION

A. Construct recessed mat frames square, tight joints at corners, rigid. Coat surfaces with protective coating where in contact with cementitious materials.

B. Fabricate mats in single unit sizes; fabricate multiple mats where indicated on drawings.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that floor opening for mats are ready to receive work.

3.02 PREPARATION

A. Mats: Verify size of floor recess before fabricating mats.

B. Vacuum clean floor recess.

3.03 INSTALLATION

A. Install frames to achieve flush plane with finished floor surface.

B. Install walk-off surface**<< in floor recess flush with finish floor; _____; or None - N/A>>** after cleaning of finish flooring.

3.04 TOLERANCES

A. Maximum Gap Formed at Recessed Frame From Mat Size: 1/4 inch.

END OF SECTION 124813

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SECTION 125651
LIBRARY FURNISHINGS

PART 1 GENERAL

1.01 SUBMITTALS

A. Product Data: Manufacturer's catalog data and descriptive information for each specified product.

B. Shop Drawings: Indicate layout plans with quantities, details, including attachment/mounting details, and interface with adjacent construction.

1. Indicate electrical service connections and fittings where electrical outlets or coordination is required.

C. Selection Samples: Manufacturer's color charts, for all finishes requiring Architect's selection.

D. Verification Samples: Provide manufacturer's standard size samples, illustrating each color selected, for each product.

E. Sustainable Design Documentation: Refer to Division 1 "Sustainable Design Requirements."

1.02 QUALITY ASSURANCE

1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver furnishings to project site with manufacturer's protective covering. Do not remove protective covering until furnishings have been moved into final installation locations.

1.04 FIELD CONDITIONS

A. Ambient Conditions: Do not install library furnishings until all finishes are complete and HVAC system is fully operating at occupancy conditions.

1.05 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Manufacturer Warranty: Provide minimum **<< 2-year; or 10-year>>** manufacturer warranty, executed by Contractor, Manufacturer, and Installer, from date of Substantial Completion. Complete forms in **<<Owner>>**'s name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Source Limitations: Provide each type of product, **<< produced by single manufacturer; produced by same manufacturer as _____; obtained from single supplier; and _____>>**.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's written instructions. Installation shall be by the manufacturer's authorized representative and shall conform to the manufacturer's standard procedure.

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B. Install level, plumb, and true; shim as required, using concealed shims.

C. Installation shall include provision of connecting hardware, closure panels and trim required for complete and finished installation.

D. Furniture shall be securely set in place with permanent attachment where required.

E. Systems Integration: Coordinate with electrical for field installation of electrical components and for connections to building electrical supply.

F. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.

G. Install accessories according to Shop Drawings and manufacturer's written instructions.

H. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated.

3.02 ADJUSTING

A. Adjust cabinets and hardware for smooth operation of doors and drawers.

B. Adjust shelving to ensure rigid attachment to supports.

3.03 CLEANING

A. Clean all exposed surfaces of installed products after completion of work in the space.

3.04 PROTECTION

A. Protect installed surfaces from subsequent construction operations with plastic film or other covering.

B. Touch up and repair surfaces that are damaged during construction to match original finish. If damage can not be repaired, replace product.

END OF SECTION 125651

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SECTION 126100
FIXED AUDIENCE SEATING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design.

B. ASTM E1352 - Standard Test Method for Cigarette Ignition Resistance of Mock-Up Upholstered Furniture Assemblies.

C. ASTM F851 - Standard Test Method for Self-Rising Seat Mechanisms.

D. BIFMA X5.4 - Public and Lounge Seating.

E. NFPA 261 - Standard Method of Test for Determining Resistance of Mock-Up Upholstered Furniture Material Assemblies to Ignition by Smoldering Cigarettes.

1.02 SUBMITTALS

A. Product Data: Manufacturer's printed data sheets for products specified.

B. Shop Drawings: Fabrication and installation details, **<< chair layouts and dimensions; seat numbering scheme; and _____>>**.

1. Field Measurements: Verify seating layout by field measurements and record field dimensions on shop drawings.

C. Selection Samples: Manufacturer's color charts and swatches for **<< fabric upholstery; plastic laminate; baked enamel finish; hardwood and finishes; plywood and finishes; molded plastic; and _____>>**, indicating full range of materials, colors, and patterns available.

D. Verification Samples: Full-size two-seat fabricated sample of each typ of chair specified, including all accessories and one end panel, illustrating all finishes and workmanship to be expected in the finished Work; approved sample **<< may; or may not>>** be incorporated into the Work.

E. Installer's qualification statement.

F. Maintenance Materials:

1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.

2. Extra Seats: Quantity equal to 5 percent of total installed, but not less than one of each type and width of seat, furnished from same production run as that installed.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer certified in writing by the seating manufacturer to be qualified for installation of specified seating.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver seats to project site in unopened containers clearly labeled with manufacturer's name and identification of contents.

B. Store seating units in dry and clean location until needed for installation. During installation, handle in a manner that will prevent marring and soiling of finished surfaces.

1.05 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

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B. Correct defective Work for the minimum following periods, from the Date of Substantial Completion. Replace parts that fail under normal use at no extra charge to **<<Owner>>**.
   1. Structural components, including failure of standards, beams, or pedestals: 10 years.
   2. Operating mechanisms, including faulty self-rising seat mechanism: 5 years.
   3. Faulty electrical operation: 3 years.
   4. Deterioration of fabric, plastic/polymer, metals and metal finishes, and wood components, beyond normal wear or deterioration: 3 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fixed Audience Seating:
   1. Ducharme Seating International, Inc.
   2. First Class Seating.
   3. Hussey Seating Company.
   4. Irwin Seating Company.
   5. Krueger International, Inc. (KI).
   6. Navetta Design.
   7. Preferred Seating Co., Inc.
   8. SERIES Seating, LLC.
   9. Sitmatic.
   10. Theatre Solutions, Inc.

B. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

C. Provide all fixed audience seating by one manufacturer.

2.02 MATERIALS

A. Sheet Steel: **<<ASTM A879/A879M>>**, Commercial Steel (CS) or Drawing Steel (DS) electrogalvanized sheet, 04Z (12G) coating class on both surfaces; chemically treated for baked enamel finish.

B. Steel Plates, Bars, and Tubes: **<<ASTM A36/A36M>>**.

C. Exposed Hardwood: Solid lumber selected for absence of visible defects; **<< birch; northern hard maple; white oak; or species standard with manufacturer>>**.

D. Laminated Plastic: **<<NEMA LD 3>>**, Type 1, Grade GP 50, nominal thickness **<< 0.050 in; or ___ in>>**; colors and patterns **<< as selected from manufacturer's standards; as scheduled; or _____>>**.

E. Polypropylene Sheet: Molded high density plastic with minimum tensile strength of **<< 3300 psi; or ____ psi>>**, integral color pigments, and textured, scuff-resistant surface finish.

F. Polyurethane Foam: Density not less than **<< 1.8 lb/cu ft; or ___ lb/cu ft>>**, fire retardant, non-hardening and non-oxidizing, with high resistance to alkalis, oils, moisture, and mildew.

G. Upholstery Fabric: **<<ASTM D3597>>** heavy-duty plain woven nylon fabric, treated to resist cigarette ignition and staining; color and pattern **<< as indicated; as selected from manufacturer's standards; or _____>>**.
   1. Fire Retardance of Upholstered Seating: Self-extinguishing when mock-up is exposed to smoldering cigarettes in accordance with **<<ASTM E1352>>** or **<<NFPA 261>>**.

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2.03 UPHOLSTERED SEATING

A. General: Fixed seating system designed to permit radial installation using common middle support standards in each row and aisle standards aligned as indicated on drawings. Width of seats not less than **<< 21 inches; 22 inches; or __ inches>>**, except exit seat locations may be reduced to **<< 20 inches; 19 inches; or __ inches>>** to complete specific row dimensions.

1. Accessibility:
   a. Provide wheelchair-accessible spaces consisting of removable chairs in groups of two or three; provide a minimum of 6 wheelchair-accessible spaces. Include a designated companion seat at each wheelchair-accessible space.
   b. Provide accessible aisle seats at a minimum of 5 percent of aisle seats, with a foldup arm rest and sign with symbol of accessibility.

B. Performance Criteria:

1. Fire Retardance of Upholstered Seating: Self-extinguishing when mock-up is exposed to smoldering cigarettes in accordance with **<<ASTM E1352>>** or **<<NFPA 261>>**.
2. Strength and Durability: Comply with **<<BIFMA X5.4>>** standards for **<< seats; backs; armrests; standards; and _____>>**.

C. Support Standards: **<< Tubular steel; Sheet steel with formed edges and; or _____>>** with welded mounting points for backs, seats, and arm rests, and welded **<< floor; riser; beam; or _____>>** anchor plates.

1. Finish: Manufacturer's standard baked enamel/powder coat; black finish.

D. Backs: **<< Fixed; or Rocker>>** type; two-panel construction with fabric covering over padding and protective back panel, with installed height not less than **<< 29 inches; 32 inches; 35 inches; 37 inches; 42 inches; or __ inches>>** above finished floor.

1. Padding: Polyurethane foam not less than **<< 1 in; 1-1/4 in; 2 in; 3 in; or __ in>>** thick bonded to structural support.
2. Covering: Fabric bonded to padding and fastened by upholstery technique that facilitates replacement.
3. Outer Back: One-piece injection molded high-impact plastic, with scuff-resistant textured surface.

E. Seats: **<< Hinged; or Fixed>>** type, constructed to permit reupholstering without removing seat from chair.

1. Molded Plastic Construction: Molded one-piece plastic shell; polyurethane foam padding of minimum 3-inch thickness glued to plywood support; bottom seat surface of **<< hardwood face veneer; fabric matching seat upholstery over glued polyurethane foam; plastic laminate; or _____>>**. Upholster with fabric sewn into box construction without welts and securely fastened with concealed clips to provide smooth, wrinkle-free surface.

F. Hinges: Self-lubricating, noiseless steel hinges with brass alloy bearings or nylon bushings, equipped with **<< spring mechanism; gravity counterweight system; or _____>>** passing **<<ASTM F851>>** that causes unoccupied seat to rise automatically to **<< uniform 3/4 fold, with 100 percent fold when additional pressure is applied; or vertical position>>**.

G. Arm Rests: Locate at aisles and between chairs; mount to support standard with concealed fasteners; exposed surfaces **<< of solid hardwood lumber with smoothed edges; of molded high-impact plastic; of solid lumber or hardwood plywood covered with plastic laminate; upholstered over foam padding to match seats; or _____>>**.

H. End Panels: One piece panels fastened securely to aisle standards with concealed fasteners, configured as follows:

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1. Shape: **<< Rectangular; Rectangular with curved bottom edge; Tapered; Custom design as indicated; or As selected from manufacturer's standard options>>**.
2. Finish: **<< Solid hardwood; Plastic laminate; Upholstered over thin foam padding with fabric to match chairs; or _____>>**; color as selected from manufacturer's standard range.

2.04 ACCESSORIES

A. Folding Tablet Arms: At standard to right side of each seat, provide manufacturer's standard fold-away tablet arm assembly, with hinge and swivel mechanism securely fastened to underside of writing surface and designed to provide solid support in the open position and semi-automatic return to stowed position beneath right arm rest and parallel to right standard.
   1. Finish: **<< Plastic laminate both sides; Hardwood plywood veneer; ABS plastic; or _____>>**, with smooth, rounded edges.
   2. Size: Writing surface not less than **<< 100 sq inches; 120 sq inches; 150 sq inches; or ___ sq inches>>**.

B. Seat and Aisle Numbers: Manufacturer's standard seat numbers securely fastened to **<< front edge of folding seats; top center of chair backs; or _____>>** and row numbers securely fastened to aisle arm rests; **<< anodized aluminum; bronze; or _____>>** finish, with letters and numbers countersunk and filled with black paint; **<< recessed; surface; or _____>>** mounting.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates for conditions detrimental to installation of fixed audience seating. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with manufacturer's installation instructions and approved shop drawings.

B. Anchor support standards securely to substrate with at least two anchoring devices recommended by manufacturer.
   1. Place standards in each row laterally so the standards at the aisle will be in alignment.
   2. Vary width of seats and backs as required to optimize sightlines, and comply with the **<<ADA Standards>>** for row and aisle widths.
   3. In curved rows, install standards to form smooth radius, without breaks or angled chords
   4. Attach components to standards with sufficient flexibility to compensate for convergence of seats toward the center.

3.03 ADJUSTING

A. Adjust seat mechanisms to ensure that seats in each row are aligned when unoccupied.

B. Repair minor abrasions and imperfections in painted finishes with a coating that matches factory-applied finish; replace units that cannot be repaired to unblemished appearance.

END OF SECTION 126100

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SECTION 126600
TELESCOPING STANDS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design.

B. AWS D1.1/D1.1M - Structural Welding Code - Steel.

C. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel.

D. ICC 300 - Standard for Bleachers, Folding and Telescopic Seating and Grandstands.

E. NFPA 102 - Standard for Grandstands, Folding and Telescopic Seating, Tents, and Membrane Structures.

F. PS 1 - Structural Plywood.

1.02 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage handling and requirements.
   3. Installation methods.

B. Shop Drawings: Complete layout with dimensions, seat heights, row spacing and rise, aisle widths and locations, points of connection to substrate, assembly dimensions, and material types and finishes.
   1. Provide drawings customized to this project.
   2. Delegated Design: Include **<< Professional Engineer certification; Professional Engineer's seal on each sheet; or _____>>** and engineering analysis data.
   3. Wiring Diagrams: Show locations of motors, electrical wiring, and rough-in connections.

C. Selection Samples: Provide manufacturer's color charts indicating full range of available colors.

D. Verification Samples: Physical samples, manufacturer's standard size, for each selected color.

E. Operation and Maintenance Data: Manufacturer's operation and maintenance instructions, including annual inspection and maintenance and bi-annual inspection by a Professional Engineer or manufacturer factory service personnel.

F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in **<<Owner>>**'s name and registered with manufacturer.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than **<< three; or _____>>** years of**<< None - N/A; or documented>>** experience.

B. Installer Qualifications: **<< Manufacturer's installation crew; Approved by manufacturer; or _____>>**.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store, in original packaging, under cover and elevated above grade.

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1.05 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Correct defective Work within a **<< five; or ____>>** year period after Date of Substantial Completion. Replace parts that fail under normal use at no extra charge to **<<Owner>>**.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Telescoping Bleachers:
   1. Interkal LLC.
   2. Irwin Telescopic Seating Company.
   3. Hussey Seating Company.

2.02 TELESCOPING BLEACHERS

A. Telescoping Bleachers: Factory assembled tiered benches that retract horizontally into depth approximately the same as a single row depth, with fixed seats mounted on leading edge of platforms.
   1. General: Telescoping bleachers shall be designed, fabricated, and installed in accordance with **<<ICC 300>>**.
   2. Delegated Design: Provide telescoping stands certified by a licensed Professional Engineer for the performance and design requirements indicated.
   3. Design to comply with applicable requirements of **<<NFPA 102>>** and requirements of code authorities having jurisdiction; where conflicts between requirements occur, comply with whichever is more stringent.
   4. Design with solid fascia (riser) or seat fronts that conceal interior mechanisms when fully retracted, fitting tightly enough to prevent climbing up face; at front row provide key locked, hinged fascia (skirt) to cover gap between seat riser/fascia and floor.
   5. Standard Extension: Top row fixed to floor, adjacent to wall**<< None - N/A; or under overhang>>**, forward extension (away from wall); **<< attachment to wall acceptable; or attachment to wall prohibited>>**.
   6. Configurations: As indicated on drawings.
   7. Wheelchair Spaces: Allow **<< entire first row; or portions of first row, as indicated,>>** to be manually retracted without affecting other rows; provide removable railings at row two behind wheelchair spaces in compliance with **<<ADA Standards>>**.
   8. Operation: **<< Manual; Motor operated; or Some manual and some motor operated>>**.

B. Design Loads: Design to withstand the following loading conditions:
   1. Live Load on Structural Supports: **<< 100 psf; or ___ psf>>**, minimum, of gross horizontal projection.
   2. Live Load on Seats and Walking Surfaces: **<< 120 pounds per linear foot; or ___ pounds per linear foot>>**.
   3. Lateral Sway Stress on Structural Supports: **<< 24 pounds per linear foot; or ___ pounds per linear foot>>** of seat plank.
   4. Perpendicular Sway Stress on Structural Supports: **<< 10 pounds per linear foot; or ___ pounds per linear foot>>** of seat plank.

C. Dimensions:
   1. Rows: **<< __>>**.

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2. Rise Per Row: **<< 10 inches; 12 inches; or __ inches>>** nominal.
3. Row Depth: **<< 22 inches; 24 inches; 26 inches; or __ inches>>**.
4. Seat Height Above Tread: **<< 6 inches; 5 inches; or __ inches>>**.

D. Structural Supports: Steel or aluminum; manufacturer's standard wheeled carriages supporting each tier separately, with moving parts permanently lubricated and metal parts cushioned to prevent metal-to-metal contact during operation.
1. Design so that each row carriage so that it will individually support the design loads and is self supporting when fully assembled without dependence on platform panels or boards, seats, or fascia.
2. Welding: In accordance with **<<AWS D1.1/D1.1M>>** and **<<AWS D1.3/D1.3M>>**.
3. Bolting: Use lock-washers or locknuts.
4. Wheels: Minimum **<< 5 inch; 6 inch; or ____ inch>>** diameter by **<< 1-1/8 inch; 1 inch; 1-1/4 inch; or ___ inch>>** wide, with non-marring rubber tires; ball, roller, or oil-impregnated metal bearings; minimum of 2 wheels at each floor support.
5. Finish: Manufacturer's standard black enamel or powder coating.
6. Row Locking: Automatically mechanically lock each carriage to adjacent carriages when fully extended.
7. Unlocking**<< (Motor); or None - N/A>>**: Automatically unlock all rows before engaging retraction mechanism.

E. Motor Operation: **<< Manufacturer's standard drive mechanism; Traction wheels, with non-marring rubber covering; Chain-drive mechanism not using traction; or _____>>**, using motor adequately sized for the purpose.
1. Provide UL listed electrical components and wiring.
2. Controls: Start, Stop, Forward, and Reverse in a single control unit.
3. Control Station: Removable plug-in low-voltage pendant station, with first-row plug-in location for each motor.
4. Limit Switches: Automatically stop operation when unit has reached fully open or fully closed position.
5. Provide all wiring internal to bleacher units, to junction box located **<< where indicated; on back wall; or under first row>>**; ensure that wiring is not energized except during operation.
6. Electrical Characteristics: **<< 120V, single phase; 208/230V, 5 wire, 3-phase; or _____ >>**, **<< 60; or __>>** Hz.
7. Provide access to motor from front side of bleachers; a hinged front skirt or hinged section at least **<< 30 inches; or ____ inches>>** wide is acceptable.

2.03 SEAT AND PLATFORM COMPONENTS

A. Seat/Fascia Assembly: Continuous, molded UV-stabilized high-density polyethylene plastic, seat minimum **<< 1 inch; or __ inch>>** thick, textured finish, homogeneous color throughout, **<< color as selected from manufacturer's standard selection; or _____>>**; approximately **<< 18 inch; or ___ inch>>** long sections independently removable with tongue-and-groove or rabbeted interlock at end joints.
1. Shape: Ergonomically contoured, with internal ribs spaced for natural flexibility; rear edge cantilevered to provide toe room of not less than **<< 3 inches; or ____ inches>>**; no openings to trap debris.
2. Provide end caps of same material and finish on each exposed end.
3. Supports: Internal steel reinforcement of each seat segment bolted to platform nose member; minimum two bolts per segment.

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B. Platform, Tread, and Step Structure: Plywood continuously supported on front and rear with side joints tongue-and-grooved.
   1. Plywood: **<<PS 1>>**, 5-ply southern pine or douglas fir, Grade **<< A-C; B-C; or ____>>**.
   2. Plywood Thickness: **<< 5/8 inch; 3/4 inch; or __ inch>>**, minimum.
   3. Front (Nose), Rear, and Intermediate Supports: Steel channel or tube, hot-dipped galvanized.
   4. Provide end caps of same material and finish on each exposed end.
   5. Finish: Polyethylene-overlay, bonded to plywood substrate with exterior glue; textured surface; color as selected from manufacturer's standard selection.
   6. At bottom of aisles provide step in front of first riser, hinged to first platform to fold for storage.

2.04 HANDRAILS AND RAILINGS

A. Provide the following railings:
   1. Aisle Handrails: **<< Single post folding; or Removable one- or two-post>>** railing segment mounted **<< in center; or at side>>** of aisle at every other row.
   2. End of Row Guardrails: **<< Self-storing; or Removable>>**, at open ends of sections beginning at row 2.
   3. Height: **<< 42 inches; or __ inches>>** above adjacent platform or tread.

B. Design handrails and railings to withstand the following loads:
   1. Concentrated Load on Handrails: **<< 200 pounds; or ___ pounds>>** in any direction.
   2. Concentrated Load on Guardrails: **<< 200 pounds; or ___ pounds>>** in any direction along top rail.
   3. Live Load on Handrails: **<< 50 pounds per linear foot; 100 pounds per linear foot; or ___ pounds per linear foot>>**, applied **<< in any direction; horizontally along top rail; or vertically along top rail>>**.
   4. Live Load on Guardrails:
      a. Horizontal: **<< 50 pounds per linear foot; or ___ pounds per linear foot>>**, applied at the guardrail height.
      b. Vertical: **<< 100 pounds per linear foot; or ___ pounds per linear foot>>**,**<< None - N/A; or simultaneously>>** applied vertically to top of guardrail.

C. Railing Construction: Round **<< steel or aluminum; steel; or aluminum>>** pipe or tube, with formed elbows at corners and caps at ends of straight runs.
   1. Aluminum: **<< 1.66 inches; or __ inches>>** minimum outside diameter; **<< natural anodized finish; textured powder coat epoxy finish; or _____>>**.
   2. Steel: **<< 1-1/2 inch; or ___ inch>>** minimum outside diameter, with **<< 11 gauge, 0.12 inch; or ___ gauge, _____ inch>>** minimum wall thickness; **<< textured powder coat epoxy finish; or _____>>**.

2.05 ACCESSORIES

A. Fillers and Closures:
   1. Top Row: Provide seat level rear filler panels to close openings between top row seat and wall; finish to match platforms.
   2. Sides of Extended Units: Vinyl curtains.
   3. Vinyl Curtains: **<< 18 ounce; or __ ounce>>** vinyl with grommets; **<< color as selected from manufacturer's standard palette; or _____>>**.

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B. Fasteners: Provide hardware and fasteners in accordance with manufacturer's recommendations.

C. Anchorage: As indicated on drawings; provide hardware in accordance with manufacturer's recommendations.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are consistent with those on the shop drawings.

B. Verify that electrical rough-ins have been installed and are accessible.

C. Do not begin installation until substrates have been properly prepared and area has been cleared of obstructions.

D. If substrate preparation is the responsibility of another installer, notify **<<Architect>>** of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Do not field cut or alter seats, fascia, or structural members without approval.

C. Provide manufacturer's field representative to inspect completed installation.

3.04 ADJUSTING

A. Lubricate, test, and adjust each moving assembly to ensure proper operation in compliance with manufacturer's recommendations.

3.05 CLEANING

A. Clean exposed and semi-exposed assembly surfaces.

B. Touch up finishes on damaged or soiled areas.

3.06 CLOSEOUT ACTIVITIES

A. Demonstration and Training: Provide manufacturer's field representative to demonstrate to and train **<<Owner>>**'s operating personnel in proper operation of equipment.

1. Location: On site using installed equipment.

3.07 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

END OF SECTION 126600

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SECTION 133416
GRANDSTANDS AND PRESS BOX

PART 1 GENERAL

1.01 DEFINITIONS

A. Grandstand: Elevated, permanent, tiered stand of benches to provide seating at a sports ground.

B. Press Box: A restricted facility located at a sporting venue to observe and announce events.

1.02 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.

B. AAMA 611 - Specification for Anodized Architectural Aluminum.

C. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).

D. ADA Standards - 2010 ADA Standards for Accessible Design.

E. AISC (MAN) - Steel Construction Manual.

F. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

G. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

H. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.

I. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

J. ASTM A529/A529M - Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality.

K. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.

L. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

M. AWS D1.1/D1.1M - Structural Welding Code - Steel.

N. AWS D1.2/D1.2M - Structural Welding Code - Aluminum.

O. NAAMM AMP 500-06 - Metal Finishes Manual.

P. NFPA 70 - National Electrical Code.

Q. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).

1.03 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design grandstands and press boxes, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance Characteristics: Engineer, fabricate, and install grandstands and press box capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

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1. Wind Loads: Determine loads based on the following minimum design wind pressures:
   a. Uniform pressure as required by local authorities having jurisdiction.
2. Snow Loads: As required by local authorities having jurisdiction.
3. Live Loads: 100 psf gross horizontal area.
4. Perpendicular Sway Load: 10lbs/lineal ft of seat plank.
5. Lateral Sway Load: 24lbs/lineal ft of seat plank.
6. Live Load for Seat and Tread Planks: 120lbs/lineal ft to seats and footboards.
7. Top Rails of Guardrails:
   a. Uniform load of 50lbf/ ft. applied in any direction.
   b. Concentrated load of 200lbf applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.
8. Infill of Guardrails:
   a. Concentrated load of 50lbf applied horizontally on an area of 1 sq. ft.
   b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Provide grandstands that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Detailing, fabrication, and installation of grandstands shall be in accordance with **<<AISC (MAN)>>** for steel and Aluminum Association's Specifications for Aluminum Structures.

E. Shop Connections: Welded and capable of carrying stress put upon them.

F. Welding: Comply with AWS Standards.

1.04 SUBMITTALS

A. Product Data: For each grandstand and press box component. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   1. Submit manufacturer's product specifications and installation instructions for each type of grandstand, press box and accessory indicated or required.

B. Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication and assembly of grandstands and press box, as well as procedures and diagrams. Submit shop drawings indicating layout of grandstand seating systems coordinated with field measurements and including seat heights, row spacing and rise, aisle widths and locations, overall dimensions, connections and relationship to adjoining work, accessories, types of materials and finishes.
   1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   2. Surveyor, at the expense of contractor, shall verify existing conditions prior to submittal drawings. Survey shall be submitted as part of submittal process.
   3. Statement of Compliance: On every sheet of submittal drawings, the following statement shall be executed and dated by the authorized agent of the contractor responsible for such work – “This is to certify that all specification requirements have been met and all dimensions, conditions and quantities are verified as shown and / or corrected on these submittal drawings”.

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C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Sustainable Design Submittals: Refer to Division 1 Section “Sustainable Design Requirements”.

E. Welding certificates.

F. Manufacturer Certificates: Signed by manufacturers certifying that they comply with requirements.

G. Qualification Data: For Installer.

H. Field Quality-Control Report: Indicate compliance of installed grandstand and press box and components with requirements.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each product to include in maintenance manuals.

B. Warranties: Special warranties specified in this Section.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Engage a firm experienced in manufacturing grandstand structures similar in size and scope to those indicated for this Project and with an established record of successful-in-service performance.

1. Manufacturer’s responsibilities include providing professional engineering services for designing grandstands and press box to comply with performance requirements.

B. Installer Qualifications: Engage an experienced Installer to perform the work of this Section who has specialized in installing types of grandstands similar to those required for this Project and who is acceptable to, or certified by, manufacturer of grandstands.

C. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in the state where the Project is located, and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of grandstands and press boxes that are similar to that indicated for this Project in material, design, and extent.

D. Source Limitations: Obtain grandstands and press box through one source from a single manufacturer.

E. Product Options: Drawings indicate size, profiles, and dimensional requirements of grandstands and press boxes and are based on the specific system indicated. Refer to Division 1 for product requirements.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

F. Welding: Qualify procedures and personnel according to **<<AWS D1.1/D1.1M>>** and **<<AWS D1.2/D1.2M>>**.

G. Regulatory Requirements: In addition to local governing regulations, comply with applicable provisions in the applicable statewide building code.

1. Comply with statewide regulations pertaining to industrialized, manufactured, or modular buildings, including completion of third-party inspections at the manufacturing facility. Arrange and provide for all necessary inspections and certifications as required to obtain a state registration seal or certificate, as applicable, indicating that structure is approved for Owner occupancy.

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H. Accessibility Requirements: In addition to local governing regulations, comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's **<<ADA Standards>>**.

I. Electrical Components, Devices, and Accessories: Listed and labeled as defined in **<<NFPA 70>>**, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

J. Safety Glass: Category II materials complying with testing requirements in **<<16 CFR 1201>>**.

K. Pre-Installation Conference: Conduct conference a minimum of 2 weeks before start of installation at Project site.

1.07 PROJECT CONDITIONS

A. Field Measurements: Control points and elevations shall be established by the project surveyor. Dimensions and measurements shall be shown on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of grandstand that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:
   1. Structural failures including, but not limited to, excessive deflection.
   2. Failure of system to meet performance requirements.
   3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   4. Warranty Period: One year from date of Substantial Completion.

B. Warranty Period for Metal Finishes: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with all requirements of the Contract Documents, provide products by one of the following:
   1. Southern Bleacher Company.
   2. Dant-Clayton Corporation.
   3. Outdoor Aluminum, Inc.
   4. Sturdisteel.

B. Submission of bid is indication that ALL parts / products of the specification shall be provided.

C. Other manufacturers seeking to be approved must submit product literature, list of similar jobs, and product samples ten days prior to bid date that matches the specified product for review and acceptance by the Architect. Architect shall provide written acceptance of additional approved manufacturers through addendum. No substitutions shall be considered after the bid.

2.02 PERMANENT GRANDSTANDS

A. Materials:
   1. Steel: **<<ASTM A36/A36M>>**.
   2. Aluminum: Extruded alloy 6063-T6.
   3. Foundation Concrete: Minimum compressive strength of 3000 psi at 28 days.
   4. Accessories:

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a. Steel Connections: **<<ASTM A307>>**, galvanized.
b. Aluminum Components: **<<ASTM A307>>**, cadmium plated.
c. Hold-Down Clip Assembly and End Caps: Aluminum Alloy 6063-T6.

B. Steel Members:
1. Stringers: 6 feet o.c.
2. Columns: Spaced at 6 feet o.c. longitudinal.
3. Cross Braces: Steel angles or rod bracing, as standard with manufacturer.

C. Guardrail System: Provide guardrails at all sides of grandstands, entry stairs, ramps, and landings. Provide also at press box rooftop observation deck.
1. Material: Anodized aluminum pipe, with end plugs at ends of straight runs and elbows at corners. Secure to angle rail risers with galvanized fasteners.
2. Top Railing: 42 inches above walkways, entrances, and above center of any adjacent seat.
3. Chain Link Infill on Side and Back: 6 gage black vinyl coated, galvanized fabric fastened in place with galvanized fittings and aluminum ties.

D. Seating: Aluminum Seat Boards: Nominal 2 inches by 10 inches, extruded aluminum with minimum wall thickness of 0.094 inches. Matching aluminum end caps shall be furnished at aisles and ends of grandstand. All steel surfaces in contact with aluminum seats shall be treated to prevent electrolytic action. Seat boards shall be secured to their steel supports by means of extruded aluminum clips and 5/16-inch-diameter bolts. All splices shall occur at steel supports. Splices in other locations will not be permitted.

E. Aluminum Footboards: Size per component requirements, non-slip aluminum planks made of 6063-T6 aluminum alloys with minimum wall thickness of 0.094 inches. Footboards shall be secured to their steel supports by means of extruded aluminum clips and 5/16-inch-diameter bolts. All splices shall occur at steel supports. Splices in other locations will not be permitted.
1. Provide tread system comprised of aluminum extrusions which fit together length-wise in a male-female shape running length of planks. This tongue and groove mechanism shall minimize deflection and not separate due to loads being applied to individual planks. The locking mechanism by design shall allow for expansion and contraction of individual planks without effecting performance of the system.
2. The system shall cause the deck planks to react together at all treads and cross walks to live load and form the appearance of a single tread system. By design, this system forms a solid, overlapping tread and riser installation.
3. The nose extrusion shall allow for a 1 inch extruded aluminum contrasting nose piece to be flush mounted on the leading edge and shall capture the vertical riser plank in an extruded pocket. The heel extrusion shall have a .70 inch vertical lip at the rear of the plank to allow for placement of vertical riser plank.
4. These extrusions shall be such that the attachment of the seat brackets, step brackets, mid-aisle rails and all other components is accomplished without deck penetrations. Through bolting or drilling of the aluminum tread / riser system is not permitted.
5. The system shall allow for seat and aisle reconfiguration at any time without evidence of its previous configuration.
6. Entry stairs to be 2 x 12 mill finish aluminum with inset extrusion to accept contrasting nosing member.
7. Ramp planks to be interlocking to resist deflection of live loads.
8. Open ends of planks to be covered with anodized aluminum end caps, securely fastened to the plank.

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9. Joint sleeves: Dual joint sleeves to be inserted at each butt joint of each load bearing aluminum plank, and to penetrate 6 inches into each plank at the joint. Joint sleeves are not required at secondary gutter locations.

F. Aluminum Risers: Aluminum planks made of 6063-T6 aluminum alloys with minimum wall thickness of 0.094 inches. Provide continuous aluminum riser closures between all footboards. Through bolting or drilling of the riser board is unacceptable.

G. Stairs: 2-by-12 inch aluminum treads with maximum 7-inch rise.

H. Hardware: Provide tamperproof and galvanized connections for seat boards, guardrails, and guardrail pipe. Footboard connections shall be made with galvanized fasteners.

I. Concrete Footings: Provide 3000 psi compressive strength concrete.

J. Concrete slabs for exits shall provide sufficient bearing area at bottom to support structural loads. Depth and design of slab shall be determined by manufacturer's engineer. Concrete shall attain working strength of 3,000 psi.

K. Understructure: Manufacturer's standard hot-dipped galvanized steel. Aluminum is unacceptable. Painted steel is unacceptable.

L. Finishes:
1. Steel: Hot-dipped galvanized after fabrication in accordance with **<<ASTM A123/A123M>>**.
2. Aluminum:
a. Aluminum Footboards: Mill finish.
b. Riser Boards: Dur-Kyn Kynar paint system.

M. Component Requirements:
1. Grandstands and Press Box: Provide **<< two (2) permanent grandstand seating systems, on home and away sides of football field, with one (1) press box on home side; two (2) permanent grandstand seating systems, at baseball field and softball field, with press box at each field; multiple grandstand seating systems and press boxes, at locations and configurations indicated on Drawings; or _____>>**.
******Verify layouts required with specific project requirements, or defer to Drawings as applicable******
a. Layout, Configuration, and Dimensions: Provide as indicated on Drawings.
b. Footboard Decking System: Tongue and Groove.
c. Riser Height: 13 inches. Aisle stairs shall have intermediate steps at 6.5 inches.
d. Tread Depth: 33 inches.
e. Seating: **<< Individual, molded UV-stabilized high-density polyethylene chairs with backrest, fold-down seat, and separating armrests on each side.; or Aluminum seat boards; 2 inches thick and 10 inches wide minimum.>>**
f. Guardrail System: Provide guardrail along front, back and sides of seating, around handicapped seating, and at all exits, ramps and stairs: Two aluminum rails with 6 gauge black vinyl coated chain link fence, 42 inches high (minimum).
1) Provide manufacturer's standard handrail assembly, minimum 34 inches high, centered in middle of each aisle stairway.
g. Handicapped Seating: As indicated on drawings.
h. Number of Handicapped Ramps: One at each grandstand.

2.03 PRESS BOXES

A. Product Description: Type II Construction.

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1. Press Box Support Structure: Press box shall be anchored with structural mechanism to support all engineered loads as determined by manufacturer's engineer.
2. Press Box Dimensions: Nominal dimensions **<< 8 feet wide by 18 feet long; 8 feet wide by 30 feet long; as indicated on Drawings; or _____>>**.
3. Press Box to be constructed in accordance with approved shop drawings.

B. Materials/Finishes
1. Press Box Support Structure:
   a. Structural shapes meet one of the following ASTM specifications: **<<ASTM A36/A36M>>**, ASTM A36/A572 grade 50, **<<ASTM A572/A572M>>** grade 50, **<<ASTM A529/A529M>>** grade 50, or **<<ASTM A500/A500M>>** grade B.
   b. Shop connections are seal welds.
   c. After fabrication, all steel is hot-dipped galvanized to **<<ASTM A123/A123M>>** specifications.
2. Press Box: All materials shall be new and shall comply with ASTM specifications.
   a. Floor
      1) Main support to be a galvanized steel floor frame sized to support structure and metal belly pan for support of insulation.
      2) Floor to be interlocking Aluminum Decking System, extruded aluminum alloy 6063-T6, mill finish. Attach Decking System to steel floor frame with mechanical fasteners at plank ends and intermediate supports. (Standard extrusions that do not connect are not acceptable.)
      3) Insulation: Kraft faced fiberglass building insulation R-11, 3 1/2 inches thick. Batt or roll per manufacturer standard.
   b. Wall Structure
      1) 4 inch x 4 inch x 11 gauge square tubing with maximum span of 14 feet on front wall and maximum span of 6 feet on back wall and 4 inch x 2 1/2 inch x 14 gauge steel "cees" with maximum spacing of 5 feet for all walls with siding. Spans greater than these require engineered calculations for design.
      2) Insulation: Kraft-faced fiberglass building insulation R-11, 3 1/2 inches thick. Batt or roll per manufacturer standard.
      3) Front Wall: Sloped as shown on drawings. Wall shall be engineered to provide for minimum supports / maximum glass coverage.
      4) Side Wall: Sloped as shown on drawings. Wall shall be engineered to provide side windows for maximum glass coverage and exit door.
      5) Interior Finish
         (a) 1/2-inch vinyl coated gypsum panels.
         (b) Cove Base: Vinyl, 4 inches x .080-thickness.
      6) Exterior Finish
         (a) 6 gauge pre-finished R-Panel paneling. Color as selected by Architect from manufacturer's standard range.
         (b) Wall panels are attached with #12 TEK screws - 6" O.C. at the top and bottom of the panels.
         (c) Lap screws are placed at panel ends, at the intermediate supports, and at the mid point between supports (TEK #14).
         (d) All fasteners to be painted same color as exterior paneling.
   c. Roof Structure

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1) 4 inch x 4 inch x 11 gauge square tubing with maximum spacing of 6 feet on center and 4 inches x 2 1/2 inches x 14 gauge steel "cees" with maximum spacing of 2 feet on center.
2) Roof: 1/8 inch four-way steel plate roof, continuous welded seams coated with acrylic metal primer and minimum 36 mils of acrylic roof coating. Plate is welded on both sides of rafters with 1-1/2 inch long 1/8-inch fillet welds on 12-inch centers.
3) Insulation: Kraft faced fiberglass building insulation, R-19 (minimum) 6 inches thick. Batt or roll per manufacturer standard.
4) Cornice: 26-gauge steel pre-finished to match metal siding.
5) Ceiling: 24 inch x 24 inch x 5/8 inch fissured-type acoustical ceiling tile with grid main tee, cross tee, wall angle, wind clips and other components as required.
6) Provide aluminum pipe and chain-link fence fabric guardrail assembly as specified at Observation Deck.

d. Exterior Doors:
1) Full flush steel construction with honeycomb core. 18 gauge skin sheets. Dimensions: 3 feet 0 inches x 6 feet 8 inches. Color: White.
2) Steel doorframe (16 gauge) complete with 1/2-inch threshold and weather-stripping.
3) Exterior Hardware: Handles shall be lever- type that allows operation without tight grasping or twisting of the wrist. Keyed alike locks.
4) Interior Hardware: Exit Device. Handle shall be panic bar that allows for opening without any grasping, twisting or turning.

e. Interior Doors:
1) Interior Birch Unit. Dimensions: 3 feet 0 inches x 6 feet 8 inches.
2) Hardware: Handles shall be lever type that allows operation without tight grasping or twisting of the wrist.

f. Interior Walls:
1) Framing to be steel galvanized studs (25 gauge) 1 1/4 inch x 3 5/8 inch at maximum 2 feet on center.
2) Finishes to be consistent with all other interior finishes.
3) Fixed glass windows (2’0” by 4’8”) shall be located at front of interior walls above counter to allow for better viewing.

g. Exterior Windows:
1) Frame: Extruded aluminum single hung, vertical sliding unit, thermally-broken.
2) Sash: Tilt toward inside for easy cleaning.
3) Glazing: Clear tempered panes.
4) Dimensions of each unit: Dependent on compartment size. At interior wall locations or structural support locations the dimension between windows shall be no greater than 6 inches.
5) Finish: Electro-statically applied acrylic enamel.

h. Work Bench:
1) 18-inch-wide workbench constructed of 4 inch x 2 1/2 inch x 14 gauge steel, and 3/4" wood. Countertop heights shall be constructed to allow wheelchair usage at all locations.
2) Plastic laminate top: Thickness: 0.50 (12 mm nominal). Color selected from manufacturer's standard range.

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3) Glue: Manufacturer's **<< standard; or low-emitting>>** contact adhesive.

i. Painting:
   1) Surfaces: Exterior Doors, Door Frames
      (a) Primer: Applied by Door Manufacturer.
      (b) Finish: 2 coats acrylic latex semi-gloss enamel applied by press box manufacturer.
   2) Surfaces: Interior Doors
      (a) Primer: Interior Exterior Oil Primer, or equal.
      (b) Finish: 2 coats acrylic latex semi-gloss enamel.
   3) Surfaces: Exterior Siding
      (a) Primer: Applied by Siding Manufacturer.
      (b) Finish: Applied by Siding Manufacturer.
      (c) Touchup: If applicable.

j. Surfaces: Wall and Roof Structure
   1) Primer: DTM Industrial acrylic metal primer applied after welding, or equal.

k. Caulking: Exterior-grade polyurethane sealant, all temperature, UV resistant. Silicone products are not acceptable.

l. Electrical
   1) Submittal drawing shall indicate devices and circuitry.
   2) Fixtures: 2-lamp, 28-watt T5 fluorescent, recessed mount design. Locate fixtures above countertop and maximize to full length of compartment space.
   3) Wiring to be run in rigid metal conduit or equal. N.E.C. breaker box to be 100-amp flush mounted on rear wall with 1-1/4-inch rigid conduit to be stubbed out bottom of press box ready for service line to be connected. (Service line to Press Box is responsibility of Owner).
   4) Electrical outlets installed per NEC shall be standard duty. All outlets shall be flush mounted on wall.
   5) Sound, Telephone, Clock, Field Communication: Empty double outlet boxes per N.E.C. with 3/4-inch conduit stubbed out bottom of Press Box for use of Owner. Outlet boxes to be flush mounted into wall. Any wiring completed on-site shall be responsibility of such contractor for inspections. Quantity. Two shall be provided. Owner shall indicate additional boxes needed.
   6) Observation Deck: Weather-tight outlet box for cameras. Quantity: Two. Owner shall indicate additional outlets needed.
   7) Baseboard heaters: 1,500-watt heaters as shown on Drawings, including circuitry to panelboards.

2.04 FINISHES, GENERAL

A. Comply with **<<NAAMM AMP 500-06>>** for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

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2.05 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: non-specular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with **<<AAMA 611>>**.

C. Aluminum Painted Finish:

1. All painted aluminum shall have factory applied, baked-on Kynar or Hylar/acrylic resin based paint coating, Dur-Kyn, as manufactured by the Val spar Corporation. Dur-Kyn meets or exceeds the physical and performance properties of **<<AAMA 2603>>**. Powder coated finishes are not considered equal to Kynar type finishes.
2. Color: As selected by Architect from manufacturer's full range.

2.06 GALVANIZED STEEL FINISHES

A. Surface Preparation: Clean surfaces with non-petroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with **<<ASTM A780/A780M>>**.

1. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds in steel, complying with **<<SSPC-Paint 20>>**.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for, installation tolerances, and other conditions affecting performance of work.

B. Verify with Owner's testing company that foundation bearing conditions are in accordance with assumptions made in design calculations and Shop Drawings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 ERECTION

A. Install pre-engineered grandstands and press boxes in accordance with manufacturer's instructions and final Shop Drawings. Provide accessories indicated or required and anchors, inserts and other items required for installation of units and attachment of adjoining construction.

B. Set press box plumb and aligned. Level base plates true to plane.

C. Connect electrical power service to power distribution system according to requirements specified in Division 26.

3.03 FIELD QUALITY CONTROL

A. Arrange for grandstands and press box manufacturer's technical personnel to inspect grandstands and press box and components during installation and at final completion and to certify compliance with requirements.

1. Notify Architect 48 hours in advance of date and time of final inspection.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Tests and Inspections:

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1. Installation: Installation shall be inspected for compliance with approved shop drawings and for safety prior to use.

3.04 ADJUSTING AND CLEANING

A. Adjust doors, operable windows, and hardware to operate smoothly, easily, properly, and without binding. Confirm that locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

C. Clean installed grandstand and press box units on exposed and semi-exposed surfaces. Touch-up shop applied finishes to restore damaged or soiled areas.

END OF SECTION 133416

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SECTION 133416.53
BLEACHERS

PART 1 GENERAL

1.01 DEFINITIONS

A. Bleacher: Non-elevated, portable, tiered stand of benches to provide seating at a sports ground.

1.02 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.

B. AAMA 611 - Specification for Anodized Architectural Aluminum.

C. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).

D. ADA Standards - 2010 ADA Standards for Accessible Design.

E. AISC (MAN) - Steel Construction Manual.

F. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

G. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

H. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.

I. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

J. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

K. AWS D1.1/D1.1M - Structural Welding Code - Steel.

L. AWS D1.2/D1.2M - Structural Welding Code - Aluminum.

M. NAAMM AMP 500-06 - Metal Finishes Manual.

N. NFPA 70 - National Electrical Code.

O. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).

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1.03 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design bleachers, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance Characteristics: Engineer, fabricate, and install bleachers capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Wind Loads: Determine loads based on the following minimum design wind pressures:
   a. Uniform pressure as required by local authorities having jurisdiction and as indicated on Structural drawings.
2. Snow Loads: As required by local authorities having jurisdiction.
3. Live Loads: 100 psf gross horizontal area.
4. Perpendicular Sway Load: 10lbs/lineal ft of seat plank.
5. Lateral Sway Load: 24 lbs/lineal ft of seat plank.

6. Live Load for Seat and Tread Planks: 120lbs/lineal ft to seats and footboards.
7. Top Rails of Guardrails:
   a. Uniform load of 50lbf/ ft. applied in any direction.
   b. Concentrated load of 200lbf applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.
8. Infill of Guardrails:
   a. Concentrated load of 50lbf applied horizontally on an area of 1 sq. ft.
   b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Provide bleachers that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Detailing, fabrication, and installation of bleachers shall be in accordance with **<<AISC (MAN)>>** for steel and Aluminum Association's Specifications for Aluminum Structures.

E. Shop Connections: Welded and capable of carrying stress put upon them.

F. Welding: Comply with AWS Standards.

1.04 SUBMITTALS

A. Product Data: For each bleacher component. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   1. Submit manufacturer's product specifications and installation instructions for each type of bleacher and accessory as required.

B. Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication and assembly of bleachers, as well as procedures and diagrams. Submit shop drawings indicating layout of bleacher seating systems coordinated with field measurements and including seat heights, row spacing and rise, aisle widths and locations, overall dimensions, connections and relationship to adjoining work, accessories, types of materials and finishes.
   1. Shop Drawings require approval of local building inspector and North Carolina Department of Public Instruction (NCDPI). Contractor shall provide shop drawings to Architect for submittal to both entities; approval from both shall be required prior to Architect's approval of Bleacher submittal.
   2. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   3. Surveyor, at the expense of contractor, shall verify existing conditions prior to submittal drawings. Survey shall be submitted as part of submittal process.
   4. Statement of Compliance: On every sheet of submittal drawings, the following statement shall be executed and dated by the authorized agent of the contractor responsible for such work – “This is to certify that all specification requirements have been met and all dimensions, conditions and quantities are verified as shown and / or corrected on these submittal drawings”.

C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

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D. Welding certificates.

E. Manufacturer Certificates: Signed by manufacturers certifying that they comply with requirements.

F. Qualification Data: For Installer.

G. Field Quality-Control Report: Indicate compliance of installed bleachers and components with requirements.

H. Maintenance Data: For each product to include in maintenance manuals.

I. Warranties: Special warranties specified in this Section.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Engage a firm experienced in manufacturing bleachers similar in size and scope to those indicated for this Project and with an established record of successful-in-service performance.

1. Manufacturer's responsibilities include providing professional engineering services for designing bleachers to comply with performance requirements.

B. Installer Qualifications: Engage an experienced Installer to perform the work of this Section who has specialized in installing types of bleacher similar to those required for this Project and who is acceptable to, or certified by, manufacturer of bleachers.

C. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in the state where the Project is located, and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of bleachers that are similar to that indicated for this Project in material, design, and extent.

D. Source Limitations: Obtain bleachers through one source from a single manufacturer.

E. Welding: Qualify procedures and personnel according to **<<AWS D1.1/D1.1M>>** and **<<AWS D1.2/D1.2M>>**.

F. Regulatory Requirements: In addition to local governing regulations, comply with applicable provisions in the applicable statewide building code.

1. Comply with statewide regulations pertaining to industrialized, manufactured, or modular buildings, including completion of third-party inspections at the manufacturing facility. Arrange and provide for all necessary inspections and certifications as required to obtain a state registration seal or certificate, as applicable, indicating that structure is approved for Owner occupancy.

G. Accessibility Requirements: In addition to local governing regulations, comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's **<<ADA Standards>>**.

H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in **<<NFPA 70>>**, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

I. Safety Glass: Category II materials complying with testing requirements in **<<16 CFR 1201>>**.

J. Pre-Installation Conference: Conduct conference at Project site to comply with requirements in Section **<< 013000 - Administrative Requirements; or _____>>**.

1.06 PROJECT CONDITIONS

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A. Field Measurements: Control points and elevations shall be established by the project surveyor. Dimensions and measurements shall be shown on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of bleacher that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:
   1. Structural failures including, but not limited to, excessive deflection.
   2. Failure of system to meet performance requirements.
   3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

B. Warranty Period: One year from date of Substantial Completion.

C. Warranty Period for Metal Finishes: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with all requirements of the Contract Documents, provide products by one of the following:
   1. Southern Bleacher Company.
   2. Dant-Clayton Corporation.
   3. Outdoor Aluminum, Inc.
   4. Sturdisteel.

B. Submission of bid is indication that ALL parts / products of the specification shall be provided.

C. Other manufacturers seeking to be approved must submit product literature, list of similar jobs, and product samples ten days prior to bid date that matches the specified product for review and acceptance by the Architect. Architect shall provide written acceptance of additional approved manufacturers through addendum. No substitutions shall be considered after the bid.

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2.02 BLEACHERS

A. Materials:
   1. Steel: **<<ASTM A36/A36M>>**.
   2. Aluminum: **<<ASTM B209/B209M>>**; 6063-T6 extruded alloy.
   3. Concrete Foundation/Pad: Minimum compressive strength of 3000 psi at 28 days. Coordinate with Civil drawings.
   4. Accessories:
      a. Steel Connections: **<<ASTM A307>>**, galvanized.
      b. Aluminum Components: **<<ASTM A307>>**, cadmium plated.
      c. Hold-Down Clip Assembly and End Caps: Aluminum Alloy 6063-T6.

B. Framing Members: Fabricate understructure framing of aluminum or galvanized steel per manufacturer's standard. Painted non-galvanized steel is not acceptable.
   1. Stringers: 6 feet o.c. maximum
   2. Columns: Spaced at 6 feet o.c. longitudinal.
   3. Cross Braces: Steel angles or rod bracing, as standard with manufacturer.

C. Guardrail System: Provide guardrails at all sides of bleacher.

1. Material: Anodized aluminum pipe, with end plugs at ends of straight runs and elbows at corners. Secure to angle rail risers with galvanized fasteners.
2. Top Railing: Minimum 42 inches above walkways, entrances, and above center of any adjacent seat.
3. Chain Link Infill on Side and Back: 6 gage black vinyl coated, galvanized fabric fastened in place with galvanized fittings and aluminum ties.
4. Handrail: Provide manufacturer's standard handrail assembly, minimum 34 inches high, centered in middle of each aisle stairway.

D. Aluminum Seat Boards: Nominal 2 inches by 10 inches, extruded aluminum with minimum wall thickness of 0.094 inches. Matching aluminum end caps shall be furnished at aisles and ends of each seat board. All steel surfaces in contact with aluminum seats shall be treated to prevent electrolytic action. Seat boards shall be secured to their steel supports by means of extruded aluminum clips and 5/16-inch-diameter bolts. All splices shall occur at steel supports. Splices in other locations will not be permitted.

E. Aluminum Footboards: Size per component requirements, non-slip aluminum planks made of 6063-T6 aluminum alloys with minimum wall thickness of 0.094 inches. Footboards shall be secured to their steel supports by means of extruded aluminum clips and 5/16-inch-diameter bolts. All splices shall occur at steel supports. Splices in other locations will not be permitted.
1. Provide tread system comprised of aluminum extrusions which fit together length-wise in a male-female shape running length of planks. This tongue and groove mechanism shall minimize deflection and not separate due to loads being applied to individual planks. The locking mechanism by design shall allow for expansion and contraction of individual planks without effecting performance of the system.
2. The system shall cause the deck planks to react together at all treads and cross walks to live load and form the appearance of a single tread system. By design, this system forms a solid, overlapping tread and riser installation.
3. The nose extrusion shall allow for a 1 inch extruded aluminum contrasting nose piece to be flush mounted on the leading edge and shall capture the vertical riser plank in an extruded pocket. The heel extrusion shall have a .70 inch vertical lip at the rear of the plank to allow for placement of vertical riser plank.
4. These extrusions shall be such that the attachment of the seat brackets, step brackets, mid-aisle rails and all other components is accomplished without deck penetrations. Through bolting or drilling of the aluminum tread / riser system is not permitted.
5. The system shall allow for seat and aisle reconfiguration at any time without evidence of its previous configuration.
6. Entry stairs to be 2 x 12 mill finish aluminum with inset extrusion to accept contrasting nosing member.
7. Ramp planks to be interlocking to resist deflection of live loads.
8. Open ends of planks to be covered with anodized aluminum end caps, securely fastened to the plank.
9. Joint sleeves: Dual joint sleeves to be inserted at each butt joint of each load bearing aluminum plank, and to penetrate 6 inches into each plank at the joint. Joint sleeves are not required at secondary gutter locations.

F. Aluminum Risers: Aluminum planks made of 6063-T6 aluminum alloys with minimum wall thickness of 0.094 inches. Provide continuous aluminum riser closures between all footboards. Through bolting or drilling of the riser board is unacceptable.

G. Stairs: 2-by-12 inch aluminum treads with maximum 7-inch rise.

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H. Hardware: Provide tamperproof and galvanized connections for seat boards, guardrails, and guardrail pipe. Footboard connections shall be made with galvanized fasteners.

I. Concrete Pad: Provide 3000 psi compressive strength concrete.

J. Finishes:

1. Steel: Hot-dipped galvanized after fabrication in accordance with **<<ASTM A123/A123M>>**.
2. Aluminum:
   a. Aluminum Footboards: Mill finish.
   b. Riser Boards: Dur-Kyn Kynar paint system.

K. Bleacher Schedule and Requirements:

1. Football Field: Provide two (2) separate units, minimum 150 seats each for a total of 300 minimum; one bleacher unit on each side of midfield as indicated on Drawings. Each unit shall be a minimum of 5 rows and 15 feet long.
2. Softball Field: Provide two (2) separate units, minimum 50 seats each for total of 100 minimum; one bleacher unit on home side and one on visitor side as indicated on Drawings. Each unit shall be a minimum of 5 rows and 15 feet long.
3. Baseball Field: Provide two (2) separate units, minimum 50 seats each for total of 100 minimum; one bleacher unit on home side and one on visitor side as indicated on Drawings. Each unit shall be a minimum of 5 rows and 15 feet long.

2.03 FINISHES, GENERAL

A. Comply with **<<NAAMM AMP 500-06>>** for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

2.04 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: non-specular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with **<<AAMA 611>>**.

C. Aluminum Painted Finish:

1. All painted aluminum shall have factory applied, baked-on Kynar or Hylar/acrylic resin based paint coating, Dur-Kyn, as manufactured by the Val spar Corporation. Dur-Kyn meets or exceeds the physical and performance properties of **<<AAMA 2603>>**. Powder coated finishes are not considered equal to Kynar type finishes.
2. Color: As selected by Architect from manufacturer's full range.

2.05 GALVANIZED STEEL FINISHES

A. Surface Preparation: Clean surfaces with non-petroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to

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be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with **<<ASTM A780/A780M>>**.

1. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds in steel, complying with **<<SSPC-Paint 20>>**.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for, installation tolerances, and other conditions affecting performance of work.

B. Verify with Owner's testing company that foundation bearing conditions are in accordance with assumptions made in design calculations and Shop Drawings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 ERECTION

A. Install pre-engineered bleachers in accordance with manufacturer's instructions and final Shop Drawings. Provide accessories indicated or required and anchors, inserts and other items required for installation of units and attachment of adjoining construction.

3.03 FIELD QUALITY CONTROL

A. Arrange for bleacher manufacturer's technical personnel to inspect bleachers and components during installation and at final completion and to certify compliance with requirements.

1. Notify Architect 48 hours in advance of date and time of final inspection.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Tests and Inspections:

1. Installation: Installation shall be inspected for compliance with approved shop drawings and for safety prior to use.

3.04 ADJUSTING AND CLEANING

A. Lubricate hardware and other moving parts.

B. Clean installed bleachers on exposed and semi-exposed surfaces. Touch-up shop applied finishes to restore damaged or soiled areas.

END OF SECTION 133416.53

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SECTION 142100
ELECTRIC TRACTION ELEVATORS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design.

B. AISC 360 - Specification for Structural Steel Buildings.

C. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices.

D. ASME A17.2 - Guide for Inspection of Elevators, Escalators, and Moving Walks Includes Inspection Procedures for Electric Traction and Winding Drum Elevators, Hydraulic Elevators, Inclined Elevators, Limited-Use/Limited-Application Elevators, Private Residence Elevators, Escalators, Moving Walks, Dumbwaiters, and Material Lifts.

E. ASME QEI-1 - Standard for the Qualification of Elevator Inspectors.

F. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

G. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes.

H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

I. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

J. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

K. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

L. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.

M. AWS D1.1/D1.1M - Structural Welding Code - Steel.

N. EPA (TSCA); Title VI - Toxic Substances Control Act, Title VI: Formaldehyde Standards for Composite Wood Products.

O. ITS (DIR) - Directory of Listed Products.

P. NEMA LD 3 - High-Pressure Decorative Laminates.

Q. NEMA MG 00001 - Motors and Generators.

R. NFPA 70 - National Electrical Code.

S. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.

T. PS 1 - Structural Plywood.

U. UL (DIR) - Online Certifications Directory.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate work with other installers for construction of hoistway to ensure hoistway is built to elevator manufacturer's requirements, including but not limited to, the following:
   a. Concrete work for elevator pit depth, hoistway size, and sump requirement.

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b. Masonry and/or metal framing and gypsum shaft wall for hoistway size, wall depth, and fire rating.
c. Metal fabricator for sizing and location of hoist beams.

2. Coordinate work with other installers to provide necessary conduits for proper installation of wiring, including but not limited to the following:
   a. Elevator equipment devices remote from elevator hoistway**<< or machine room; or None - N/A>>**.
   b. Emergency communication service.
   c. Elevator pit for **<< lighting; sump pump; and _____>>**.
   d. Automatic transfer switches and disconnects.
   e. Fire alarm panel.
3. Coordinate work with other installers for equipment provisions necessary for proper elevator operation, including but not limited to the following:
   a. Automatic transfer switches with auxiliary contacts for emergency power transfer status indication.
   b. Shunt trip devices for automatic disconnection of elevator power prior to fire suppression system activation; include provisions for shunt trip power monitoring.
   c. Overcurrent protection devices selected to achieve required selective coordination.

B. Preinstallation Meeting: Convene meeting at least two weeks prior to start of this work.
1. Review schedule of installation, proper procedures and conditions, and coordination with related work.

C. Construction Use of Elevator: Not permitted.

1.03 SUBMITTALS

A. Product Data: Submit data on following items:
1. Signal and operating fixtures, operating panels, and indicators.
2. Car design, dimensions, layout, and components.
3. Car and hoistway door and frame details.
4. Electrical characteristics and connection requirements.

B. Shop Drawings: Include appropriate plans, elevations, sections, diagrams, and details on following items:
1. Elevator Equipment and Machines: Size and location of driving machines, power units, controllers, governors, and other components.
2. Hoistway Components: Size and location of car machine beams, guide rails, buffers, ropes, and other components.
3. Clearances and over-travel of car and counterweight.
4. Locations in hoistway and in controller closet of traveling cables and connections for car lighting, telephone, and .
5. Location and sizes of hoistway and car doors and frames.
6. Interface with building security and access control systems.
7. Electrical characteristics and connection requirements.
8. Indicate arrangement of elevator equipment and allow for clear passage of equipment through access openings.

C. Design Data: Include calculations and sizing of structural components including but not limited to the following:

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1. Hoistway Components: Size and location of car machine beams, guide rails, suspension cables and wire ropes, buffers, and other components.
2. Rail bracket spacing; maximum loads imposed on guide rails requiring load transfer to building structural framing.
3. Individual weight of principal components; load reaction at points of support.
4. Sizes of and loads on hoisting and fall protection beams.

D. Samples: Submit samples illustrating **<< car interior finishes; car floor material; car and hoistway door and frame finishes; handrail material and finish; or _____>>** in the form of cut sheets or finish color selection brochures.

E. Designer's qualification statement.

F. Fabricator's/Installer's qualification statement.

G. Installer's qualification statement.

H. Welders' Qualification Statement: Welders' certificates in accordance with **<<AWS B2.1/B2.1M>>** and dated no more than 12 months before start of scheduled welding work.

I. Testing agency's qualification statement.

1.04 CLOSEOUT SUBMITTALS

A. Initial Maintenance Contract: Submit one year initial maintenance contract to run concurrently with General Contractor's one year guarantee and with warranty; beginning on date of Substantial Completion.

B. Continuing Maintenance Contract: Submit proposal to Owner for standard two-year continuing maintenance contract agreement in accordance with **<<ASME A17.1>>** and requirements as indicated, starting on date initial maintenance contract/warranty is scheduled to expire.

1. Indicate in proposal the services, obligations, conditions, and terms for agreement period and for renewal options.

C. Operation and Maintenance Data:

1. Parts catalog with complete list of equipment replacement parts; identify each entry with equipment description and identifying code.
2. Operation and maintenance manual.
3. Schematic drawings of equipment, and wiring diagrams of installed electrical equipment with list of corresponding symbols to identify markings in controller closet and on hoistway apparatus.

D. Executed Warranty: Submit concurrently with Initial Maintenance Contract.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design guide rails, brackets, and suspension cables under direct supervision of a licensed Professional Structural Engineer experienced in design of this type of work and licensed in the State of Maryland.

B. Fabricator Qualifications: Company specializing in providing non-proprietary elevator systems as specified in this section with a minimum of 5 projects of comparable size and scope. Provide reference list with Owner contact info on request.

C. Installer Qualifications: Company specializing in performing the work of this section, and shall be an approved installation representative of elevator equipment manufacturer.

D. Welder Qualifications: Welding processes and welding operators qualified in accordance with **<<AWS D1.1/D1.1M>>** and no more than 12 months before start of scheduled welding work.

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E. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.

F. Products Requiring Fire Resistance Rating: Listed and classified by **<<ITS (DIR)>>**, **<<UL (DIR)>>**, or other testing agency acceptable to authorities having jurisdiction (LAHJ).

G. Products Requiring Electrical Connection: Listed and classified by **<<UL (DIR)>>** or other testing agency acceptable to authorities having jurisdiction (LAHJ)) as suitable for the purpose indicated in construction documents.

1.06 WARRANTY

A. Manufacturer Warranty: Provide 1-year manufacturer warranty for elevator operating equipment and devices meeting term of initial maintenance contract. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations: Manufacturer shall be a single full-service elevator fabrication/installation company that shall design, engineer, furnish, and install elevator(s) for this Project based on the requirements included in the Contract Documents. Each elevator component shall be non-proprietary and shall be produced by a single manufacturer and obtained from a single supplier. Non-proprietary components from different manufacturers shall be compatible with each other for a complete operational elevator system.

B. Basis-of-Design Elevator Manufacturer: **<< _____ >>**. ******Work with selected elevator company to provide basic basis-of-design information including hoistway layout & dimensions. Then update list here******

C. Other Acceptable Manufacturers - Electric Traction Elevators (provide substitution request with full data per requirements below):
   1. Alliance Elevator Solutions.
   2. American Elevator.
   3. Eastern Elevator, an AEG Company.
   4. Kencor Elevator, an AEG Company.
   5. ~~KONE.~~
   6. ~~Otis Elevator Company.~~
   7. ~~Schindler Elevator Corporation.~~ ******Discuss Schindler with MCPS prior to using******
   8. ~~TK Elevator.~~ ******Previously ThyssenKrupp, purchased by KONE******

D. Substitutions: Refer to Division 1 for substitution and product requirements.
   1. Products other than Basis-of-Design: If submitting a substitution for a product by a manufacturer other than the Basis-of-Design, the submitting manufacturer shall provide a substitution request and provide the Contractor with changes required to indicated design and requirements, including but not limited to: hoistway dimensions, pit depth, overhead height, hoist beam size, location, and configuration, electrical characteristics, motor size, and disconnects, controller closet and control panel locations, and rated load and speed.
      a. Changes to the work due to substitution of a product other than the Basis-of-Design shall be accomodated at no additional cost to the Owner. The Contractor shall coordinate with all affected subcontractors during the bidding/pricing process to ensure accurate pricing for submitting elevator manufacturer.

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b. The manufacturer, Contractor, and Architect shall coordinate changes prior to the start of construction on the hoistway. The Architect shall incorporate changes into the documents and re-issue for distribution to affected subcontractors.

2.02 ELECTRIC TRACTION ELEVATORS

A. Electric Traction Passenger Elevator:

1. Electric Traction Elevator Equipment:
   a. Gearless Traction Machine: **<< Single wrapped; Double wrapped; or _____>>** traction driving sheave, with **<< dual; single; or _____>>** brake.
   b. Suspension Cables: Provide cables of diameter complying with ASME A17.1, or a modification/waiver approved by the LAHJ to use an alternate size verified by engineering analysis. Cables shall be non-combustible FT-1 fire-rated steel cables. Standard steel cables are not acceptable.
2. Drive System: Synchronous alternating current (AC) motors and variable voltage variable frequency (VVVF) drive.
3. Operation Control Type: Single automatic (push button) operation control.
4. Service Control Type: Standard service control only.
5. Interior Car Height: 93 inches.
6. Electrical Power: **<< 208; or 480>>** volts; alternating current (AC); three phase; 60 Hz. ******Verify with building electrical and basis-of-design******
7. Rated Net Capacity: **<< 2100 pounds; 2500 pounds; 3000 pounds; or 3500 pounds>>**. ******Verify all following paragraphs with basis-of-design******
8. Rated Speed: **<< 100 to 150 feet per minute; 100 feet per minute; or 150 feet per minute>>**.
9. Hoistway Size: As indicated on Drawings.
10. Elevator Pit Depth: **<< 60 inch; or 48 inch>>**.
11. Overhead Clearance at Top Floor: **<< _____>>**.
12. Travel Distance and Stops: As indicated on drawings.
13. Openings: Front only.
14. Traction Machine Location: Top of hoistway shaft.

2.03 COMPONENTS

A. General: All elevator equipment and systems shall be fabricated completely of non-proprietary parts and components. Non-proprietary components shall be standard, commonly available parts for ease of repair and maintenance, and shall be as required for a complete system.

B. Elevator Equipment:

1. Motors, Controllers, Controls, Buttons, Wiring, Devices, and Indicators: Comply with **<<NFPA 70>>** requirements, and refer to Division 26 and Electrical Drawings for additional information.
2. Guide Rails, Cables, Counterweights, Sheaves, Buffers, Attachment Brackets, and Anchors: Design criteria for components includes safety factors in accordance with applicable requirements of Elevator Code, **<<ASME A17.1>>**.
3. Fire-Resistant Materials: Elevator drive belts, suspension cables/ropes, and other elevator components located within the hoistway shall be non-combustible or FT-1 fire rated.
4. Suspension Cables: Provide cables of diameter complying with ASME A17.1, or alternate size verified by engineering analysis and approved in writing as a modification/waiver by the authority having jurisdiction.

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5. Buffers: Spring or polyurethane type; complying with ASME A17.1.

C. Electrical Equipment:
1. Motors: Compliant with **<<NEMA MG 00001>>**. Manufacturer shall size motor(s) specifically for this project to account for indicated load capacity, rated speed, and other factors as required.
a. Electrical characteristics are based on a **<< _____>>** HP motor. If a different motor size is required, coordinate any necessary revisions to electrical supply with electrical contractor at no additional cost to Owner. ******Verify with electrical engineer to ensure panelboard is sized appropriately******
2. Boxes, Conduit, Wiring, and Devices: Comply with **<<NFPA 70>>** requirements, and refer to Division 26 and Electrical Drawings for additional information.
3. Sump Pump in Pit: Refer to Division 22 and Plumbing Drawings for additional information.
4. Spare Conductors: Provide **<< ten; or _____>>** percent in extra conductors and **<< two; or ____>>** pairs of shielded audio cables in traveling cables.
5. Include wiring and connections to elevator devices remote from hoistway and to controller closet. Coordinate with Division 26 and Electrical Drawings.

2.04 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with **<< ASME A17.1; applicable local codes; authorities having jurisdiction (AHJ); and _____>>**.

B. Accessibility Requirements: Comply with **<<ADA Standards>>**.

C. Perform structural steel design, fabrication, and installation in accordance with **<<AISC 360>>**.

D. Perform welding of steel in accordance with **<<AWS D1.1/D1.1M>>**.

E. Fabricate and install door and frame assemblies in accordance with **<<NFPA 80>>** and complying with requirements of authorities having jurisdiction (AHJ).

F. Perform electrical work in accordance with **<<NFPA 70>>**.

2.05 OPERATION CONTROLS

A. Elevator Controls: Provide landing operating panels and landing indicator panels.
1. Restricted Access/Card Reader Operation: Landing call buttons shall be subject to card reader access; call buttons shall be inoperable unless authorized credential is presented at the card reader. Coordinate with Division 26 Electrical and Division 28 Access Control.
2. Landing Operating Panels (Call Buttons): Metallic type, one for originating "Up" and one for originating "Down" calls, one button only at terminating landings; with illuminating indicators.
3. Landing Indicator Panels (Hall Lanterns): Illuminating, with audible signal. At manufacturer's option, audible signal may be mounted on cab.
4. Signage:
a. Provide floor designator signage mounted to each hoistway jamb.
b. Provide emergency pictograph signage adjacent to landing operating panel, with text and graphics, directing occupants to egress stairs in the event of fire.
5. Comply with **<<ADA Standards>>** for elevator controls. All controls and signage shall include braille letters and all symbols shall be tactile.

B. Interconnect elevator control system with building **<< security; fire alarm; card access; smoke alarm; building management control; and _____>>** systems.

C. Door Operation Controls:

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1. Program door control to open doors automatically when car arrives at floor landing.
2. Render "Door Close" button inoperative when car is standing at dispatch landing with doors open.
3. Door Safety Devices: Moveable, retractable safety edges, quiet in operation; equipped with photo-electric light rays and/or proximity detector.

D. Low Energy/Standby Mode: Elevator control system shall have a standard low energy/standby mode; after 5 minutes of inactivity, elevator controller shall switch to standby and power down non-essential components until call button is pressed.

E. Emergency Monitoring and Communication: Provide two-way communication system mounted in a control panel that will connect elevator cab to outside monitoring service. Monitoring service shall be interactive and available live 24/7.
1. In accordance with Maryland state law, monitoring access is not permitted over wireless. Monitoring shall be provided over a hard-wired connection that is compliant with ASME A17.1.
a. Coordinate with Montgomery County Public Schools security staff to ensure connection does not create interference with, and is compatible with, MCPS' centralized security network.
2. Emergency system shall activate by push button and not require use of handset.
3. Emergency system shall include visual, text-based, and video-based system, and with a voice-only option, that is accessible to deaf, hard-of-hearing, or visually impaired individuals in accordance with applicable edition of the IBC.

2.06 OPERATION CONTROL TYPE

A. Single Automatic (Push Button) Operation Control: Applies to car in single elevator shaft.
1. Refer to description provided in **<<ASME A17.1>>**.
2. Set system operation so that momentary pressure of landing button dispatches car from other landing to that landing.
3. Allow call registered by momentary pressure of landing button at any time to remain registered until car stops in response to that landing call.
4. If elevator car door is not opened within predetermined period of time after car has stopped at terminal landing, allow car to respond to call registered from other landing.

2.07 EMERGENCY POWER

A. Set-up elevator operation to run with **<< building emergency power supply; or elevator emergency power supply>>** when the normal building power supply fails, and in compliance with **<<ASME A17.1>>** requirements. ******Verify if emergency power supply is provided by battery backup or by generator. Coordinate with electrical engineer******

B. Building Emergency Power Supply: Supplied by **<< backup generator>>**; provide elevator system components as required for emergency power characteristics with phase rotation the same as for normal power.
1. Provide transfer switches and auxiliary contacts.
2. Install connections to power feeders.

C. Elevator Emergency Power Supply: Supplied by **<< battery backup>>**; provide elevator system components as required for emergency power characteristics.

D. Emergency Lighting: Provide emergency elevator lighting complying with ASME A17.1.

E. Provide operational control circuitry for adapting the change from normal to emergency power.

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1. Provide selector switch with illuminated signal indicating that building power supply has failed and elevator is on emergency power, in accordance with **<<ASME A17.1>>**.

F. Upon transfer to emergency power, advance one elevator at a time to ground floor/egress landing, stop car, open doors, disable operating circuits, and hold in standby condition.

2.08 MATERIALS

A. Rolled Steel Sections, Shapes, Rods: **<<ASTM A36/A36M>>**.

B. Sheet Steel: Hot-dipped galvanized steel sheet, **<<ASTM A653/A653M>>**, with G90 coating.

C. Stainless Steel Sheet: **<<ASTM A666/A666M>>**, Type 304; No. 4 Brushed finish.

D. Stainless Steel Bars, Shapes and Moldings: **<<ASTM A276/A276M>>**, Type 304.

E. Extruded Aluminum: **<<ASTM B221>>** (**<<ASTM B221M>>**), natural anodized finish unless otherwise indicated.

F. Plywood: **<<PS 1>>**, Structural I, Grade C-D or better, sanded.

1. Composite Wood: All composite wood materials installed inside the weatherproofing system shall meet either **<<EPA (TSCA); Title VI>>** for ultra-low-emitting formaldehyde or no added formaldehyde (ULEF / NAUF).

G. Flooring Finish: **<< Resilient tile flooring; Carpet tile flooring; Porcelain tile flooring; or _____>>**; refer to Finish Schedule and applicable Division 9 flooring section.

H. Plastic Laminate: **<<NEMA LD 3>>**, Type HGS, color as selected by Owner and Architect from manufacturer's standard line of colors.

2.09 CAR AND HOISTWAY ENTRANCES

A. Elevator Car and Hoistway Entrances:

1. Car and Hoistway Entrances:

a. Hoistway Fire Rating: **<< 1 Hour; 2 Hours; or As indicated on Drawings>>**. ******Verify with life safety drawings; 1 hour is standard for less than 4 stores, but 2 hours is also common******

b. Elevator Door Fire Rating: **<< 1 Hour; or 1-1/2 Hours>>**. ******Verify with hoistway rating******

c. Framed Opening Finish and Material: Stainless steel, brushed/satin finish.

d. Car Door Material: Stainless steel, brushed/satin finish, with rigid sandwich panel construction.

e. Hoistway Door Material: Stainless steel, brushed/satin finish, with rigid sandwich panel construction.

f. Door Operation: **<< Center opening, single speed; Side opening, two speed; or _____>>**. ******Verify with basis-of-design. May vary based on size and orientation******

g. Door Size: **<< 42 inches wide by 84 inches high>>**. ******42 x 84 is fairly standard. Verify with MCPS******

h. Sills: Extruded aluminum.

B. Sills/Thresholds: Configure to align with frame return and coordinate with floor finish.

C. Gasketing: Provide acoustic-type gasketing at hoistway doors and frames to minimize audible noise due to car activities in the hoistway and air pressure differential between hoistway and landing floors.

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2.10 CAR EQUIPMENT AND MATERIALS

A. Elevator Car:

1. Car Operating Panel: Provide **<< main; auxiliary; and _____>>**; **<< flush-mounted applied face plate; or _____>>**, with**<< illuminated; _____; or None - N/A>>** call buttons corresponding to floors served with **<< "Door Open/Door Close" buttons; "Door Open" button; "Door Close" button; alarm button; and _____>>**.
   a. Panel Material: **<< Integral with front return; Stainless steel; Bronze face; or _____>>**; **<< one; or two>>** per car.
   b. Car Floor Position Indicator: **<< Above door; Above car operating panel; or _____>>** with illuminating position indicators.
   c. Locate alarm button where it is unlikely to be accidentally actuated; not more than **<< 54 inch; or ____ inch>>** above car finished floor.
2. Ventilation: Single-speed fan with grille in ceiling.
3. Subfloor: Provide **<<PS 1>>**, Structural I plywood subfloor, 5/8 inch thick, prepared for installation of indicated flooring material.
4. Front Return Panel: Stainless steel, brushed/satin finish to match door.
5. Door Wall: Stainless steel, brushed/satin finish to match door.
6. Side and Rear Walls: Plastic laminate on plywood.
   a. Reveals Between Wall Panels: Stainless steel, to match front return panel/door. Align reveal/joint locations with ceiling panel joints.
7. Hand Rails: Stainless steel with #4 brushed/satin finish, at three side and rear walls. Provide open clear space of 1-1/2 inch from back of rail to face of wall.
   a. Flat Bar Stock, Solid: 1/4- or 1/2-inch thick by 2 inch high, nominal.
8. Ceiling: **<< Suspended stainless steel ceiling panels with compact fluorescent or LED downlights centered in each panel; Suspended luminous ceiling - translucent panels with linear fluorescent or LED light fixtures; or _____>>**.

B. Car Accessories:

1. Certificate Frame: **<< Bronze; Stainless steel; or _____>>** frame glazed with clear **<< tempered glass; acrylic plastic; polycarbonate; or acrylic or polycarbonate>>**, and attached with**<< tamper-proof; _____; or None - N/A>>** screws.
2. Protective Pads: **<< Vinyl; Canvas; Heavy-Duty; or _____>>** cover, padded with **<< cotton wadding; impact-resistant; or _____>>** fill material, sewn with piping edges; fire resistant in compliance with **<<ASME A17.1>><< ; brass grommets for supports; ; _____; or None - N/A>>**, covering side and rear walls and front return**<< , with cut-out for control panel; , _____; or None - N/A>>**; provide **<< one set; ____ sets; or one set for each elevator>>**.
   a. Pad Supports: **<< Brass studs; Aluminum studs; Stainless steel studs; Plastic zee-hooks; Plastic clamps; As selected by Architect; or _____>>**; mounted **<< from ceiling frame; from top of wall panels; from wall mounted channel; at _____ inches above the floor; or _____>>**.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting this work.

B. Verify that **<< hoistway; pit; machine room; and _____>>** are ready for work of this section.

C. Verify hoistway shaft and openings are of correct size and within tolerance.

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D. Verify location and size of machine foundation and position of machine foundation bolts.

E. Verify that electrical power is available and of correct characteristics.

3.02 PREPARATION

A. Arrange for temporary electrical power for installation work and testing of elevator components. Coordinate with Division 1 Section "Temporary Facilities and Controls" for additional requirements.

B. Maintain elevator pit excavation free of water.

3.03 INSTALLATION

A. Coordinate this work with installation of hoistway wall construction.

B. Install system components, and connect equipment to building utilities.

C. Provide conduit, electrical boxes, wiring, and accessories; refer to Division 26 Electrical sections.

D. Mount **<< machines; motors; and _____>>** on vibration and acoustic isolators.

1. Place on structural supports and bearing plates.
2. Securely fasten to building supports.
3. Prevent lateral displacement.

E. Install hoistway, elevator equipment, and components in accordance with approved shop drawings.

F. Install guide rails to allow for expansion and contraction movement of guide rails.

G. Accurately machine and align guide rails, forming smooth joints with machined splice plates.

H. Field Welds: Chip and clean away oxidation and residue with wire brush; spot prime with two coats of manufacturer's recommended primer.

I. Install hoistway door sills, frames, and headers in hoistway walls; grout sills in place, set hoistway floor entrances in alignment with car openings, and align plumb with hoistway.

J. Fill hoistway door frames solid with grout.

K. Structural Metal Surfaces: Clean surfaces of rust, oil, or grease; wipe clean with solvent; prime with two coats.

L. Wood Surfaces not Exposed to Public View: Finish with one coat primer; **<< one coat; two coats; or _____>>** enamel.

M. Adjust equipment for smooth and quiet operation.

3.04 TOLERANCES

A. Guide Rail Alignment: Plumb and parallel to each other in accordance with **<<ASME A17.1>>** and **<<ASME A17.2>>**.

B. Car Movement on Aligned Guide Rails: Smooth movement, without any objectionable lateral or oscillating movement or vibration.

3.05 FIELD QUALITY CONTROL

A. Provide Acceptance Testing and inspections by regulatory agencies certified in accordance with**<<ASME QEI-1>>**.

1. As a part of final acceptance of the project and in accordance with the General Conditions, a minimum of 30 days prior to completion, the Elevator Installer/General

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Contractor shall officially request to the State of Maryland to have a third-party Qualified Elevator Inspector (QEI) conduct a full Acceptance Inspection and Test in accordance with ASME A17.1 before final acceptance by the Owner.

a. The Elevator Installer/General Contractor shall provide all data affecting the elevator installation or modification, including "as-installed" circuit and control wiring diagrams and maintenance manuals.

2. The Elevator Installer shall coordinate and participate with all tests, inspections, and approvals required by the building code, including but not limited to inspections by QEI, fire marshal and elevator inspector. The elevator installer shall attend and assist with tests, inspections, and approvals required by the building code at no additional cost to the Owner.
3. Schedule acceptance tests with agencies and notify Owner and Architect a minimum of two weeks in advance.
4. Obtain permits as required to perform tests.
5. Document regulatory agency tests and inspections in accordance with requirements.
6. Perform tests required by regulatory agencies.
7. Furnish test and approval certificates issued by authorities having jurisdiction.

3.06 ADJUSTING

A. Adjust for smooth acceleration and deceleration of car to minimize passenger discomfort.

B. Adjust with automatic floor leveling feature at each floor landing to reach 1/4-inch maximum from flush with sill.

3.07 CLEANING

A. Remove protective coverings from finished surfaces.

B. Clean surfaces and components in accordance with manufacturers written instructions.

3.08 CLOSEOUT ACTIVITIES

A. Provide demonstration and training at the Project site, using the installed elevator equipment.

B. Demonstration and training instructor shall be an experienced employee of elevator fabricator/installer, knowledgeable in all components of elevator installation, with a minimum 10 years experience.

C. Demonstration: Demonstrate operation of system to Owner's personnel.
   1. Use operation and maintenance data as reference during demonstration.
   2. Briefly describe function, operation, cleaning, and maintenance of each component.

D. Training: Train Owner's personnel on cleaning and operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of onr-half day (4 hours) of training.

3.09 PROTECTION

A. Do not permit construction traffic within car after cleaning.

B. Protect installed products until Date of Substantial Completion.

C. Touch up, repair, or replace damaged products and materials before Date of Substantial Completion.

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3.10 MAINTENANCE

A. Provide Initial Maintenance Contract of elevator system and components in accordance with **<<ASME A17.1>>** and requirements as indicated for a period of one year from the Date of Substantial Completion.

B. Submit proposal for a two-year continuation of Maintenance Contract beyond the initial 12 month contract in accordance with **<<ASME A17.1>>** and requirements as indicated for installed elevator equipment; matching examination and maintenance requirements of initial maintenance contract.

C. Perform maintenance contract services using competent and qualified personnel under the supervision and direct employ of the elevator manufacturer or installer.

D. Maintenance contract services shall not be assigned or transferred to any agent or other entity without prior written consent of Owner.

E. Include systematic examination at maximum monthly intervals (12 visits total for initial contract). Examination shall include adjustment, lubrication, and other preventive maintenance, and repair or replacement of defective or worn parts or equipment. Monthly inspection shall include Phase II Fire Recall testing.

1. As part of initial maintenance contract, coordinate with the State of Maryland for annual re-inspection at the one year mark by State Inspector/QEI. Coordinate with Owner to ensure acceptable dates and times for Owner to be present, and provide a minimum of two weeks notice.

F. Ensure proper lubrication of all components; replace wire ropes/cables when necessary to maintain the required factor of safety.

G. Perform work without removing cars from use during peak traffic periods.

H. Provide emergency call back service during regular working hours throughout period of this maintenance contract.

I. Maintain an adequate stock of parts for replacement or emergency purposes, and have personnel available to ensure the fulfillment of this maintenance contract without unreasonable loss of time.

END OF SECTION 142100

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SECTION 144200
WHEELCHAIR LIFTS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design.

B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

C. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices.

D. ASME A18.1 - Safety Standard for Platform Lifts and Stairway Chairlifts.

E. ASME QEI-1 - Standard for the Qualification of Elevator Inspectors.

F. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

G. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

H. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.

I. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

J. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.

K. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

L. AWS D1.1/D1.1M - Structural Welding Code - Steel.

M. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel.

N. ICC A117.1 - Accessible and Usable Buildings and Facilities.

O. ITS (DIR) - Directory of Listed Products.

P. NFPA 70 - National Electrical Code.

Q. UL (DIR) - Online Certifications Directory.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate installation of wheelchair lift system with adjacent construction using necessary attachments; provide anchoring devices in accordance with manufacturer's installation instructions; coordinate installation of cast-in-place concrete components.

1. Electrical System: Coordinate utility and electrical system connections to ensure they are made in an orderly and expeditious manner.

B. Preinstallation Meeting: Convene meeting at least two weeks prior to start of this work.

1. Review schedule of installation, proper procedures and conditions, and coordination with related work.

1.03 SUBMITTALS

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A. Product Data: Include data on material descriptions, construction details, component dimensions and profiles, and finishes; include data on rated capacities, electrical and operating characteristics, and necessary accessories.

B. Shop Drawings: Include plans, elevations, sections, and attachment details; include equipment assembly details with dimensions, weights, loads, required clearances, components, size and location of anchors and required field connections, and methods for field assembly; provide diagrams indicating signal, power, and control wiring.

C. Installer's qualification statement.

D. Testing agency's qualification statement.

1.04 CLOSEOUT SUBMITTALS

A. Maintenance contracts.

B. Executed warranty.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of type specified and a licensed installer of listed manufacturer. Installer certifies that they maintain an adequate stock of maintenance parts and have qualified maintenance staff to fulfill maintenance activities and emergency call back services.

B. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.

1.06 FIELD CONDITIONS

A. Use of wheelchair lifts during construction for hoisting materials or personnel is not permitted.

1.07 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Manufacturer Warranty: Provide 2-year manufacturer warranty to repair or replace wheelchair lift system components that fail in materials or workmanship. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with **<<ASME A18.1>>**, **<<ASME A17.1>>**, applicable local codes, and authorities having jurisdiction (AHJ).

B. Accessibility Requirements: Comply with **<<ADA Standards>>** and **<<ICC A117.1>>**.

C. Structural Performance: Comply with **<<ASCE 7>>** for loading of wheelchair lift components and assemblies.

D. Perform welding of steel in accordance with **<<AWS D1.1/D1.1M>>**.

E. Perform electrical work in accordance with **<<NFPA 70>>**.

2.02 VERTICAL PLATFORM WHEELCHAIR LIFTS

A. Manufacturers:

1. Basis-of-Design; Garaventa Lift;
2. Butler Mobility Products.

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3. Savaria.

B. Vertical Platform Wheelchair Lifts: Provide manufacturer's standard type that complies with indicated requirements. Use manufacturer's standard components for vertical platform wheelchair lifts as required for complete system unless otherwise indicated.

1. Type of Vertical Platform Wheelchair Lift:
   a. Vertical platform wheelchair lift without shaftway or enclosure; platform includes sidewalls and gate creating safety barrier for passenger.
2. Configuration: ******Verify configuration below on job-to-job basis******
   a. Straight through entry/exit, with front and rear openings.
   b. 90-degree turn entry/exit, with front and side openings.
   c. Number of Stops: Two.
   d. Landing Openings, Self-Closing:
      1) Lower landing with platform-mounted gate.
      2) Upper landing with platform-mounted gate and fixed upper landing gate.
3. Lift Load Capacity: 750 lb, maximum.
4. Lifting Height from Bottom to Upper Floor Level: As indicated on Drawings.
5. Platform Width Clearance: 36 inches. ******Width and Length here are from Garaventa Opal "Mid-Size" Platform - for wheelchair user with companion******
6. Platform Length Clearance: 54-7/8 inches.
7. Platform Gate: Self-closing and flush-mounted, minimum height of 42 inches with width corresponding to width of platform.
8. Platform Side Wall Panels: Minimum height of 42 inches, with **<< galvanized steel; aluminum; or _____>>** sheet panels, and enclosed within rectangular **<< extruded aluminum; steel; or _____>>** framework.
9. Platform Floor: **<< Steel; Galvanized steel; Stainless steel; Aluminum; or _____>>** sheet with **<< matte finish; primed finish; checkered texture; non-skid painted finish; or _____>>**, having overall thickness not greater than **<< 1-1/2 inches; or ___ inches>>**.
10. Access Ramp at Bottom Landing: Fold-up/retractable ramp to transition from floor level to lift platform, with ramp finish to match lift platform. ******Common for retrofit; for new work, try to coordinate slab recess with structural engineer to not require a ramp******
    a. Size: Provide end ramps at least 32 inches wide and side ramps at least 42 inches wide; length as required for slope with 1:12 maximum slope.
11. Pit Depth: 3 inches. ******Common for new work; verify with manufacturer and coordinate with Structural Engineer for slab recess******
12. Drive System:
    a. Self-lubricating acme screw drive.
       1) Rated Speed: 10 fpm, nominal.
13. Drive System Enclosure: Provide rectangular **<< galvanized steel; extruded aluminum; or _____>>** tube frame with flush **<< steel; galvanized steel; aluminum; or _____>>** sheet panels on sides and top to enclose drive system components; securely attach enclosure to adjacent substrate.

2.03 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics: Motor for leadscrew drive system.

1. 2.0 HP motor; 120V single phase, 60 Hz, on a dedicated 20-amp circuit.

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2. Motor Control: **<< Inverter control; or _____>>** and other components as required by manufacturer for system indicated.
3. Disconnect Switch: Factory mount disconnect switch **<< in control panel; or _____>>**.

B. Platform Controls: 24V, continuous pressure switch, one for each direction, with keyed operation.
1. Include illuminated emergency stop switch to sh audible audio alarm when activated; with battery backup.

C. Call Stations: 24V control; keyed operation. Provide station at upper landing mounted to gate frame; provide wall-mount station at lower landing, final location as indicated on Drawings or as approved by Architect.

D. Emergency Operation: Provide battery-powered lowering, to lower lift to landing due to malfunction or loss of power.

E. Electrical Components, Boxes, Conduit, Wiring, and Devices: Comply with **<<NFPA 70>>** and **<<UL (DIR)>>** or **<<ITS (DIR)>>** listed and labeled, and marked as applicable for proposed locations.

2.04 MATERIALS

A. Rolled Steel Sections, Shapes, and Rods: Comply with **<<ASTM A36/A36M>>**.

B. Sheet Steel: Hot-dipped galvanized steel sheet, **<<ASTM A653/A653M>>**, Designation SS (structural steel), Grade **<< 33 (230); 37 (255); 55 (380); or _____>>**, with **<< G90/Z275; or ____>>** coating.

C. Rolled Steel Floor Plates: Comply with **<<ASTM A786/A786M>>**, **<< 1/8 inch; or ___ inch>>** thick, with **<< manufacturer's standard surface pattern; Pattern No.4; or Pattern No. ___>>**; rolled from steel plate complying with **<<ASTM A572/A572M>>**, Grade **<< 55 (380); or _____>>**.

D. Steel Tubing: Comply with **<<ASTM A500/A500M>>**, cold formed.

E. Anchor Bolts and Rods: Comply with **<<ASTM F1554>>**, **<< Grade 36; Grade 55; or Grade 105>>**.

F. Welding: Comply with applicable requirements of **<<AWS D1.1/D1.1M>>** and **<<AWS D1.3/D1.3M>>**.

2.05 EQUIPMENT

A. Lubrication of Equipment: Provide grease fittings for lubricating bearings requiring periodic lubrication, automatic feed type grease cups, and visible and easily accessible lubrication points.

B. Guide Rails, Ropes, Counterweights, Sheaves, Attachment Brackets, and Anchors: Sized in accordance with local building code, including safety factors.

C. Maintenance Devices: Provide as necessary within wheelchair lift system, supported on structural members within accessible locations.

2.06 FINISHES

A. Baked-On Factory Finish for Structural Metal Surfaces: Clean surfaces of rust, oil, or grease and wipe clean with solvent; apply manufacturer's standard two-coat, baked-on finish consisting of primer and thermosetting top coat.
1. Color: **<< Manufacturer's standard color; As selected by Architect from manufacturer's standard line; or _____>>**.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that areas and conditions comply with installation tolerances and other conditions affecting this work.

B. Verify that locations for electrical rough-in connections to system equipment are in acceptable locations before installing equipment.

C. Verify that electrical power is available and of correct characteristics.

D. Verify that adjacent walls and floors for wheelchair lift areas are plumb and square, and slab recess (if applicable) is properly sized.

E. Do not proceed with installation until unacceptable conditions have been corrected.

3.02 PREPARATION

A. Prepare surfaces of substrates using methods in accordance with lift manufacturer's installation instructions.

B. Clean surfaces thoroughly before starting installation of lifts.

3.03 INSTALLATION

A. Install wheelchair lift system and components in accordance with manufacturer's written installation instructions.

B. Install wheelchair lift system securely to supporting structure, and flush with adjacent surfaces.

C. Install structural components using methods that comply with requirements indicated relative to layout and structural position.

3.04 ADJUSTING

A. Adjust wheelchair lift equipment to operate smoothly and safely.

B. Verify vertical travel of wheelchair lift system; adjust as necessary to maintain operating range indicated.

C. After installation, inspect exposed factory-finished wheelchair lift equipment and repair damaged finishes.

3.05 CLEANING

A. Remove protective coverings from finished surfaces.

B. Clean surfaces and components.

3.06 FIELD QUALITY CONTROL

A. Provide Acceptance Testing and inspections by regulatory agencies certified in accordance with **<<ASME A18.1>>**.

1. As a part of final acceptance of the project the Contractor shall have third-party certified testing and inspection firm conduct a full Acceptance Inspection and Test in accordance with ASME A18.1 before final acceptance by the Owner. The Contractor shall furnish to the Owner all data affecting the lift installation or modification, including "as-installed" circuit and control wiring diagrams and maintenance manuals.
2. The lift installer shall coordinate and participate with all tests, inspections, and approvals required by the building code, including but not limited to inspections by testing and inspection firm, fire marshal and LAHJ inspector. The lift installer shall attend and assist

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with tests, inspections, and approvals required by the building code at no additional cost to the Owner.

3. Schedule tests with agencies and notify **<<Owner>>** and **<<Architect>>**.
4. Obtain permits as required to perform tests.
5. Document regulatory agency tests and inspections in accordance with requirements.
6. Perform tests required by regulatory agencies.
7. Furnish test and approval certificates issued by authorities having jurisdiction.

3.07 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate operation of wheelchair lift system to **<<Owner>>**'s personnel.
   1. Use operation and maintenance data as a reference during the demonstration.
   2. Briefly describe function, operation, and maintenance of each component.

B. Training: Train **<<Owner>>**'s personnel on operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of **<< two hours; one day; or _____>>** of training.
   3. Instructor: Manufacturer's training personnel.
   4. Location: At project site, us.

3.08 MAINTENANCE

A. Provide an initial maintenance contract for service and maintenance of wheelchair lifts system and components for one year after Date of Substantial Complietion.
   1. Perform maintenance work using competent personnel under supervision and directly employed by wheelchair lift installer.
   2. Assigning or transfer of maintenance service to any agent or subcontractor is not permitted without prior consent of **<<Owner>>**.
   3. Examine at bi-monthly intervals (every two months, minimum); clean, adjust, and lubricate equipment.
   4. Repair, or replace parts when required with parts produced by original equipment manufacturer.
   5. Provide emergency call back service during working hours during maintenance period.

END OF SECTION 144200

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SECTION 210500
COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.

C. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard.

D. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings.

E. ASME B16.25 - Buttwelding Ends.

A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators.

B. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.

C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

D. ASTM A135/A135M - Standard Specification for Electric-Resistance-Welded Steel Pipe.

E. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

F. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.

G. ASTM A536 - Standard Specification for Ductile Iron Castings.

H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

I. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.

J. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).

K. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

L. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.

M. AWS D1.1/D1.1M - Structural Welding Code - Steel.

N. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems.

O. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings.

P. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

Q. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast.

R. AWWA C606 - Grooved and Shouldered Joints.

S. FM 1920 - Approval Standard for Pipe Couplings and Fittings for Aboveground Fire Protection Systems.

T. NFPA 13 - Standard for the Installation of Sprinkler Systems.

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U. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.

V. NFPA 1963 - Standard for Fire Hose Connections.

W. UL 405 - Standard for Safety Fire Department Connection Devices.

1.02 SUBMITTALS

A. Coordinate submittals for all fire-suppression sections as a complete submission per requirements of Division 21 Section "Water-Based Fire-Suppression Systems."

1.03 QUALITY ASSURANCE

A. Equipment and appliances comprising portions of the mechanical systems regulated by the International Mechanical Code shall be listed and labeled in accordance with the applicable edition of the Maryland Building Code.

B. Equipment and appliances comprising portions of the fire suppression systems regulated by **<<NFPA 13>>** shall be installed in accordance with the listing and the manufacturer's installation instructions. Manufacturer's installation instructions shall be available on the job site for use and inspection.

C. Steel Support Welding: Comply with **<<AWS D1.1/D1.1M>>**.

D. Steel Pipe Welding: Comply with **<<ASME BPVC-IX>>**; "Welding and Brazing Qualifications."

1. Comply with applicable provisions of ASME B31 series "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

E. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

1. Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

F. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

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1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers, with labeling in place.

B. Provide factory-applied temporary protective coating on cast iron and steel valves.

C. Provide factory-applied temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.05 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.

1.06 INTENT OF CONTRACT DOCUMENTS

A. Fire Suppression/Protection drawings are diagrammatic, indicating general locations and arrangements of pipe, and equipment. Not necessarily indicating all offsets, conditions, and appurtenances required to provide clearances for maximum practical accessibility to perform maintenance.

B. Coordinate work to achieve proper operation and to provide maintainable installed conditions.

C. Notify representatives of Owner and Architect immediately of conditions which do not comply or will not produce this result.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Fire-Suppression System:
   1. Design and provide complete fire-suppression system in accordance with all Division 21 sections and Fire Protection drawings.
   2. Comply with **<<NFPA 13>>**and **<<NFPA 14>>**, as applicable.

B. Provide system pipes, fittings, sleeves, escutcheons, seals, and other related components and accessories as required for a complete fire-suppression system.

2.02 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match fire-suppression piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 degrees F.

D. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
   1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 degrees F.

F. Dielectric Nipples: Electroplated steel nipple with inert and non-corrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 degrees F.

2.03 SLEEVES

A. Galvanized-Steel Sheet: **<<ASTM A653/A653M>>**; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: **<<ASTM A53/A53M>>** Schedule 40, Type E, Grade B, galvanized; with plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to **<<AWWA C151/A21.51>>** cast ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Molded Polyethylene: Reusable PE, tapered-cup shape, and smooth-outer surface, with nailing flange for attaching to wooden forms.

E. Clearances:
   1. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch greater than outside pipe diameter, unless otherwise indicated.
   2. Rated Openings: Caulked tight with a tested firestopping material complying with **<<ASTM E814>>** and in accordance with Division 7 section "Firestopping," to prevent the spread of fire, smoke, and gases.

2.04 MECHANICAL PIPE SLEEVE-SEAL SYSTEMS

A. Manufacturers:

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1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

B. Modular Mechanical Seals:
1. Elastomer-based (EPDM) interlocking links to continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
3. Size and select seal component materials in accordance with service requirements.
4. Glass-reinforced plastic pressure end plates (two per seal).
5. Fasteners: **<<ASTM A307>>** bolts, nuts, and washers; carbon steel with a corrosion-resistant coating; length as required to secure pressure end plates to sealing elements.

2.05 ESCUTCHEONS

A. Material:
1. Chrome-plated brass, unless otherwise indicated.
a. Rough brass is acceptable in unfinished service spaces/equipment rooms.
b. Galvanized cast iron is acceptable for floor-plate type in unfinished service spaces/equipment rooms.
2. Metals and Finish: Comply with **<<ASME A112.18.1>>**.

B. Construction:
1. Provide one-piece construction for mounting on chrome-plated pipe unless otherwise indicated. One piece or split-pattern acceptable for retrofit to existing piping where applicable.
2. Size to fit fire-suppression piping dimension, with outside flange diameter sized to fully cover the opening size.
3. Internal setscrews to maintain a fixed position against a surface.

2.06 PIPE HANGERS AND SUPPORTS

A. General: Comply with applicable requirements of **<<NFPA 13>>**.

B. Hangers for Pipe Sizes 1/2- to 1-1/2 inch: Malleable iron or carbon steel, adjustable swivel, split ring.

C. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.

D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

E. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

2.07 MECHANICAL COUPLINGS

A. Manufacturers:
1. Victaulic Company.

B. Rigid Mechanical Couplings for Grooved Joints:
1. Dimensions and Testing: Comply with **<<AWWA C606>>**.
2. Minimum Working Pressure: **<< 175 psig; 300 psig; or ___ psig>>**.
3. Housing Material: Fabricate of ductile iron complying with **<< ASTM A536; or _____>>**.

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4. Housing Coating: Factory applied **<< orange enamel; or _____>>**.
5. Gasket Material: EPDM suitable for operating temperature range from **<< minus 30 degrees F; or _____ degrees F>>** to **<< 230 degrees F; or ____ degrees F>>**.
6. Bolts and Nuts: Hot-dipped-galvanized or zinc-electroplated steel.
7. Provide stops for direct stab installation without field assembly.

2.08 ACCESSORIES

A. Joining Material: Provide UL listed pipe joint compound for threaded pipe.

B. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
1. Grout: Comply with **<<ASTM C1107/C1107M>>** Grade B; non-shrink and non-metallic, with minimum 5,000 psi compressive strength after 28 days cured.

2.09 PIPING SPECIALTIES

A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber-faced clapper to automatically actuate water motor alarm, pressure retard chamber and variable pressure trim with the following additional capabilities and features:
1. Activate electric alarm.
2. Test and drain valve.
3. Replaceable internal components without removing valve from installed position.
4. Manufacturers:
a. Victaulic Company.

B. Dry Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber-faced clapper to automatically actuate water motor alarm, accelerator, and with the following additional capabilities and features:
1. Activate electric alarm.
2. Test and drain valve.
3. Externally resettable.
4. Replaceable internal components without removing valve from installed position.

C. Preaction Valve:
1. Operated by detection system listed for releasing service and independent of building fire alarm system with provisions for **<< indicated remote, ; _____ , ; or None - N/A>>**local, and manual releases.
2. Incorporate **<< mechanical; or _____>>** latching mechanism with valve clappers independent of system water pressure fluctuations.
3. Provide test detection device for each actuation circuit adjacent to each controlled valve in accordance with **<<NFPA 13>>**.

D. Auxiliary Drains: Condensate collection drain for each section of trapped pipe in preaction or dry fire protection system.
1. Manufacturers:
a. AGF Manufacturing.

E. Air Venting Valves:
1. Manufacturers:
a. AGF Manufacturing.

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F. Backflow Preventer: **<< Reduced-pressure principle; Double-check; or _____>>** valve assembly backflow preventer with drain and OS & Y gate valve on each end.

G. Commercial Riser Manifold: Preassembled and tested riser manifold in accordance with **<<NFPA 13>>**.
   1. Manufacturers:
      a. AGF Manufacturing.

H. Test Connections:
   1. Combination Inspector's Test Connection and Drain Valve:
      a. Provide test connections approximately **<< 6 feet; or ____ feet>>** above floor for **<< each; portion of each; or _____>>** sprinkler system equipped with an alarm device, located at most remote part of each system.
      b. Route combination test connection and drain valve to an open-site drain location, excluding janitor sinks, accepting full flow without negative consequences.
      c. Supply discharge orifice with same size as corresponding sprinkler orifice.
      d. Limit vertical height of exterior wall penetration to **<< 2 feet; or ____ feet>>** above finished grade.
      e. Manufacturers:
         1) AGF Manufacturing**<< ; _____; or None - N/A>>**: www.agfmfg.com/#sle.
   2. Backflow Preventer Test Connection:
      a. Provide downstream of the backflow prevention assembly, listed hose valves with **<< 2.5-inch; or ____-inch>>** National Standard male hose threads with cap and chain.
      b. Provide one valve for each **<< 250 gpm; or ____ gpm>>** of system demand or fraction thereof.
      c. Provide permanent sign reading "Test Valve." See Section **<< 210553>>**.

I. Electric Alarm: Electrically operated **<< chrome-plated; red-enameled; or _____>>** gong with pressure alarm switch.

J. Water Flow Switch: Vane-type switch for mounting horizontally or vertically, with two contacts; rated **<< 10; or ____>>** A at 125 VAC and **<< 2.5; or ____>>** A at 24 VDC.

K. Fire Department Connections:
   1. Type: **<< Free standing; Flush, wall mount; Exposed, projected wall mount; or _____>>** made of corrosion-resistant metal**<< complying with UL 405; _____; or None - N/A>>**.
      a. Inlets: **<< Two; Three; Four; or _____>>**-way, **<< 2-1/2 inch>>** swivel fittings, internal threaded. Thread size and inlets according to **<<NFPA 1963>><< or authority having jurisdiction; _____; or None - N/A>>**. Brass caps with gaskets, chains, and lugs.
      b. Configuration: **<< Horizontal; Vertical; Square; or _____>>**.
      c. Outlet: **<< With pipe threads; Back with pipe threads; Bottom with pipe threads; or _____>>**, **<< 4 NPS; 5 NPS; 6 NPS; or _____ NPS>>**.
         1) Location: **<< Back; Bottom; Left; Right; or _____>>**.
      d. Rated Working Pressure: **<< 175 psi>>**.
      e. Finish: **<< Chrome; Polished chrome; Brass or bronze; Polished brass; or _____>>**.
      f. Sleeve: **<< Brass,; _____ ,; or None - N/A>><< 18-inch>>** height.

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g. Signage: Raised or engraved lettering **<< 1 inch>>**, minimum, indicating system type.
h. Manufacturers:

PART 3 EXECUTION

3.01 INSTALLATION

A. Install sprinkler system and service main piping, hangers, and supports in accordance with **<<NFPA 13>>**.
B. Install standpipe piping, hangers, and supports in accordance with **<<NFPA 14>>**.
C. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
D. Install piping to conserve building space, to not interfere with use of space and other work.
E. Group piping whenever practical at common elevations.
F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
G. Pipe Hangers and Supports:
   1. Install hangers to provide minimum **<< 1/2 inch>>** space between finished covering and adjacent work.
   2. Place hangers within **<< 12 inches>>** of each horizontal elbow.
   3. Use hangers with **<< 1-1/2 inch>>** minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   4. Support vertical piping at every**<< other; _____; or None - N/A>>** floor. Support riser piping independently of connected horizontal piping.
   5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
   6. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
      a. Painting of interior fire suppression systems is specified in Section **<< 099123>>**.
H. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
I. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
   1. Painting of interior fire suppression systems is specified in Section **<< 099123>>**.
J. Structural Considerations:
   1. Do not penetrate building structural members unless indicated.
K. Provide sleeves when penetrating **<< footings; floors; walls; partitions; and _____>>**. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
   1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
   2. Aboveground Piping:
      a. Pack solid using mineral fiber complying with **<<ASTM C592>>**.
      b. Fill space with an elastomer caulk to a depth of **<< 0.50 inch; or _____ inch>>** where penetrations occur between conditioned and unconditioned spaces.

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3. All Rated Openings: Caulk tight with firestopping material complying with **<<ASTM E814>>** in accordance with Section **<< 078400>>** to prevent the spread of fire, smoke, and gases.
4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.

L. Manufactured Sleeve-Seal Systems:
1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
3. Locate piping in center of sleeve or penetration.
4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
5. Tighten bolting for a watertight seal.
6. Install in accordance with manufacturer's recommendations.

M. Escutcheons:
1. Install and firmly attach escutcheons at piping penetrations into finished spaces.
2. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.
3. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.

N. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.

3.02 CLEANING

A. Upon completion of work, clean all parts of the installation.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION 210500

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SECTION 211000
WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch.

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.

C. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard.

D. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings.

E. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded.

F. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

G. ASME B16.25 - Buttwelding Ends.

H. ASME B36.10M - Welded and Seamless Wrought Steel Pipe.

I. ASME B40.100 - Pressure Gauges and Gauge Attachments.

J. ASSE 1015 - Performance Requirements for Double Check Backflow Prevention Assemblies.

K. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

L. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

M. ASTM A135/A135M - Standard Specification for Electric-Resistance-Welded Steel Pipe.

N. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

O. ASTM A536 - Standard Specification for Ductile Iron Castings.

P. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.

Q. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings.

R. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

S. ASTM B63 - Standard Test Method for Resistivity of Metallically Conducting Resistance and Contact Materials.

T. AWS D1.1/D1.1M - Structural Welding Code - Steel.

U. AWWA C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.

V. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems.

W. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings.

X. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

Y. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast.

Z. AWWA C153/A21.53 - Ductile-Iron Compact Fittings.

AA. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.

BB. AWWA C515 - Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.

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CC. AWWA C550 - Protective Interior Coatings for Valves and Hydrants.

DD. AWWA C606 - Grooved and Shouldered Joints.

EE. AWWA C800 - Underground Service Line Valves and Fittings.

FF. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. through 60 In. (100 mm through 1500 mm).

GG. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 In. through 65 In. (100 mm through 1650 mm), for Waterworks.

HH. FM (AG) - FM Approval Guide.

II. FM 1920 - Approval Standard for Pipe Couplings and Fittings for Aboveground Fire Protection Systems.

JJ. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves.

KK. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

LL. NFPA 13 - Standard for the Installation of Sprinkler Systems.

MM. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.

NN. NFPA 1963 - Standard for Fire Hose Connections.

OO. UL (DIR) - Online Certifications Directory.

PP. UL 213 - Rubber Gasketed Fittings for Fire-Protection Service.

QQ. UL 262 - Gate Valves for Fire-Protection Service.

RR. UL 312 - Check Valves for Fire-Protection Service.

SS. UL 393 - Indicating Pressure Gauges for Fire-Protection Service.

TT. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service.

UU. UL 405 - Standard for Safety Fire Department Connection Devices.

VV. UL 1091 - Standard for Butterfly Valves for Fire-Protection Service.

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1.02 ADMINISTRATIVE REQUIREMENTS

A. Description of Work:

1. The work includes designing and providing an automatic fire extinguishing system of required hazard for building occupancy to afford complete fire protection coverage throughout. The design, equipment, materials, installation and workmanship shall be in strict accordance with the Owners insurance underwriters requirements, the Maryland Uniform Statewide Building Code, and the required and advisory provisions of NFPA.
2. Unless otherwise indicated piping shall not be run in spaces containing electrical equipment in the form of transformers, panel-boards, switchgear, or computer servers.
    a. Exceptions:
        1) Spaces with Personal Computers (PCs).
        2) Spaces whose name does not include the term "Electrical", "Data", or "Computer."
3. Each system shall include materials, accessories and equipment necessary to provide each system complete and ready for use.
4. The design of each system shall give full consideration to blind spaces, piping, electrical equipment, ductwork, and all other construction and equipment to afford complete coverage.

5. Devices and equipment for fire protection service shall be of an approved make and type listed by the Underwriters' Laboratories, Inc., or approved by the Factory Mutual System.
6. In the publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears.
7. Reference to the "authority having jurisdiction" shall be interpreted to mean the Local Fire Marshal.
8. The work shall begin outside the building at a point five feet from the exterior surface of the wall at the location indicated on the drawings.
9. Calculations shall include delivering water from the point of the fire hydrant flow test through the site piping.
10. Consideration shall be given to all unheated areas such as attics, utility rooms, loading docks, outdoor storage spaces with canopies, etc., to provide freeze protection in accordance with NFPA 13. This shall include the installation of dry sprinklers or **<< dry-pipe>>** sprinkler systems where necessary.

1.03 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fxtures, HVAC equipment, and partition assemblies.

1.04 SUBMITTALS

A. Product Data: Provide data on piping materials, sprinklers, valves, hose connections, hose stations, fire department connections, alarm devices, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, flow characteristics, mounting, finish, size, types, electrical data, and piping connections.

B. Shop Drawings:
   1. Prepare in compliance with NFPA 13.
   2. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.
   3. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components, and accessories. Indicate system controls.
   4. Submit **<< shop drawings; product data; hydraulic calculations; and _____ >>** to **<< Fire Marshall; Authorities Having Jurisdiction; or _____>>** for approval. Submit proof of approval to **<<Architect>>**.
   5. Sprinklers shall be referred to on drawings, submittals, and other documentation by the sprinkler identification or Model number as specificially published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.

C. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds**<< specified requirements and; _____; or None - N/A>>** code requirements.

D. Fire hydrant flow test report.
   1. Bids shall be based on indicated fire hydrant flow and pressure.
   2. Design calculations shall be based on the results of a confirming fire hydrant flow test performed or caused to be performed by the Contractor.

E. Field Test Reports submitted to Architect and Authorities Having Jurisdiction.

F. Designer's qualification statement.

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G. Installer's qualification statement.

H. Welder's qualification statement.

I. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

J. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.

1. See Section **<< 016000 - Product Requirements>>** for additional provisions.
2. Extra Sprinklers: Type and size matching those installed in quantity required by referenced NFPA design and installation standard.
3. Sprinkler Wrenches: For each sprinkler type.

K. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.

1.05 QUALITY ASSURANCE

A. Maintain one copy of referenced design and installation standard on site.

B. Comply with **<< FM (AG); ITS (DIR); UL (DIR); or _____>>** requirements.

C. Designer Qualifications: Design system under direct supervision of a **<< Professional Engineer; Professional Fire Protection Engineer; or _____>>** experienced in design of this type of work and licensed in **<<the State in which the Project is located>>**.

D. Installer Qualifications: Company specializing in performing the work of this section**<< with minimum _____ years experience; _documented experience; _____; or None - N/A>><< and approved by manufacturer; _____; or None - N/A>>**.

E. Welder's Qualifications: Specializing in performing the work of this section in accordance with **<<ASME BPVC-IX>>**.

F. Equipment and Components: Provide products that bear **<< FM (AG); ITS (DIR); UL (DIR); or _____>>** label or marking.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

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PART 2 PRODUCTS

2.01 SINGLE SOURCE RESPONSIBILITY

A. Grooved couplings, fittings, valves and specialties shall be products of a single manufacturer.

B. Grooving tools shall be of the same manufacturer as the grooved components.

C. Castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.

D. Couplings requiring a torque wrench in accordance with manufacturer's instructions shall have a test tag attached to each bolt showing torque used for each. Tags shall be date stamped and initialed by installer.

2.02 SPRINKLER SYSTEM

A. Fire-suppression sprinkler system shall be approved by authorities having jurisdiction.

B. Sprinkler System Rated Working Pressure: Minimum 175 psig.

C. Sprinkler System: Wet-pipe sprinkler system - automatic sprinklers attached to pipes connected to water supply with immediate water discharge when opened through fusible link or frangible device. Provide coverage for **<< entire building; building areas noted; building areas noted in Schedule; or _____>>**.

D. Occupancy: Comply with **<<NFPA 13>>**. Refer to drawings.
   1. Light Hazard: 0.10 gpm over 1500 sf area.
   2. Ordinary Hazard, Group 1 Occupancy: 0.15 gpm over 1500 sf area.
   3. Ordinary Hazard, Group 2 Occupancy: 0.20 gpm over 1500 sf area.

E. Maximum Protection Coverage per Sprinkler: Comply with **<<UL (DIR)>>** listing.
   1. Office Spaces: 225 square feet.
   2. Storage Areas: 130 square feet
   3. Mechanical Equipment Rooms: 130
   4. Electrical Equipment Rooms: 130 square feet.
   5. Other Areas: Comply with **<<NFPA 13>>**, unless indicated otherwise.

F. Water Supply: Margin of safety for available water flow and pressure:
   1. 10 percent or 10 psi, whichever is greater.
   2. Include losses through water-service piping, valves, and backflow preventers.

G. Sprinkler System Combined Hose-Stream Demand Requirement: Compy with **<<NFPA 13>>**, unless indicated otherwise.
   1. Light Hazard Occupancy: 100 gpm for 30 minutes.
   2. Ordinary Hazard Occupancy: 250 gpm for 60 to 90 minutes.

H. Interface system with **<< building control system; building fire and smoke alarm system; or _____>>**.

I. Provide fire department connections where indicated.

J. Storage Cabinet for Spare Sprinklers and Tools: Steel, **<< located adjacent to alarm valve; in location designated; or _____>>**.

K. Pipe Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:

L. Exposed Sprinkler Piping: Coordinate to eliminate or reduce visibility of exposed sprinkler piping as much as possible, including:
   1. For clerestories: Coordinate sprinkler piping to avoid piping installed in front of glazing assemblies. Routing shall be in between windows or in front of mullions for a neat, exposed appearance approved by Architect.
   2. For roof height elevation changes in exposed areas: Limit sprinkler piping to 1 or 2 locations within a single open space to reduce visibility of vertical piping. Sprinkler mains shall not be routed in exposed areas unless required. If required, mains locations shall be coordinated with Architect.
   3. Where vertical exposed piping occurs, the piping shall be installed along the wall and in the corner to reduce visibility.

M. Locations and Arrangements: General locations and arrangements indicated on drawings.
   1. Piping shall be exposed in spaces without ceilings only if supplying sprinklers in the same space.
   2. Only piping serving sprinklers within electrical equipment spaces shall be allowed in electrical equipment rooms.
      a. Exception: Generator or transformer rooms separated from the remainder of the building by walls and floor/ceiling or roof/ceiling assemblies having a fire-resistance

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rating of not less than two hours shall not require sprinkler coverage provided that such rooms are protected with an approved automatic fire detection system.

3. Deviations from approved Shop Drawnigs for piping require written approval from authorities having jurisdiction. Receive written approval from Owner and Architect/Engineer before deviating from approved Shop Drawings.

2.03 WATER PIPING

A. Steel Pipe: Threaded end, **<< ASTM A53/A53M Schedule 40; ASTM A135/A135M Schedule 10; ASTM A795/A795M Standard Weight; and _____>>**, galvanized**<< , with AWWA C105/A21.5 polyethylene jacket, or double layer, half-lapped polyethylene tape; , _____; or None - N/A>>**.

1. Steel Fittings: **<< ASME B16.3, malleable iron threaded; ASME B16.4, gray iron threaded; ASTM A733, steel threaded pipe nipples made of ASTM A53/A53M or ASTM A106, Schedule 40 seamless steel pipe, include ends matching joining method; and ASTM A865, steel threaded couplings>>**.
2. Cast Iron Fittings: **<<ASME B16.1>>**, flanges and flanged fittings.
3. Joints: Welded in accordance with **<<AWS D1.1/D1.1M>>**.
4. Casing for Underground Installation: **<< Closed glass cell insulation; Polyurethane insulation with high density polyethylene jacket and heat shrink sleeves; or _____>>**.

B. Steel Pipe: Plain end, **<< ASTM A53 Schedule 40; ASTM A135/A135M; and ASTM A795>>**.

1. Steel Fittings: **<< ASME B16.9 and, ASTM A234/A234M or ASME B16.11 , steel welding fittings; and ASME B16.5 steel flanges and flanged fittings>>**.
2. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
3. Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.
4. Mechanical Press Sealed Fittings: **<<ASTM F3226/F3226M>>**; listed as complying with **<<UL 213>>** or **<<FM 1920>>**, with EPDM seals.

C. Steel Pipe: Grooved end, **<< ASTM A53 Schedule 40; ASTM A135/A135M; and ASTM A795>>**.

1. Steel Fittings: **<< ASME B16.9 and, ASTM A234/A234M or ASME B16.11 , steel welding fittings; and ASME B16.5 steel flanges and flanged fittings>>**.
2. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
3. Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.
4. Mechanical Press Sealed Fittings: **<<ASTM F3226/F3226M>>**; listed as complying with **<<UL 213>>** or **<<FM 1920>>**, with EPDM seals.

D. Steel Pipe: Grooved end, NPS (DN 125) Schedule 10 and smaller, NFPA 13 compliant wall thickness in NPS 6 to NPS 10 (DN 150 to DN250).

1. Steel Fittings: **<< ASME B16.9 and, ASTM A234/A234M or ASME B16.11 , steel welding fittings; and ASME B16.5 steel flanges and flanged fittings>>**.

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2. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
3. Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.
4. Mechanical Press Sealed Fittings: **<<ASTM F3226/F3226M>>**; listed as complying with **<<UL 213>>** or **<<FM 1920>>**, with EPDM seals.

E. Ductile Iron Pipe: **<<AWWA C151/A21.51>>**, with mechanical joint bell end and plain end.
1. Fittings: uctile or gray iron **<<AWWA C110/A21.10>>**, standard thickness or **<<AWWA C153/A21.53>>**, compact thickness.
2. Joints: **<<AWWA C111/A21.11>>**, ductile or gray iron gland, styrene-butadiene rubber (SBR) or vulcanized SBR gasket.
3. Mechanical Couplings: Shaped composition sealing gasket, steel bolts, nuts, and washers.

F. Ductile Iron Pipe: Listed, **<<AWWA C151/A21.51>>**, with push-on joint bell and plain end.
1. Fittings: Ductile or gray iron **<<AWWA C110/A21.10>>**, standard thickness or **<<AWWA C153/A21.53>>**, compact thickness.
2. Joints: **<<AWWA C111/A21.11>>**, styrene-butadiene rubber (SBR) or vulcanized SBR rubber gasket with **<< 3/4 inch>>** diameter rods.

G. Ductile Iron Pipe: Listed, **<<AWWA C151/A21.51>>**, with factory or field formed, radius cut grooved ends in accordance with **<<AWWA C606>>**.
1. Fittings: **<<ASTM A536>>**, ductile iron casting with outside diameter matching outside diameter of ductile iron pipe.
2. End Couplings: **<<AWWA C606>>**, grooved with gasket fitting matching outside diameter of ductile iron pipe. Include ductile iron housing with keys matching ductile iron pipe and fitting grooves, prelubricated rubber gasket with center leg, and steel bolts and nuts.
3. Transition Couplings: **<<UL 213>>** and **<<AWWA C606>>**, grooved with gasket fitting and end matching outside diameter of ductile iron pipe and steel pipe. Include ductile iron housing with keys matching ductile iron pipe and steel pipe grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.

H. Piping fittings for NPS 2 and smaller: Use any of the following:
1. For threaded end, black, Schedule 40 steel pipe:
   a. Cast or malleable iron thraded fittings.
   b. Threaded joints.
2. For plain end, black, Schedul 40 steel pipe:
   a. Steel welding fittings.
   b. Welded joints.
3. For grooved end, black, Schedule 40 steel pipe with square cut or roll grooved ends:
   a. Grooved end fittings.
   b. Grooved end pipe couplings.
   c. Grooved joints.

I. Piping fittings for NPS 2 1/2 and larger: Use any of the following:
1. For threaded end, black, Schedule 40 steel pipe:
   a. Cast or malleable iron threaded fittings.
   b. Threaded joints.

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2. For plain end, black, Schedule 10 steel pipe:
   a. Steel welding fittings.
   b. Welded joints.
3. For grooved end, black, Schedule 10 steel pipe:
   a. Grooved end fittings.
   b. Grooved end pipe couplings.
   c. Roll grooved joints.

J. Specialty sprinkler fittings of size NPS 2 and smaller, including mechanical T and cross fittings, may be used downstream from sprinkler zone valves.

2.04 MECHANICAL COUPLINGS

A. Manufacturers:
   1. Tyco Fire Protection Products.
   2. Victaulic Company.

B. Rigid Mechanical Couplings for Grooved Joints:
   1. Dimensions and Testing: Comply with **<<AWWA C606>>**.
   2. Minimum Working Pressure: **<< 175 psig; 300 psig; or ___ psig>>**.
   3. Housing Material: Fabricate of ductile iron complying with **<< ASTM A536; or _____>>**.
   4. Housing Coating: Factory applied **<< orange enamel; or _____>>**.
   5. Gasket Material: EPDM suitable for operating temperature range from **<< minus 30 degrees F; or _____ degrees F>>** to **<< 230 degrees F; or ____ degrees F>>**.
   6. Bolts and Nuts: Hot-dipped-galvanized or zinc-electroplated steel.
   7. Provide stops for direct stab installation without field assembly.

2.05 FLEXIBLE CONNECTORS

A. Manufacturers:
   1. Tyco Fire Protection Products.
   2. Victaulic Company

B. Provide connectors suitable for system fluid rated for minimum 175 psig working pressure with ends as follows:
   1. NPS 2 and smaller: Grooved.
   2. NPS 2 1/2 (DN 65) and larger: Grooved or grooved for use with grooved end pipe couplings.

C. Flexible Connectors for Stainless Steel Hose or Pipe: Corrugated, stainless steel inner tubing covered with stainless steel wire braid with stainless steel nipples or

2.06 VALVES, GENERAL

A. Valve types and locations are indicated on Drawings.

B. Valve requirements for locations without specific valve types indicated:
   1. Listed Fire Protection Valves:
      a. Shutoff Duty: Use ball, butterfly, or gate valves.
   2. Non-Listed General Duty Valves:
      a. Shutoff Duty: Use ball, butterfly, or gate valves.
      b. Throttling Duty: Use ball or globe valves.

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2.07 LISTED FIRE PROTECTION VALVES

A. General:
   1. Minimum Compliance: **<<UL (DIR)>>** listed and labeled.
   2. Minimum Rated Working Pressure: 175 psig.

B. OSY Gate:
   1. Comply with **<<UL 262>>**.
   2. Ductile iron body.
   3. Ends: Flanged x grooved or grooved x grooved ends. Flanged x flanged is not permitted.

C. Ball Valves:
   1. Comply with **<<UL 1091>>** for ball, not disc.
   2. NPS 1 1/2 and smaller: Bronze body with grooved ends.
   3. NPS 2 and NPS 2 1/2: Ductile iron body with grooved ends.
   4. NPS 3: Ductile iron body with grooved ends.

D. Butterfly Valves:
   1. Comply with **<<UL 1091>>**.
   2. NPS 2 and smaller: Bronze body with grooved ends.
   3. NPS 2 1/2 and larger: Bronze, cast iron, or ductile iron body, wafer type or with flanged or grooved ends. Pressure responsive valve seat and offset stem to provide 360 degree seating.

E. Check Valves - NPS 2 or larger:
   1. Comply with **<<UL 312>>**.
   2. Spring-assisted swing type for vertical or horizontal installation.
   3. Cast or ductile iron body.
   4. Ends: Flanged or grooved.

F. Indicating Valves:
   1. Comply with **<<UL 1091>>**.
   2. Integral indicating device with ends matching connecting piping.
   3. Indicator: Weatherproof actuator housing.
   4. Switches: Prewired, single pole, single throw, supervisory.
   5. Electrical Requirements: 15 A; 125 V; 60 HZ.
   6. NPS 2 and smaller: Ball or butterfly valve with bronze body and grooved ends.
   7. NPS 2 1/2 and larger: Butterfly valve with cast or ductile iron body, wafer type or with flanged or grooved ends.

G. Sprinkler System Contol Valves - Riser Check Valve:
   1. Comply with UL 193.
   2. Installation: Vertical or horizontal.
   3. Description:
      a. Bronze grooved seat with O-ring seals.
      b. Single hinge pin.
      c. Latch design.
      d. Trim sets for drain and pressure gauges.

H. Sprinkler System Control Valves - Automatic Drain Valve:
   1. Comply with UL 1726, N

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2. Size: NPS 3/4.
3. Description: ball check device.
4. Ends: Threaded or grooved.

2.08 NON-LISTED GENERAL DUTY VALVES

A. Ball Valves - NPS 2 and smaller:
   1. **<<MSS SP-110>>**.
   2. Body: 2 piece copper alloy with chrome plated brass ball.
   3. CWP Rating: 600 psig minimum.
   4. Ends: Threaded with blowout-resistent stem.

B. Check Valves - NPS 2 and smaller:
   1. **<<MSS SP-80>>**, Type 4, Class 125 minimum.
   2. Body: Brass, swing type with non-metallic disc.
   3. Ends: Threaded.

C. Globe Valves - NPS 2 and smaller:
   1. **<<MSS SP-80>>**, Type 2, Class 125 minimum.
   2. Body: Brass with non-metallic disc.
   3. Ends: Threaded.

2.09 SPRINKLERS

A. Refer to drawings for sprinkler type locations. For locations not indicated on drawings, use the following:
   1. Rooms without Ceilings: Upright sprinklers.
   2. Rooms with Suspended Ceilings: Recessed pendant sprinklers unless otherwise indicated then concealed sprinklers as indicated.
   3. Wall Mounting: Recessed sidewall sprinklers.
   4. Spaces Subject to Freezing: Upright, dry pendant, dry sidewall sprinklers as indicated.
   5. Special Applications: Extended coverage, flow control, and quick response sprinklers where indicated or required.

B. Suspended Ceiling Type: **<< Semi-recessed; Recessed; Concealed; or _____>> << pendant; upright; or _____>>** type with matching **<< push on; clamp on; screw on; or _____>> << escutcheon; cover; or _____>>** plate.
   1. Response Type: **<< Quick; Standard; or _____>>**.
   2. Coverage Type: **<< Standard; Extended; or _____>>**.
   3. Finish:
      a. Exposed to view: Chrome plated.
      b. Not visible: Rough bronze.
      c. Exposed to acids, chemicals, and corrosive fumes: Wax coated.
   4. Fusible Link: **<< Fusible solder link type; Glass bulb type; or _____>>** temperature rated for specific area hazard.

C. Exposed Area Type: **<< Pendant; Standard; Upright; or _____>>** type**<< with guard; _____; or None - N/A>>**.
   1. Response Type: **<< Quick; Standard; or _____>>**.
   2. Coverage Type: **<< Standard; Extended; or _____>>**.
   3. Finish: Chrome plated.

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4. Fusible Link: **<< Fusible solder link type; Glass bulb type; or _____>>** temperature rated for specific area hazard.

D. Sidewall Type: **<< Semi-recessed; Recessed; or _____>>** horizontal sidewall type with matching **<< push on; clamp on; screw on; or _____>>** escutcheon plate.
1. Response Type: **<< Quick; Standard; or _____>>**.
2. Coverage Type: **<< Standard; Extended; or _____>>**.
3. Finish:
a. Exposed to view: Chrome plated.
b. Not visible: Rough bronze.
c. Exposed to acids, chemicals, and corrosive fumes: Wax coated.
4. Fusible Link: **<< Fusible solder link type; Glass bulb type; or _____>>** temperature rated for specific area hazard.

E. Dry Sprinklers: **<< Concealed; Exposed; Plain barrel; Recessed; or _____>>** pendant type with matching push on **<< escutcheon plate; cover plate; or _____>>**.
1. Response Type: **<< Quick; Standard; or _____>>**.
2. Coverage Type: **<< Standard; Extended; or _____>>**.
3. Finish: Rough
4. Fusible Link: **<< Fusible solder link type; Glass bulb type; or _____>>** temperature rated for specific area hazard.

F. Storage Sprinklers: **<< Pendant; Standard; Upright; or _____>>** type**<< with guard; _____; or None - N/A>>**.
1. Response Type: **<< Standard; or _____>>**.
2. Coverage Type: **<< Standard; Extended; or _____>>**.
3. Finish:
a. Exposed to view: Chrome plated.
b. Not visible: Rough bronze.
c. Exposed to acids, chemicals, and corrosive fumes: Wax coated.
4. Fusible Link: **<< Fusible solder link type; Glass bulb type; or _____>>** temperature rated for specific area hazard.

G. Guards: Wire cage with fastening device to attach to sprinkler, finish to match sprinkler finish.

H. Spray Nozzles: Brass with solid cone discharge, **<< 30; 60; 90; 120; 140; or _____>>** degrees of arc**<< with blow-off dust cap; _____; or None - N/A>>**.
1. Finish: **<< Brass.; Nickel.; Enamel, color as selected.; or _____ .>>**

I. Wrenches: Provided by sprinkler manufacturer, directly engages with integral hex-shaped wrench boss in sprinkler body.

J. Flexible Drop System: Stainless steel, multiple use, open gate type.
1. Application: Use to properly locate sprinkler heads.
2. Include all supports and bracing.
3. Provide **<< braided; unbraided; or _____>>** type tube as required for the application.
4. Manufacturers:
a. Victaulic Company**<< ; Vic-Flex; ; _____; or None - N/A>>**: www.victaulic.com/#sle.

2.10 ALARM DEVICES

A. General: Match piping and equipment connections.

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B. Wet Pipe Sprinkler Alarm Valve: UL 346, paddle operated waterflow detector with 250 psig pressure rating for mounting horizontal or vertical with the following additional capabilities and features:
   1. Activate electric alarm.
   2. Test and drain valve.
   3. Replaceable internal components without removing valve from installed position.

C. Dry Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm, accelerator, and with the following additional capabilities and features:
   1. Activate electric alarm.
   2. Test and drain valve.
   3. Externally resettable.
   4. Replaceable internal components without removing valve from installed position.

D. Flooding Deluge Valve: Gate type valve with rubber faced disc actuated **<< manually; pneumatically; electrically; hydraulically; or _____>>** with water motor alarm**<< and electric alarm; _____; or None - N/A>>**, with alarm testing trim.

E. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated **<< 10; or 7>>** amp at 125 volt AC and **<< 2.5; or ____>>** amp at 24 volt DC. Provide with factory set, field adjustable retard element for preventing false signals and tamperproof cover that sends signal when removed.

F. Supervisory Switches: UL 753.
   1. Electrical, single pole, double throw switches with normally closed contacts.
   2. Signals when controlled valve is not in fully open position.
   3. Manufacturers:
      a. McWane, Inc.; Kennedy Valve Division.
      b. Potter Electric Signal Company, LLC.
      c. System Sensor.

G. Electric Alarm: UL 753, electrically operated **<< chrome plated; red enameled; or _____>>** gong with pressure alarm switch in weatherproof backbox.
   1. Manufacturers:
      a. Notifier.
      b. Potter Electric Company.
      c. System Sensor

H. Sprinkler Drain and Alarm Test Fittings: Cast or ductile iron body, threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.

2.11 PIPING SPECIALTIES

A. Provide UL listed or FMG approved sprinkler and piping specialty fittings materials compatible with adjacent materials and rated for a minimum 175 psig working pressure.

B. Backflow Preventer: **<< Reduced pressure principle; Double check; or _____>>** valve assembly backflow preventer complying with **<<ASSE 1015>>** with drain and OS & Y gate valve on each end.
   1. Manufacturers:
      a. Ames Co.
      b. Conbraco Industries.

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c. Febco.
d. Apollo Valves, part of Conbraco Industries.
e. Watts Industries, Inc.
f. Zurn Plumbing Products Group.

2. Pressure Loss: 8 psig maximum, through middle
3. Size: 3/4 inch to 10 inch, matching connected piping.
4. Body: Brass or bronze for
   a. NPS 2 and smaller: Brass or bronze with ball type valve on inlet and outlet.
   b. NPS 2 1/2 or larger: Cast iron or steel with interior lining complying with **<<AWWA C550>>** with outside screw and yoke-gate type valve with flanged ends on inlet and outlet.

C. Test Connections:
1. Test Header - Manufacturers:
   a. Elkhart Brass Manufacturing Company, Inc.
   b. Fire End and Croker Corporation.
   c. Guardian Fire Equipment Incorporated.
   d. Potter-Roemer Fire Protection.
2. Inspector's Test Connection for Preaction Systems:
   a. Provide test connections approximately **<< 6 ft; or ____ ft>>** above floor for **<< each; portion of each; or _____>>** sprinkler system equipped with an alarm device, located at the most remote part of each system.
   b. Route test connection to an open-site drain location, excluding janitor sinks, accepting full flow without negative consequences.
   c. Supply discharge orifice with same size as corresponding sprinkler orifice.
   d. Limit vertical height of exterior wall penetration to **<< 2 ft; or ____ ft>>** above finished grade.
3. Backflow Preventer Test Connection:
   a. Provide downstream of the backflow prevention assembly, listed hose valves with **<< 2.5 inch; or ____ inch>>** National Standard male hose threads with cap and chain.
   b. Furnish one valve for each **<< 250 gpm; or ____ gpm>>** of system demand or fraction thereof.
4. Hose Valve Manifold Assembly:
   a. Header Pipe: Schedule 40, steel or ductile iron.
   b. Header Pipe Fittings: Galvanized cast-iron threaded fittings.
   c. Automatic Drain Valve: UL 1726.
   d. Hose Valves: UL 668, straightway pattern, chrome plated with cap and chain. Include NFPA 1963 hose thread complying with local fire codes. Match finish of test header manifold escutcheon plate.
   e. Nipples: Schedule 40 galvanized steel pipe with threaded ends.
   f. Caps with Chain: Chrom plated with threaded outlet.
5. Escutcheon Plate: Chrome plated, rectangular.
   a. Finish - exposed parts: Chrome plated.
   b. Escuthcheon Plate Marking: "BKFL TEST CONN."

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2.12 FIRE DEPARTMENT CONNECTIONS:

A. Type: **<< Free standing; Flush, wall mount; Exposed, projected wall mount; or _____>>** made of corrosion resistant metal**<< complying with UL 405; _____; or None - N/A>>**.

1. Inlets: **<< Two; Three; Four; or _____>>** way, **<< 2-1/2 inch>>** swivel fittings, internal threaded. Thread size and inlets according to **<<NFPA 1963>><< or Authority Having Jurisdiction; _____; or None - N/A>>**. Brass caps with gaskets, chains, and lugs.
2. Configuration: **<< Horizontal; Vertical; Square; or _____>>**.
3. Outlet: **<< With pipe threads; Back with pipe threads; Bottom with pipe threads; or _____>>**, **<< 4 NPS; 5 NPS; 6 NPS; or _____ NPS>>**.
   a. Location: **<< Back; Bottom; Left; Right; or _____>>**.
4. Rated Working Pressure: **<< 175 psi>>**.
5. Finish: **<< Chrome; Polished chrome; Brass or bronze; Polished brass; or _____>>**.
6. Signage: Raised or engraved lettering **<< 1 inch>>** minimum indicating system type with marking similar to "AUTO SPKR & STANDPIPE."
7. Manufacturers:
   a. Central Sprinkler Corp.
   b. Elkhart Brass Manufacturing Company, Inc.
   c. Fire End & Croker Corporation.
   d. Guardian Fire Equipment Incorporated.
   e. Potter-Roemer Fire Protection.

2.13 HOSE REELS AND HOSES

A. Manufacturers:
1. American Fire Hose & Cabinet.
2. Elkhart Brass Manufacturing Company, Inc.
3. Guardian Fire Equipment Inc.
4. National Fire Products.
5. Potter Roemer Fire Protection.

B. Construction:
1. Semiautomatic hose station complying with UL 47.
2. **<< Red enameled; or _____>>** hose reels, frames, and accessories suitable for hose length and diameter.
3. Reels fitted with swivel and piping to allow continuous flow through hoses.
4. Friction breaks to prevent hoses from accidental unwinding.

C. Hoses:
1. Construction: Complies with NFPA 1961 and UL 219. **<< Flexible 3-braid, single-jacket, hard rubber or heavy duty synthetic red cover, non-collapsible, non-kinking, and fitted with couplings; or _____>>**.
2. Outside Diameter: **<< 1 1/2 inch>>**.
3. Length: 75 feet

D. Couplings: Provide **<< hole type; or _____>>** couplings, **<< one female and one male; or _____>>**, both with chemical hose thread.

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E. Control Valve: **<< 175 psi; or ___ psi>>** rated, quarter turn, **<< ball; butterfly; or _____>>** for quick-opening operation.

F. Hose Nozzle: **<< 1-1/2 inch NPS; or _____ inch NPS>>** chemical hose thread, polished brass, adjustable fog, off-and-on solid-stream type. Complies with UL 401.

2.14 PRESSURE GAUGES

A. Manufacturers:
1. AGF Manufacturing.
2. AMETEK, Inc.
3. Brecco Corporation.
4. Dresser Equipment Group.
5. Marsh Bellofram.
6. WIKA Instrument Corporation.

B. Pressure Gauges: **<<ASME B40.100>>**, **<< UL 393; UL 404; or _____>>** drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
1. Case: **<< Steel with brass bourdon tube; Cast aluminum with phosphor bronze bourdon tube; or _____>>**.
2. Diameter: **<< 2 inch; 2-1/2 inch; 3-1/2 inch; 4-1/2 inch; 6 inch; 8-1/2 inch; or ___ inch>>**.
3. Mid-Scale Accuracy: **<< One; Two; One-half; or ____>>** percent.
4. Scale: Display in **<< psi; kPa; and _____>>**.
5. Water System Piping: Include caption "WATER" or "AIR/WATER" on dial face.
6. Air System Piping: Include caption "AIR" or "AIR/WATER" on dial face.

2.15 JOINT FABRICATION

A. Coordinate with Division 21, "Common Work Results for Fire Suppression" for basic piping joint construction.

B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Threading pipe with wall thickness less than Schedule 40 and smaller than NPS 8 (DN 200) must be checked by a ring gauge and comply with **<<ASME B1.20.1>>**, and shall be approved by authorities having jurisdiction.

C. Form twist-locked joints using plain-end piping with locking-lug fitting. Rotate retainer lug one-quarter turn.

D. Form pressure sealed joints using UL-listed tool and procedure.

E. Grooved Joints: Assemble joints with listing coupling and gasket, lubricant, and bolts, and as follows:
1. Ductile Iron Pipe: Radius cut groove ends of piping and use groove-end fittings and pipe couplings.
2. Steel Pipe: Square cut or roll groove piping as indicated and use groove end fittings and rigid, groove end pipe couplings.
3. Dry Pipe Systems: Use fittings and gaskets listed for dry pipe service.

F. Dissimilar Metal Piping Joints: Construct joints using dielectric fittings compatible with adjacent pipe materials and as follows:
1. NPS 2 and smaller: Use dielectric unions, couplings, or nipples
2. NPS 2 1/2 to NPS 4: Use dielectric flanges.

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3. NPS 5 and larger: Use dielectric flange insulation kits.

PART 3 EXECUTION

3.01 PREPARATION

A. Conduct fire hydrant flow test in accordance with **<<NFPA 13>>**, **<<NFPA 14>>**, and NFPA 291 and report written results promptly.

B. Coordinate with Division 31 sections for earth moving, excavating, trenching, and backfilling.

3.02 EXAMINATION

A. Verify locations of piping connections with roughing-in for hose connections and stations prior to installation.

B. Verify thicknesses of walls and partitions at locations of fire and smoke rated construction, framing for hose stations, and other locations of hose connections and stations.

C. Proceeding with installation indicates acceptance of conditions.

3.03 INSTALLATION, GENERAL

A. Shop weld

B. Do not weld joints

C. For above ground applications: Couplings, fittings, and transitions with the same finish and pressure ratings as the system or higher may be used.

D. Piping between Fire Department Connections and Check Valves: Provide the following:
   1. Galvanized, standard-weight steel pipe with threaded ends.
   2. Cast or malleable iron threaded fittings.
   3. Threaded joints or grooved ends.
   4. Grooved end fittings.
   5. Groove end pipe couplings.
   6. Grooved joints.

E. Underground Service Entrance Piping: Provide ductile iron, mechanical joint pipe and fittings and restrained joints with encasement for corrision protection.

3.04 INSTALLATION - PIPING

A. Coordinate with Division 21, "Common Work Results for Fire Suppression" for basic piping installation.

B. Install in accordance with referenced NFPA design and installation standard.

C. Install equipment in accordance with manufacturer's instructions.

D. Install piping as indicated on drawings as far as practical.

E. Install underground piping in accordance with NFPA 13 and NFPA 24, using restrained joints and corrosion protective encasement.

F. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

G. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

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H. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2 1/2 and larger connections.

I. Install sprinkler piping with drains for complete system drainage.

J.

K. Install buried shut-off valves in valve box. Provide post indicator.

L. Install Inspector's Test Connections in sprinkler system piping. Provide approved shutoff valve, sized and located in accordance with NFPA 13. Test connections that discharge to exterior shall discharge 1 foot above concrete splash block. Provide splash block under this section of the specifications.

M. Install spinkler zone valves, test assemblies, and drain risers adjacent to standpipes when sprikler piping is connected to standpipes.

N. Install drain valves on standpipes.

O. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.

P. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.

Q. Install alarm devices in piping systems.

R. Locate outside alarm gong on building wall **<< as indicated; or _____>>**.

S. Place pipe runs to minimize obstruction to other work.

T. Place piping in concealed spaces above finished ceilings.

U. Comply with NFPA 13 for hangers and supports.

V. Install pressure gauges on riser or feed main and sprinkler test connection. Use minimum NPS 1/4 removable pressure gauges for reinstallation outside of freeze/thaw zones.

3.05 INSTALLATION - VALVES

A. Install valves in accordance with NFPA 13 and authorities having jurisdiction.

B. General:
   1. Set valves on solid bearing.
   2. Center and plumb valve box over valve.
   3. Set box cover flush with finished grade.

C. Install listed fire protection shutoff valves supervised-open with permanent identification signs indicating portion of system controlled by each valve in locations for controlling water supplies, except fire department connections.

D. Install non-rising stem gate valve in water supply pipe in wall type fire hydrants.

E. Install backflow preventer in potable water suppy sources.

F. Provide approved shutoff valve, backflow preventer, pressure gauge, and drain assemblies at sprinkler system water source connection and service entrance piping. Coordinate with Division 22 sections for backflow preventers.

G. Specialty Valves:
   1. Install alarm check valves, bypass check valve and retarding chamber drain-line connection in vertical position.
   2. Install dry pipe valves with trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gauges, priming chamber attachment, and fill line attachmnet.

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a. Air Pressure Maintenance Devices for Dry Pipe Systems: Install shutoff valves, bypass valves, pressure regulator, and strainer rated with maximum inlet pressure of 175 psig.
b. Install air compressor and compressed air supply piping.

3. Deluge Valves: Install in vertical position in deluge system main supply.

3.06 INSTALLATION - SPRINKLER

A. Center sprinklers in **<< two directions in ceiling tile and provide piping offsets as required; one direction only in ceiling tile with location in other direction variable, dependent upon spacing and coordination with ceiling elements; or _____>>**.

B. Do not install wet type sprinklers in freeze/thaw zones. Use dry pipe sprinklers with water supply from heated space, antifreeze sprinkler systems, or dry pipe systems.

C. Flush entire piping system of foreign matter.

D. Hydrostatically test entire system.

E. Require test be witnessed by Authority Having Jurisdiction.

3.07 INSTALLATION - HOSE CONNECTION AND STATION

A. Install hose connections adjacent to standpipes, unless otherwise indicated.

B. Install freestanding hose connections for access and minimum passage restriction.

C. Install NPS 2 1/2 hose-connection valves with flow-restricting device and quick disconnect NPS 2 1/2 by 2 1/2 reducer adapter, unless otherwise indicated.

D. Install hose reel hose stations on wall with bracket attached to substrate.

E. Install free standing hose stations for access and minimum passage restriction.

F. Install free standing hose stations with support or bracket attached to standpipe or substrate.

G. Install wall mounting type hose connections in cabinets with pipe eschutcheons matching finish of valves. Install valves as required for connection of fire hose. Refer to Division 10, "Fire Protection Specialties" for cabinets.

3.08 INSTALLATION - FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install wall type fire department connections in vertical wall.

B. Install free standing type fire department connections in level surface with protective pipe bollards on **<< two; or three>>** sides of each fire deparment connection. Refer to Division 05, "Metal Fabrications" for pipe bollards.

C. Install ball drip valve at each check valve for fire department connection.

3.09 CONNECTIONS

A. Refer to drawings for general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Connect water supply piping to fire suppression piping. Include backflow preventer between potable water piping and fire suppression piping. Refer to Division 22, "Domestic Water Piping Specialties" for backflow preventers.

D. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.

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E. Connect piping specialty valves, hose valves, specialties, fire department connections, and accessories.

F. Connect excess pressure pumps to the following piping and wiring:
   1. Sprinkler system, hydraulically.
   2. Pressure gauges and controls, hydraulically.
   3. Electrical power system.
   4. Alarm device accessories for pump.
   5. Fire alarm.

G. Connect compressed air supply to dry pipe sprinkler piping.

H. Connect air compressor to the following piping and wiring:
   1. Pressure gauges and controls.
   2. Electrical power system.
   3. Fire alarm devices, including low pressure alarm.

I. Electrical connections: Coordinate with Division 26 for power wiring.

J. Coordinate connection of fire alarm devices to fire alarm.

K. Ground equipment according to Division 26, "Grounding and Bonding for Electrical Systems."

L. Coordinate connection of wiring according to Division 26, "Low-Voltage Electrical Power Conductors and Cables."

M. Tighten electrical connectors and terminals in accordance with manufacturer's written torque-tightening values or UL 486A and UL 486B.

3.10 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers in accordance with NFPA 13.

B. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

C. Install tags with corrosion resistant chain.

D. Apply stencil painting in accordance with Division 09, "Painting."

E. Install plastic pipe markers in accordance with manufacturer's instructions.

F. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

G. Install underground plastic pipe markers **<< 6 to 8 inches>>** below finished grade, directly above buried pipe.

H. Use tags on piping **<< 3/4 inch>>** diameter and smaller.
   1. Identify service, flow direction, and pressure.
   2. Install in clear view and align with axis of piping.
   3. Locate identification not to exceed **<< 20 feet>>** on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

3.11 FIELD QUALITY CONTROL

A. Field Tests and Inspections:
   1. See Section **<< 014000 - Quality Requirements>>** for additional requirements.
   2. Conduct piping tests before joints are covered.

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3. Prior to hydrostatic testing, obtain approval from the architect/ engineer for proposed method for disposal of wastewater from hydrostatic testing.
4. Fill pipeline and notify owner 24 hours prior to testing and apply test pressure to stabilize system, using only potable water.
5. Perform the following field tests and inspections:
   a. Leak Test: Charge system and test for leaks.
   b. Test and adjust controls and safeties.
   c. Energize circuits to electrical equipment and devices.
   d. Confirm equipment hose threads match local fire department equipment.
6. Test water piping in accordance with **<<NFPA 13>>**, where the additional water added to the system must not exceed the limits given in **<<NFPA 13>>**.
7. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to **<<Owner>>**.
8. Prepare reports of testing activities.

3.12 DEMONSTRATION AND TRAINING

A. Demonstration: Manufacturer's authorized representative shall demonstrate operation of system to **<<Owner>>**'s personnel.

B. Training: Manufacturer's authorized representative shall train **<<Owner>>**'s personnel on operation and maintenance of system.
   1. Provide minimum of **<< two hours; one day; or _____>>** of training.
   2. Location: At project site.

3.13 CLEANING AND PROTECTION

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

C. Protect sprinklers from damage until Date of Substantial Completion.

D. Protect exterior of building when operating drains and test connections discharging to exterior.

E. Remove dirt and stains resulting from work of this section.

END OF SECTION 211000

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SECTION 220500
COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

B. Single phase electric motors.

C. Electronically Commutated Motors (ECM).

1.02 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
   1. ABS: Acrylonitrile-butadiene-styrene plastic.
   2. CPVC: Chlorinated polyvinyl chloride plastic.
   3. PE: Polyethylene plastic.
   4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

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1.03 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

1.04 QUALITY ASSURANCE ***REFER TO CURRENT MCPS MECH-PLUMB DESIGN CHECKLIST***

A. **Comply with the requirements of the current MCPS Mechanical and Plumbing Design Checklist. Refer to the latest edition for applicable design, coordination, and documentation standards.**

B. WSSC Code of Regulations: All applicable and current WSSC codes, regulations, and requirements.

C. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

D. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

E. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

F. All plumbing-related work shall be conducted with a licensed journeyman plumbing present on-site at all times to supervise and ensure compliance with applicable codes and standards.

G. Comply with all applicable ASME/ANSI/ASTM/NSF standards and codes, latest adopted editions.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.06 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Panels."

1.07 INTENT OF CONTRACT DOCUMENTS

A. Plumbing drawings are diagrammatic, indicating general locations and arrangements of pipe, and equipment. Not necessarily indicating all offsets, conditions, and appurtenances required to provide clearances for maximum practical accessibility to perform maintenance.

B. Coordinate work in order to achieve proper operation and to provide a maintainable installed condition.

C. Notify the Architect’s representative immediately of conditions which do not comply or will not produce this result.

D. Indicated configurations were used to size pipes, pumps, expansion tanks and other devices. Install piping and equipment generally as indicated. Minor deviations are permitted in the course of necessary coordination. Major changes shall be submitted for approval by the Architect’s representative. Additional fittings and offsets not shown on the drawings are expected, anticipated by the design, and shall be provided. If more than 5% of the indicated

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number of fittings are required or if one change in direction is within six inches of another change in direction and this “Z” shape is not indicated notify the Architect’s representative immediately. Provide necessary additional fittings and offsets. Changes in pipe size shall be made only with written approval from the Architect’s representative.

PART 2 PRODUCTS

2.01 PIPE, TUBE, AND FITTINGS

A. Refer to other Division 22 piping sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

C. Copper Press Fittings: ASME B16.51 and listed to NSF/ANSI 61.

D. Carbon Steel Press Fittings: ASME B16.5 or ASME B16.3.

2.02 JOINING MATERIALS

A. Refer to individual Division 22 piping sections for joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions inside & outside pipe and:

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is otherwise indicated.
    a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
2. AWWA C110, rubber, flat face, 1/8-inch-thick, unless otherwise indicated, and full-face or ring type, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free (95% Tin, 5% Antimony) alloy. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

F. Solvent Cements for Joining Plastic Piping: (Primer for all solvent-cements will be purple in color for visible verification)

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

2.03 DIELECTRIC FITTINGS

A. Where piping of dissimilar metals is joined together use only yellow brass fittings.

2.04 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

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C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with set screws.

2.05 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.06 GROUT

A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
   1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.
   3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following and Division 22 Sections specifying piping systems.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at the minimum slopes required by authorities having jurisdiction unless otherwise indicated.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

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K. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. Exposed, Interior Installations/Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
   2. Exposed, Interior Installations/Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish and set-screw.
   3. Exposed, Interior Installations/Insulated Piping: One-piece, cast-brass type with polished chrome-plated finish.
   4. Exposed, Interior Installations/Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with finish to match surrounding surfaces.
   5. Exposed, Interior Installations/Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with finish to match surrounding surfaces.
   6. Exposed, Interior Installations/Piping in Unfinished Service Spaces: None, provide sealant.
   7. Exposed, Interior Installations/Piping in Equipment Rooms: None, provide sealant.
   8. Exposed, Interior Installations/Piping at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces: None - provide sealant and sleeve extending 2” above floor to prevent liquid leaking to floor below

L. Sleeves are not required for core-drilled holes.
   1. Exception: Exposed, Interior Installations at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces.

M. Permanent sleeves are not required for holes formed by removable PE sleeves.
   1. Exception: Exposed, Interior Installations at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces.

N. Install sleeves for pipes passing through walls, floors, or roofs.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring.
   2. Install sleeves as walls and slabs are constructed.
      a. PVC Pipe Sleeves: Permitted for pipes smaller than NPS 6 except aboveground, exterior-walls.
      b. Steel Sheet Sleeves: Permitted for pipes NPS 6 and larger, penetrating gypsum-board partitions except aboveground, exterior-walls.
      c. Stack Sleeve Fittings: For pipes penetrating floors. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor. Seal space outside sleeve fittings with grout.
   3. Except for penetrations where mechanical sleeve seals are used, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants".

O. Aboveground Exterior Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for annular clear space required by the mechanical sleeve seal manufacturer between pipe and sleeve for installing mechanical sleeve seals.
   1. Install steel pipe for sleeves smaller than 6 inches in diameter.
   2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
   3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble

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mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

4. Sleeves from an approved sleeve seal manufacturer shall be acceptable.

P. Underground Exterior Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for annular clear space required by the mechanical sleeve seal manufacturer between pipe and sleeve for installing mechanical sleeve seals.

Q. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Section "Penetration Firestopping" for materials.

S. Verify final equipment locations for roughing-in.

T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

U. Install all mechanical and plumbing piping as high as possible in mechanical rooms.

V. Seal all penetrations around piping through walls and floors.

W. Extend all floor sleeves 2" above finished floor; caulk full depth and provide floor plates.

X. Provide yellow brass fittings only (NO dielectric fittings).

Y. All valves shall be full-port ball valves unless otherwise approved.

Z. Provide isolation valves throughout piping systems.

AA. Provide shutoff valves at all equipment.

BB. Balancing valves shall not serve as shutoff valves.

CC. Provide valve extensions on insulated piping.

DD. Mark ceilings with permanent tags identifying valves and equipment above ceiling.

EE. Do not route piping through electrical, server, telecommunications, or similar sensitive spaces unless such piping directly serves the equipment or systems within those spaces.

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3.02 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
   3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   5. PVC Non-pressure Piping: Join according to ASTM D 2855.
   6. PVC to ABS Non-pressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.
   2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

N. Mechanical Joints: Prepare pipe ends and fittings, apply coupling, and join according to joint manufacturer's written instructions.

3.03 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping, one adjacent to each valve, and at final connections to each piece of equipment.
   2. Install yellow brassfor connections of dissimilar metals.

B. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

3.04 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

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C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.05 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.06 HOUSEKEEPING PADS AND EQUIPMENT PADS

A. Housekeeping pads and equipment pads: Anchor equipment to concrete according to equipment manufacturer's written instructions and according to seismic codes at project location.

1. Construct concrete pads in accordance with drawing details.
2. Details may be found on structural drawings. If details are not provided comply with the following:
    a. Housekeeping pads inside the building shall be 4” thick and 6” larger all around than supported equipment. Provide a 1” chamfer on all edges.
    b. If details are not provided, equipment pads outside the building shall be 8” thick with a 24” deep 12” wide turndown (footing) all around the outside edge of the pad. Provide welded wire mesh reinforcement. Pad shall be 12” larger all around than supported equipment.
    c. Install dowel rods to connect housekeeping pad to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the pad. Provide a 1” chamfer on all edges.
    d. Install epoxy-coated anchor bolts. For equipment on housekeeping pads bolts shall extend through housekeeping pad, and anchor into structural concrete floor.
    e. Place and secure anchor bolts using supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions for placement.
    f. Install anchor bolts to elevations required for proper attachment to supported equipment.
    g. Install anchor bolts according to anchor bolt manufacturer's written instructions.
    h. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section "Cast-in-Place Concrete”.

3.07 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.08 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

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E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.09 EXCAVATION AND BACKFILL

A. Excavation and backfill shall be as indicated in Division 1 specifications and on the drawings. If excavation and backfill is not otherwise indicated the following shall apply:

1. Excavate trenches to indicated gradients, lines, depths, and elevations.
    a. Beyond the building perimeter, excavate trenches to allow installation of top of pipe below frost line.
2. Excavate trenches to uniform widths to provide twelve inches clear on each side of pipe. Excavate trench walls vertically from trench bottom.
3. Trench Bottoms: Excavate trench bottoms to provide flat surface. Place and compact six inches of sand. Excavate and shape sand to provide uniform bearing and support of pipes. Shape sand to provide continuous support for bells, joints, fittings, and barrels of pipes. Sand shall be free of projecting stones and sharp objects.
4. Backfill and hand tamp to 95% proctor to six inches above the top of the pipe.
5. Backfill and machine tamp the remainder of the trench to 95% proctor in twelve inch lifts.

END OF SECTION 220500

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SECTION 220513
COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.02 SUBMITTALS

A. Manufacturer's catalog and efficiency data.

B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.

D. Operation Data: Include instructions for safe operating procedures.

E. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.03 QUALITY ASSURANCE ***REFER TO CURRENT MCPS MECH-PLUMB DESIGN CHECKLIST***

A. **Comply with the requirements of the current MCPS Mechanical and Plumbing Design Checklist. Refer to the latest edition for applicable design, coordination, and documentation standards.**

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.04 COORDINATION

A. Equip all motors with overload protection.
   1. Locate overload protection near the motor.
   2. Overload protection:
      a. Locate between the circuit breaker/fuse provided under Division 26 and the motor windings.
      b. Comply with one of the following:
         1) Locate in motor by motor manufacturer. (Design Standard)
         2) Locate separate overload device near motor.
         3) Locate in, or with, disconnect switch by equipment manufacturer. Provision of such switch shall not modify, change, or eliminate Division 26 requirements. Provide indicated disconnecting means.

B. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:

C. Compatible with controller.

D. Matched to torque and horsepower requirements of the load.

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E. Matched to ratings and characteristics of supply circuit and required control sequence.

F. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.

G. Belt tension must be wrench and socket adjustable.

H. Belt tensioning device must accommodate adjustable sheaves.

PART 2 PRODUCTS

2.01 MOTOR REQUIREMENTS

A. Motor requirements apply except as follows:

1. Ratings, performance, or characteristics for a motor are specified in another Section or are scheduled on the drawings.
2. Motor manufacturer requires ratings, performance, or characteristics, other than those specified to meet indicated performance.

2.02 MOTOR CHARACTERISTICS

A. Frequency Rating: 60 Hz.

B. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

C. Duty: Continuous at 105 deg F and 3300 feet above sea level.

D. Capacity and Torque sufficient to:

1. Start, accelerate, and operate connected load.
2. Maintain designated speeds.
3. Operate at installed altitude and environment.
4. Operate with indicated operating sequence.

E. Operate without exceeding nameplate ratings.

1. Operate without utilizing service factor.

F. Enclosure: Open drip-proof unless otherwise indicated.

G. Minimum Service Factor: 1.15 unless otherwise indicated.

2.03 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Premium efficiency motors shall meet the following full load efficiency:

HP	ODP			TEFC		
	6 POLE	4 POLE	2 POLE	6 POLE	4 POLE	2 POLE
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	97.1	93.0	90.2	91.7	92.4	91.0

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20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0

C. Efficiency: Premium

D. Stator: Copper windings, unless otherwise indicated.

E. Rotor: Squirrel cage, unless otherwise indicated.

F. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating, unless otherwise indicated.

H. Insulation: Class F, unless otherwise indicated.

I. Code Letter Designation: NEMA starting Code F or G.

J. Enclosure: Cast iron.

K. Finish: Gray enamel.

L. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

M. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:

N. Measure winding resistance.

O. Read no-load current and speed at rated voltage and frequency.

P. Measure locked rotor current at rated frequency.

Q. Perform high-potential test.

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PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation when required or recommended by manufacturer.

C. Check line voltage and phase and ensure agreement with nameplate.

3.02 FIELD QUALITY CONTROL

A. Perform the following:

1. Run each motor with its controller at load.
2. Demonstrate correct rotation, alignment, and speed.
3. Test interlocks and control features for proper operation.
4. Verify that current in each phase is within nameplate rating.

5. Verify RPM is in accordance with nameplate.
6. Where a generator is provided, run each motor on the generator with its controller and load. Demonstrate correct rotation, alignment, and speed.

3.03 ADJUSTING

A. Align motors, bases, and shafts.

3.04 CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

END OF SECTION 220513

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SECTION 220516
EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.02 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Data: Indicate selection calculations.

C. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.

D. Maintenance Data: For expansion joints to include in maintenance manuals. Include adjustment instructions.

E. Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.

1.04 QUALITY ASSURANCE ***REFER TO CURRENT MCPS MECH-PLUMB DESIGN CHECKLIST***

A. **Comply with the requirements of the current MCPS Mechanical and Plumbing Design Checklist. Refer to the latest edition for applicable design, coordination, and documentation standards.**

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

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PART 2 PRODUCTS

2.01 PACKLESS EXPANSION JOINTS

A. Flexible Packless Expansion Joints

1. Manufacturers:
   a. Flex-Hose Co., Inc.
   b. Flexicraft Industries.
   c. Flex Pression Ltd.
   d. Metraflex, Inc.
   e. Unisource Manufacturing, Inc.
2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.

4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.
    a. Retain one or both of first two subparagraphs below to suit pressure and temperature requirements of systems in which these devices are installed. If retaining both, indicate location of each on Drawings.
    b. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.
5. Expansion Joints for Copper Tubing 2-1/2" to 4": Copper-alloy fittings with threaded end connections.
    a. Retain one or both of first two subparagraphs below to suit pressure and temperature requirements of systems in which these devices are installed. If retaining both, indicate location of each on Drawings.
    b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F and 315 psig at 450 deg F ratings.

2.02 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:
1. Available Manufacturers:
    a. Adsco Manufacturing LLC.
    b. Advanced Thermal Systems, Inc.
    c. Flex-Hose Co., Inc.
    d. Flexicraft Industries.
    e. Flex-Weld, Inc.
    f. Hyspan Precision Products, Inc.
    g. Metraflex, Inc.
    h. Unisource Manufacturing, Inc.
2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:
1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
    a. Stud: Threaded, zinc-coated carbon steel.
    b. Expansion Plug: Zinc-coated steel.
    c. Washer and Nut: Zinc-coated steel.
5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
    a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
    b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
    c. Washer and Nut: Zinc-coated steel.

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PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B.

C. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.

D. Install rubber, packless, expansion joints according to FSA-NMEJ-702.

E. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.

F. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

G. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

H. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

3.02 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Connect risers and branch connections to mains with a minimum of 5 (five) pipe fittings including tee in main.

B. Connect risers and branch connections to terminal units with a minimum of 4 (four) pipe fittings including tee in riser.

C. Connect mains and branch connections to terminal units with a minimum of 4 (four) pipe fittings including tee in main.

3.03 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four Insert number pipe diameters from expansion joint.

C. Attach guides to pipe and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

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G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 220516

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SECTION 220517
SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

1.03 QUALITY ASSURANCE ***REFER TO CURRENT MCPS MECH-PLUMB DESIGN CHECKLIST***

A. **Comply with the requirements of the current MCPS Mechanical and Plumbing Design Checklist. Refer to the latest edition for applicable design, coordination, and documentation standards.**

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

PART 2 PRODUCTS

2.01 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

2.02 STACK-SLEEVE FITTINGS

A. Available Manufacturers:
   1. Smith, Jay R. Mfg. Co.
   2. Wade
   3. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with setscrews.

2.03 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   1. Available Manufacturers:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.

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c. GPT, EnPro Industries
d. Metraflex Co.
e. Pipeline Seal and Insulator, Inc.

B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Plastic. Include two for each sealing element.

D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

PART 3 EXECUTION

3.01 SLEEVE INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

B. Install piping to conserve building space, to not interfere with use of space and other work.

C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

D. Install sleeves for piping passing through penetrations in footings, floors, walls, roofs, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.

E. Manufactured Sleeve-Seal Systems:
1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
3. Locate piping in center of sleeve or penetration.
4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
5. Tighten bolting for a water-tight seal.
6. Install in accordance with manufacturer's recommendations.

F. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
1. Sleeves are not required where piping penetrations are core-drilled through poured-in-place or precast concrete and where conditions permit clean, structurally sound holes with sufficient annular space for joint sealing or firestopping. Sleeves are required for all penetrations through CMU (concrete masonry unit) walls, regardless of method, due to the need to contain voids and ensure a smooth, sealable annular space.

G. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.
a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

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H. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide ¼" clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants.

I. Fire Ratings: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.02 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.
   1. Install fittings that are large enough to provide ¼" clear space between sleeve and pipe or pipe insulation.
   2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
   3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
   4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire Rating: Maintain indicated fire rating at pipe penetrations. Seal pipe penetrations with firestop materials.

3.03 SLEEVE-SEAL SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building unless otherwise indicated.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.04 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Exterior Concrete Walls above Grade, below Grade, Concrete Slabs-on-Grade, and Concrete Slabs above Grade:
      a. Piping Smaller Than 6": Cast-iron wall sleeves with sleeve-seal system.
         1) Select sleeve size to allow for one inch (1") annular clear space between piping and sleeve for installing sleeve-seal system.
      b. Piping 6" and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.

3.05 CLEANING

A. Upon completion of work, clean all parts of the installation.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION 220517

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SECTION 220519
METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

1.03 ABBREVIATIONS

A. AFF Above finished floor

B. F Fahrenheit

C. SS Stainless Steel

1.04 QUALITY ASSURANCE ***REFER TO CURRENT MCPS MECH-PLUMB DESIGN CHECKLIST***

A. **Comply with the requirements of the current MCPS Mechanical and Plumbing Design Checklist. Refer to the latest edition for applicable design, coordination, and documentation standards.**

PART 2 PRODUCTS

2.01 FLOWMETERS

A. Turbine Flowmeters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB; Instrumentation and Analytical.
   b. Data Industrial Corp.
   c. EMCO Flow Systems; a division of Spirax Sarco, Inc.
   d. ERDCO Engineering Corp.
   e. Hoffer Flow Controls, Inc.
   f. Liquid Controls; a unit of IDEX Corporation.
   g. McCrometer, Inc.
   h. Midwest Instruments & Controls Corp.
   i. ONICON Incorporated.
   j. SeaMetrics, Inc.
   k. Sponsler, Inc.; a unit of IDEX Corporation.
2. Description: Flowmeter with sensor and indicator.
3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.

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4. Sensor: Impeller turbine; for inserting into pipe fitting or for installing in piping and measuring flow directly in gallons per minute.
    a. Design: Device or pipe fitting with inline turbine and integral direct-reading scale for water.
    b. Construction: Bronze or stainless-steel body, with plastic turbine or impeller.
    c. Minimum Pressure Rating: 150 psig.
    d. Minimum Temperature Rating: 180 deg F.
5. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
6. Accuracy: Plus or minus 1-1/2 percent.
7. Display: Shows rate of flow.
8. Operating Instructions: Include complete instructions with each flowmeter.

2.02 PRESSURE GAUGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gauges:
1. Available Manufacturers:
    a. AMETEK, Inc.; U.S. Gauge.
    b. Ashcroft Inc.
    c. Ernst Flow Industries.
    d. Flo Fab Inc.
    e. Marsh Bellofram.
    f. Miljoco Corporation.
    g. Noshok.
    h. Palmer Wahl Instrumentation Group.
    i. REOTEMP Instrument Corporation.
    j. Tel-Tru Manufacturing Company.
    k. Trerice, H. O. Co.
    l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
    m. Weiss Instruments, Inc.
    n. WIKA Instrument Corporation - USA.
    o. Winters Instruments - U.S.
2. Standard: ASME B40.100.
3. Case: Solid-front, lead-free, pressure relief type; stainless steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Phosphor bronze.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Brass.
11. Accuracy: + or – 1.0 percent of full scale.

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2.03 GAUGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of brass pipe with NPS 1/4 pipe threads.

C. Valves: Brass or stainless-steel needle, with NPS 1/4, ASME B1.20.1 pipe threads.

2.04 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
   1. Available Manufacturers:
      a. Flo Fab Inc.
      b. Miljoco Corporation.
      c. Palmer Wahl Instrumentation Group.
      d. Tel-Tru Manufacturing Company.
      e. Trerice, H. O. Co.
      f. Weiss Instruments, Inc.
      g. Winters Instruments - U.S.
   2. Standard: ASME B40.200.
   3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
   4. Case Form: Adjustable angle unless otherwise indicated.
   5. Tube: Glass with magnifying lens and blue or red organic liquid.
   6. Tube Background: Non-reflective aluminum with permanently etched scale markings graduated in degrees F.
   7. Window: Glass
   8. Stem: Aluminum length = 1/2 pipe diameter, 1/2 duct width or 12” whichever is less.
      a. Air-Duct Installation: Provide ventilated shroud.
      b. Thermowell Installation: Provide Bare stem.
   9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
   10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.05 THERMOWELLS

A. Thermowells:
   1. Standard: ASME B40.200.
   2. Description: Pressure-tight, socket-type fitting made for insertion into threaded fitting.
   3. Material: Brass.
   4. Type: Stepped shank unless straight or tapered shank is indicated.
   5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
   6. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
   7. Bore: Diameter required to match thermometer bulb or stem.
   8. Insertion Length: Length required to match thermometer bulb or stem.
   9. Lagging Extension: Include on thermowells for insulated piping and tubing.
   10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

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2.06 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Flow Design, Inc.
   2. Miljoco Corporation.
   3. National Meter, Inc.
   4. Peterson Equipment Co., Inc.
   5. Sisco Manufacturing Company, Inc.
   6. Trerice, H. O. Co.
   7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   8. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install metering products in accordance with manufacturer's instructions for intended fluid type and service.

B. Install thermowells with socket extending to center of pipe in piping tees.

C. Install thermowells of sizes required to match thermometer connectors. Include bushings to match sizes.

D. Install thermowells with extensions on insulated piping.

E. Install direct-mounted thermometers in thermowells and adjust positions.

F. Install pressure gauges in piping tees located between 36” and 60” above finished floor unless otherwise indicated.

G. Install valve and snubber for each pressure gauge.

H. Install test plugs in piping tees at locations indicated.

I. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

J. Install flowmeter elements in accessible positions in piping systems.

K. Install permanent indicators on walls or brackets at 50” above finished floor unless otherwise indicated.

L. Install connection fittings in accessible locations for attachment to portable indicators.

M. Install thermometers in the following locations:
   1. Inlet and outlet of each water heater.

N. Install pressure gauges in the following locations:
   1. Inlet and outlet of each water heater.

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2. Suction and discharge of each pump.

O. Install a test plug at each thermometer and pressure gauge.

3.02 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 F with 2-degree scale divisions.

B. Scale Range for Domestic Hot-Water and Hot-Water Recirculation Piping 30 to 240 F with 2-degree scale divisions.

3.03 PRESSURE-GAUGE SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Water Piping: 0 psi to 100 psi.

1. Provide pressure scale range so that normal operating high and low pressures are within 25%-75% of the full-scale range.

3.04 FLOWMETER SCHEDULE

A. Flowmeters for Domestic Water Piping: Turbine type

END OF SECTION 220519

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SECTION 220523
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.02 DEFINITIONS

A. The following are standard abbreviations for valves:
   1. CWP: Cold working pressure.
   2. EPDM: Ethylene-propylene-diene terpolymer rubber.
   3. MPTFE: Modified polytetrafluoroethylene plastic.
   4. NBR: Acrylonitrile-butadiene rubber.
   5. PTFE: Polytetrafluoroethylene plastic.
   6. RPTFE: Reinforced polytetrafluoroethylene plastic.
   7. SWP: Steam working pressure.
   8. TFE: Tetrafluoroethylene plastic.
   9. WOG: Water Oil Gas.

1.03 SUBMITTALS

A. Product Data: For each type of valve proposed. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include proposed specialties and accessories.

1.04 QUALITY ASSURANCE ***REFER TO CURRENT MCPS MECH-PLUMB DESIGN CHECKLIST***

A. **Comply with the requirements of the current MCPS Mechanical and Plumbing Design Checklist. Refer to the latest edition for applicable design, coordination, and documentation standards.**

B. ASME Compliance: ASME B31.1 for power piping valves and ASME B31.9 for building services piping valves.
   1. Exceptions: Domestic hot- and cold-water valves unless referenced.

C. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

D. NSF Compliance:
   1. NSF 61 for valve materials for potable-water service.
   2. NSF 372 for Lead content requirements in drinking water system components.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set ball valves open to minimize exposure of functional surfaces.
   4. Block check valves in either closed or open position.

B. Use the following precautions during storage:

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1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

B. Valve Sizes: Match upstream piping unless otherwise indicated.

C. Refer to Part 3 "Valve Applications" Article for applications of valves.

D. Bronze & Brass: Shall be dezincification resistant. (Zinc content shall be less than 15%)

E. Bronze Valves: 2” and smaller with threaded or soldered ends, unless otherwise indicated.

F. Ferrous Valves: 2-1/2” and larger with flanged ends, unless otherwise indicated.

G. Valve Pressure and Temperature Ratings: Not less than indicated for system pressure and temperature.

H. Valve Sizes: Same as the larger of the upstream or downstream pipe, unless otherwise indicated.

I. Valve Actuators:
   1. As indicated in other Part 2 articles.
   2. Where indicated, provide a chain actuator.
   3. Chain Actuator: For attachment to valves of size and mounting height indicated.
   4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.

J. Extended Valve Stems: Provide on insulated valves.

K. Valve Flanges: Provide ASME B16.1 for cast-iron valves, ASME B16.5 for steel, and ASME B16.24 for bronze.

L. Valve Grooved Ends: AWWA C606.

M. Threaded: With threads according to ASME B1.20.1.

N. Valve Bypass and Drain Connections: MSS SP-45.

2.02 COPPER-ALLOY BALL VALVES

A. Two-Piece, Copper-Alloy Ball Valves (Full Port) (Up to 2-1/2”):
   1. Conbraco Industries-Apollo 77CLF series with stainless steel ball & stem (Un-insulated piping)
   2. Conbraco Industries-Apollo 77CLF series with stainless steel ball & stem. Provide 2-1/4” stem extension (Insulated piping)
   3. Other Manufacturers:
      a. Milwaukee
      b. Watts
      c. Nibco

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4. Handle Nut: Zinc plated steel or 300 series stainless steel.
5. Handle: Zinc plated steel, clear chromate plastic, or vinyl coated.
6. Threaded Pack Gland: Brass ASTM B-16
7. Packing: MPTFE or TFE
8. Stem (Blowout Proof): ASTM A-276 type 316 stainless steel. Provide 2-1/4" stem extension for Insulated piping.
9. Thrust Washer: MPTFE or RPTFE
10. Ball: Full-port, ASTM A-276 Type 316 stainless steel.
11. Seats: MPTFE or Reinforced TFE (RPTFE)
12. Body: Bronze ASTM B-584 for solder or threaded connection.
13. Body End Piece: Bronze ASTM B-584 for solder or threaded connection.
14. Rating: 150 psig saturated steam, 600 psig non-shock cold water, oil, and gas.
15. Conform To: MSS SP-110

B. Two-Piece, Bronze Ball Valves UL listed for shut-off gas service (Up to 2-1/2"):
1. Conbraco Industries-Apollo 80-100 series (Un-insulated piping).
2. Conbraco Industries-Apollo 80-100 series with stainless steel ball & stem. Provide 2-1/4" stem extension (Insulated piping)
3. Other Manufacturers:
   a. Milwaukee
   b. Watts
   c. Nibco
4. Handle Nut: Zinc plated steel or 300 series stainless steel.
5. Handle: Zinc plated steel, clear chromate plastic, or vinyl coated.
6. Threaded Pack Gland: Brass ASTM B-16
7. Packing: MPTFE or TFE
8. Stem (Blowout Proof): ASTM A-276 type 316 stainless steel. Provide 2-1/4" stem extension for Insulated piping.
9. Thrust Washer: MPTFE or RPTFE
10. Ball: Brass ASTM B-16, chrome plated.
11. Seats: MPTFE or Reinforced TFE (RPTFE)
12. Body: Bronze ASTM B-584 for threaded connection.
13. Body End Piece: Bronze ASTM B-584 for threaded connection.
14. Rating: 150 psig saturated steam, 250 psi gas, vacuum service to 29".
15. Conform To: MSS SP-110

C. Two-Piece, Copper-Alloy Ball Valves (Full Port) (2-1/2" to 4"):
1. Conbraco Industries - Apollo 94ALF-A series with stainless steel ball & stem (Un-insulated piping)
2. Conbraco Industries - Apollo 94ALF-A series with stainless steel ball & stem. Provide 2-1/4" stem extension (Insulated piping)
3. Other Manufacturers:
   a. Milwaukee
   b. Watts
   c. Nibco.
4. Handle Nut: Zinc plated steel or 300 series stainless steel.

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5. Handle: Zinc plated steel, clear chromate plastic, or vinyl coated.
6. Threaded Pack Gland: Brass ASTM B-16 Alloy 360
7. Packing: RPTFE or TFE
8. Stem (Blowout Proof): ASTM A-276 type 316 stainless steel. Provide 2 ¼" stem extension for Insulated piping.
9. Thrust Washer: MPTFE or Reinforced TFE
10. Ball: Full-port, ASTM A-276 Type 316 stainless steel.
11. Seats: MPTFE or Reinforced TFE
12. Body: Bronze ASTM B-584 for solder or threaded connection.
13. Body End Piece: Bronze ASTM B-584 for solder or threaded connection.
14. Rating: 150 psig saturated steam, 600 psig non-shock cold water, oil, and gas.
15. Conform To: MSS SP-110

2.03 LARGE GAS BALL VALVES (3" TO 10")

A. Carbon Steel ANSI class 150, flanged, standard port ball valve with stainless steel ball and stem.
   1. Conbraco Industries-Apollo 88A-140 series
   2. Other Manufacturers:
   3. Milwaukee
      a. Watts
      b. Nibco
   4. Provide gear operator with oversized hand wheel.
   5. Packing Gland: ASTM A108 Type 1215
   6. Packing: RPTFE or TFE
   7. Stem (Blowout Proof): ASTM A108 Type 1215
   8. Ball: Standard-port, ASTM A-276 Type 316 stainless steel solid ball.
   9. Seats: RPTFE
   10. Thrust Washer: RPTFE.
   11. Body: Carbon steel ASTM A216 WCB.
   12. Body Nut: ASTM A194, grade 2H.
   13. UL (YRPV): Listed for gas shut-off service.
   14. Rating: 150 psig saturated steam

2.04 BRONZE CHECK VALVES

A. Bronze, Horizontal Swing Check Valves:
   1. Conbraco Industries-Apollo 161S/T
   2. Other Manufacturers:
      a. Milwaukee
      b. Stockham
      c. Nibco
   3. Bonnet: ASTM B-62 bronze.
   4. Body: ASTM B-62 bronze.
   5. Hinge Pin: ASTM B-140 alloy C31400 bronze, or B-134 alloy C23000 bronze.
   6. Disc Hanger:
      a. Sizes ¼" thru ¾": Type 304 stainless steel.

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b. Sizes 1” and larger: ASTM B-62 bronze.
7. Hanger Nut: ASTM B-16 bronze.
8. Disc Holder: ASTM B-62 bronze.
9. Seat Disc:
   a. Water and Other Heat Transfer Fluids: ASTM B-62 bronze.
   b. Steam: TFE
10. Seat Disc Nut: ASTM B-16 or B-62 bronze.
11. Hinge Pin Plug: ASTM B-140 alloy C31600 bronze.
12. Seat Disc Washer (When Provided): ASTM B-98 alloy C65500 or B-103 bronze.
13. Rating: 125 psig SWP and 200 psig CWP.
14. Conform To: MSS SP-80

B. Bronze, Inline Spring Loaded Check Valves:
1. Conbraco Industries-Apollo 61-100 series
2. Other Manufacturers:
   a. Milwaukee
   b. Stockham
   c. Nibco
3. Body: ASTM B-584 alloy C84400 bronze.
4. Retainer/Stem: ASTM B16 brass or ASTM A-582 alloy C30300 stainless steel.
5. Ball Check: RPTFE
6. Disc Holder 316 Stainless steel
   a. Disc:
      1) Water, Oil, Gas: Buna-N
      2) Steam: TFE
   b. Seat Screw: ASTM A-276 alloy S43000 stainless steel.
   c. Body End: ASTM B-584 alloy C84400 bronze.
   d. Rating: 125 psig SWP and 250 psig CWP.
7. Guide: ASTM B16 Brass
8. Spring: Type 316 stainless steel.
9. Rating: 125 psig SWP and 400 psig WOG.

C. IRON BODY CHECK VALVES

D. Iron Body, Horizontal Swing Check Valves:
1. Conbraco Industries-Apollo 910F
2. Other Manufacturers:
   a. Milwaukee
   b. Stockham
   c. Nibco
3. Body Bolt: ASTM A-307 steel.
4. Bonnet: ASTM A-126 class B cast iron.
5. Body Gasket: Synthetic Fibers.
6. Body Nut: ASTM A-307 steel
7. Side Plug: ASTM B-16 alloy C36000 Brass.
8. Hanger Pin: ASTM B-16 alloy C36000 Brass.

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9. Hanger: ASTM B-584 alloy C84400 cast bronze.
10. Disc: ASTM B-584 alloy C84400 cast bronze or ASTM A-536 ductile iron w/bronze face ring.
11. Seat Ring: ASTM B-584 alloy C84400 cast bronze.
12. Disc Nut: ASTM B-16 alloy C36000.
13. Body: ASTM A-126 class B cast iron.
14. Disc Bolt: ASTM B-16 alloy C36000 Brass.
15. Disc Plate: ASTM A-126 class B cast iron.
16. Disc Cage: ASTM A-126 class B cast iron.
17. Rating: 125 psig SWP and 200 psig CWP.
18. Conform To: MSS SP-71 Type 1.

E. Spring Actuated Silent Check Valves:
1. NIBCO Model F-910
2. Other Manufacturers:
a. Milwaukee
b. Stockham
3. Body: ASTM A48 class 35 cast iron.
4. Seat: ASTM B-584 alloy C83600 (B) bronze.
5. Disc: ASTM B-584 alloy C83600 bronze.
6. Spring: Type 302 ASTM A313 stainless steel.

F. Bushing:
a. 6” and Smaller: ASTM B-16 brass
b. 8” and Larger: ASTM B-584 alloy C83600 bronze.
2. Set Screws: Type 304 ASTM A-276 stainless steel.
3. Rating: 200 psig CWP.
4. Conform To: MIL-V-18436F

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PART 3 EXECUTION

3.01 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully-open to fully-closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

C. Locate valves for easy access.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

F. Install chainwheels on operators for ball valves 4” and larger and more than 96 inches above finished floor. Extend chains to 60 inches above finished floor.

G. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
   3. Lift Check Valves: With stem upright and plumb.

H. Shutoff valves shall be provided and located on each floor, on takeoffs from all vertical risers, branch lines from the mains, and at the branch connections to each fixture.

3.03 ADJUSTING

A. Adjust valve packing after piping systems have been tested and put into service but before final testing and balancing. Replace valves if persistent leaking occurs.

3.04 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball valves.
   2. Throttling Service: Ball or Balancing valves.
   3. Pump Discharge: Spring-loaded, lift-disc, check valves and ball valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Domestic Water Piping: Use the following types of valves:
   1. Valves, NPS 2” and Smaller: Two-Piece, Copper-Alloy Ball Valves (Full Port).
   2. Valves, NPS 2-1/2” and 3”: Two-piece or three-piece, Copper-Alloy Ball Valves (Full Port).
   3. Valves, NPS 4” and Larger: Two-piece or three-piece, Copper-Alloy Ball Valves (Full Port).
   4. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2” and Smaller: Bronze, Inline Lift Check Valves.
   5. Horizontal Check Valves, NPS 2” and Smaller: Bronze, Horizontal Swing Check Valves.
   6. Vertical Check Valves, NPS 2” and Smaller: Bronze, Inline Lift Check Valves.
   7. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2-1/2” and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves or Spring Actuated Silent Check Valves.
   8. Horizontal Check Valves, NPS 2-1/2” and Larger: Bronze, Horizontal Swing Check Valves.
   9. Vertical Check Valves, NPS 2-1/2” and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves or Spring Actuated Silent Check Valves.

D. Gas Piping: Use the following types of valves:
   1. Valves, NPS 2” and Smaller: Two-Piece, Copper-Alloy Ball Valves (Full Port).
   2. Valves, NPS 2-1/2” and 3”: Two-piece or three-piece, Copper-Alloy Ball Valves (Full Port).

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3. Valves, NPS 4” and Larger: Two-piece or three-piece, Copper-Alloy Ball Valves (Full Port).
4. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2” and Smaller: Bronze, Inline Lift Check Valves.
5. Horizontal Check Valves, NPS 2” and Smaller: Bronze, Horizontal Swing Check Valves.
6. Vertical Check Valves, NPS 2” and Smaller: Bronze, Inline Lift Check Valves.
7. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2-1/2” and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves or Spring Actuated Silent Check Valves.
8. Horizontal Check Valves, NPS 2-1/2” and Larger: Bronze, Horizontal Swing Check Valves.
9. Vertical Check Valves, NPS 2-1/2” and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves or Spring Actuated Silent Check Valves.

END OF SECTION 220523

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SECTION 220529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.02 DEFINITIONS

A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.03 PERFORMANCE REQUIREMENTS

A. Design Requirement: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer where using methods other than indicated.

B. Structural Performance: Hangers and supports for Plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test medium.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.04 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.

B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.05 QUALITY ASSURANCE ***REFER TO CURRENT MCPS MECH-PLUMB DESIGN CHECKLIST***

A. **Comply with the requirements of the current MCPS Mechanical and Plumbing Design Checklist. Refer to the latest edition for applicable design, coordination, and documentation standards.**

B. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Provide required hardware to hang or support piping, equipment, or fixtures with related accessories as necessary to complete installation of plumbing work.

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B. Provide hardware products listed, classified, and labeled as suitable for intended purpose.

C. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 20%. Include consideration for vibration, equipment operation, and shock loads where applicable.

D. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.

2.02 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
   3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
   4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
   5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:
   1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
   2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.03 TRAPEZE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

B. Trapeze Pipe Hanger Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
   1. Assemble and provide according to manufacturer's written instructions. Center piping on channel to evenly distribute load.
   2. Pipe sizes and numbers shall be in accordance with the following:

TRAPEZE PIPE HANGER TABLE

PIPE SIZE	4"	3"	2-1/2"	2"	1-1/2"	1-1/4"	1"	TOTAL # OF PIPES
	2	0	0	0	0	0	0	2
	0	2	2	0	0	0	0	4
	0	2	0	4	0	0	0	6
	0	2	0	0	6	0	0	8
	0	0	4	2	0	0	0	6
	0	0	4	0	2	2	0	8
	0	0	4	0	0	8	0	12
	0	0	0	6	2	2	2	12
	0	0	0	8	0	2	0	10
	0	0	0	0	14	0	0	14
	0	0	0	0	0	16	0	16

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Notes:
1. Piping larger than 4" in diameter is not permitted in a channel support system.
2. Channel support systems shall be limited to eight (8) pipes per channel and two (2) channels (levels) per support system.
3. Smaller pipes can be substituted for larger pipes. For example two ¾" pipes may be installed in lieu of two 1" pipes, or 2" in lieu of 3", etc.
4. Spacing shall be in accordance with requirements for the smallest supported pipe. Refer to other specification sections for spacing requirements. If spacing requirements are not indicated comply with MSS SP-69.

C. Metal Framing Systems:
   1. Available Manufacturers:
      a. Anvil International; a subsidiary of Mueller Water Products Inc.
      b. Empire Industries, Inc.
      c. ERICO International Corporation.
      d. Haydon Corporation; H-Strut Division.
      e. NIBCO INC.
      f. PHD Manufacturing, Inc.
      g. PHS Industries, Inc.
   2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
   3. Standard: Comply with MFMA-4.
   4. Channels: Continuous slotted steel channel with in-turned lips.
   5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
   6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
   7. Coating: Zinc.

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2.04 THERMAL-HANGER SHIELD INSERTS

A. Available Manufacturers:
   1. Carpenter & Paterson, Inc.
   2. Clement Support Services.
   3. ERICO International Corporation.
   4. National Pipe Hanger Corporation.
   5. PHS Industries, Inc.
   6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
   7. Piping Technology & Products, Inc.
   8. Rilco Manufacturing Co., Inc.
   9. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig, or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2” beyond sheet metal shield for piping operating below ambient air temperature.

2.05 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
   1. Available Manufacturers:
      a. Cooper B-Line – Dura-Blok
      b. MAPA Products
      c. Mifab, Inc. – C-Port
      d. Miro Industries, Inc.
      e. OMG, Inc.
      f. PHP Systems/Design
      g. Pipe Prop
      h. Roof Top Blox
   2. Provide pipe supports for supporting gas, condensate, refrigeration lines, or hydronic piping on flat roof surfaces. Support shall rest on roof surface without penetrating the roof surface. Supports for condensate piping shall be adjustable vertically to ensure pipe slopes as required.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Curb Mounted Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.06 EQUIPMENT SUPPORTS

A. Description: Welded, shop or field fabricated equipment support made from structural carbon-steel shapes unless indicated otherwise.

2.07 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
   1. Properties: Non-staining, noncorrosive, and nongaseous.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

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D. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

E. Secure fasteners according to manufacturer's recommended torque settings.

F. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Provide hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

G. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69, MSS SP-89, and Table above. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

H. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

I. Thermal-Hanger Shield Installation: Provide in pipe hanger or shield for insulated piping.

J. Pipe Stand Installation: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

K. Provide hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

L. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

M. Provide hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

N. Provide lateral bracing with pipe hangers and supports to prevent swaying.

O. Provide building attachments within concrete slabs or attach to structural steel. Building attachments may not used on steel joists unless otherwise indicated. Provide additional attachments at concentrated loads, including valves, flanges, and strainers, 2-1/2” and larger and at changes in direction of piping. Provide concrete inserts before concrete is placed; fasten inserts to forms and provide reinforcing bars through openings at top of inserts.

P. Load Distribution: Provide hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

Q. Pipe Slopes: Provide hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

R. Insulated Piping:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature: Provide thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
   2. Provide MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   3. Provide MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   4. Shield Dimensions for Pipe: Not less than the following:
      a. Pipe ¼” to 3-½”: 12 inches long and 0.048 inch thick.
      b. Pipe 4”: 12 inches long and 0.06 inch thick.
      c. Pipe 5” and 6”: 18 inches long and 0.06 inch thick.

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d. Pipe 8” to 14”: 24 inches long and 0.075 inch thick.

5. Pipes 8” and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Provide with insulation same thickness as piping insulation.

S. Provide hangers and supports per specifications.

T. Supports shall be coordinated with and mechanically fastened to structure.

U. Install pipe hanger under all roof drains.

3.02 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.03 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Provide materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.04 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.05 PAINTING

A. Touchup: Unless otherwise indicated clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Provide same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and immediately apply galvanizing-repair paint. Paint shall comply with ASTM A 780.

3.06 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

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B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Provide hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Provide nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Provide copper-plated pipe hangers and copper attachments for copper piping and tubing.

F. Provide padded hangers for piping that is subject to scratching.

G. Provide thermal-hanger shield inserts for insulated piping and tubing.

H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated provide the following:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of stationary pipes ½" to 30".
   2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes 4" to 14", requiring up to 4" of insulation.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes ¾" to 14", requiring clamp flexibility and up to 4 inches of insulation.
   4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes ½" to 14" if little or no insulation is required.
   5. Pipe Hangers (MSS Type 5): For suspension of pipes ½" to 4", to allow off-center closure for hanger installation before pipe erection.
   6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes ¾" to 8".
   7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes ½" to 8".
   8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes ½" to 8".
   9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes ½" to 8".
   10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes ½" to 8".
   11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS ½" to 3".
   12. U-Bolts (MSS Type 24): For support of heavy pipes ½" to 14".
   13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
   14. Pipe Saddle Supports (MSS Type 36): For support of pipes 4" to 14", with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
   15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes 4" to 14", with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
   16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes 2-½" to 14" if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
   17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes 1" to 14", from two rods if longitudinal movement caused by expansion and contraction might occur.
   18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes 2-½" to 14", from single rod if horizontal movement caused by expansion and contraction might occur.

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19. Complete Pipe Rolls (MSS Type 44): For support of pipes 2” to 14” if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes 2” to 14” if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes 2” to 14”if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

I. Vertical-Piping Clamps: Unless otherwise indicated provide the following:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers ¾” to 14”.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers ¾” to 14” if longer ends are required for riser clamps.

J. Hanger-Rod Attachments: Unless otherwise indicated provide the following:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
6. Flat Plate, Double Nut, and Washer as Detailed on Structural Drawings: For attaching to bar joists. Method of attachment to bar joists must be approved by the structural engineer and joist manufacturer.

K. Building Attachments: Unless otherwise indicated provide the following:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Flat Plate, Double Nuts, and Washer as Detailed on Structural Drawings: For use under roof installations with bar-joist construction to attach to bottom chord of joist.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Provide one of the following for indicated loads:
    a.
    b. Medium (MSS Type 32): 1500 lb.

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c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

L. Saddles and Shields: Unless otherwise indicated provide the followings:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

M. Spring Hangers and Supports: Unless otherwise indicated provide the following:

1. Restraint-Control Devices (MSS Type 47): To control pipe movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
   a. Horizontal (MSS Type 54): Mounted horizontally.
   b. Vertical (MSS Type 55): Mounted vertically.
   c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Provide powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where indicated in concrete construction.

3.07 FIELD QUALITY CONTROL

A. Inspect support and attachment components for damage and defects.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

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C. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 220529

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SECTION 220533
HEAT TRACING FOR PLUMBING PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

B. Coordinate the work with other trades to provide ground fault protection for electric heat tracing circuits as required by NFPA 70.

C. Coordinate the work with other trades to provide circuit breaker ratings suitable for installed circuit lengths.

1.03 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.

1. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.

B. Shop Drawings: For electric heating cable. Include plans, sections, details, and attachments to other work.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Operation and Maintenance Data: For electric heating cable controls to include in operation and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.04 QUALITY ASSURANCE ***REFER TO CURRENT MCPS MECH-PLUMB DESIGN CHECKLIST***

A. **Comply with the requirements of the current MCPS Mechanical and Plumbing Design Checklist. Refer to the latest edition for applicable design, coordination, and documentation standards.**

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.05 ABBREVIATIONS

A. BAS: Building Automation System.

B. F: Fahrenheit

C. HZ: Hertz

D. IEEE: Institute of Electrical and Electronics Engineers

E. IP: Ingress Protection

F. NEMA: National Electrical Manufacturers Association

G. NFPA: National Fire Protection Association

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H. OD: Outside Diameter

I. PH: Phase

J. UV: Ultraviolet

K. V: Voltage

1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 SELF-REGULATING PARALLEL RESISTANCE ELECTRIC HEATING CABLE

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Chromalox, Inc.; Wiegard Industrial Division; Emerson Electric Company.
2. Delta-Therm Corp.
3. Raychem; a division of Tyco Thermal Controls.
4. Thermon Manufacturing Co.

B. Heating Element:

1. Provide pair of parallel No. 16 nickel-coated stranded copper bus wires embedded in cross-linked conductive polymer core with varying heat output in response to temperature along its length.
2. Terminations: Waterproof, factory-assembled, non-heating leads with connector at one end and water-tight seal at opposite end.
3. Capable of crossing over itself without overheating.

C. Insulated Jacket: Flame-retardant polyolefin.

D. Cable Cover: Provide metallic braid and polyolefin outer jacket with UV inhibitor.

E. Maximum Power-On Operating Temperature: As scheduled. If not scheduled, 150 degrees F.

F. Maximum Power-Off Exposure Temperature: As scheduled. If not scheduled, 185 degrees F.

G. Capacities and Characteristics: As scheduled. If not scheduled 3 watts per linear foot at 115V, 1PH, 60HZ, to maintain 120 degrees F.

2.02 CABLE OUTER JACKET MARKINGS

A. Name of manufacturer, trademark, and/or other recognized symbol of identification.

B. Catalog number, reference number and/or model number.

C. Month and year of manufacture, date coding, applicable serial number, or equivalent.

D. Agency listing or approval.

E. Applicable environmental or are use requirements, such as NEMA 4, Type 4, IP ratings, and hazardous (classified) locations markings including temperature rating.

F. Any applicable warning/caution statements such as “WARNING: De-energize circuit before removing cover.”

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2.03 CONNECTION KITS

A. Provide power connection, splice/tee, and end seal kits compatible with the heating cable and without requiring cutting of the cable core to expose bus wires.

B. Provide with NEMA 4X rating for prevention of corrosion and water ingress.

C. Provide UV stabilized components.

2.04 ACCESSORIES

A. Provide accessories as indicated or as required for complete installation, including but not limited to:

1. High temperature, glass filament tape for attachment of heating cable to metal piping.
2. Aluminum self-adhesive tape for attachment of heating cable to plastic piping.
3. Heat-conductive putty.
4. Cable ties.
5. Silicone end seals and splice kits.
6. Installation clips.
7. Warning labels for attachment to exterior of piping insulation.
8. Warning labels for attachment to exterior of piping insulation. Continuously printed "Electrical Heat Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
    a. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
    b. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

2.05 CONTROLS

A. Pipe-Mounted Thermostats for Freeze Protection:

1. Remote bulb unit with adjustable temperature range from 30 to 50 deg F.
2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
3. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
4. Corrosion-resistant, waterproof control enclosure.

B. Precipitation and Temperature Sensor for Snow Melting on Roofs and in Gutters:

1. Automatic control with manual on, automatic, and standby/reset switch.
2. Precipitation and temperature sensors shall sense the surface conditions of roof and gutters and shall be programmed to energize the cable as follows:
    a. Temperature Span: 34 to 44 deg F.
    b. Adjustable Delay Off Span: 2 minutes.
    c. Energize Cables: Following two-minute delay if ambient temperature is below set point and precipitation is detected.
    d. De-Energize Cables: On detection of a dry surface plus time delay.
3. Corrosion-proof and waterproof enclosure suitable for outdoor mounting, for controls and precipitation and temperature sensors.
4. Minimum 30-A contactor to energize cable or close other contactors.
5. Provide relay with contacts to indicate operational status, on or off, for interface with BAS.

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C. Interface with BASInterface with BAS for Domestic Hot-Water Temperature Maintenance:
   1. Relays with contacts to permit On/Off setting and to indicate operational status, (On or Off).

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
   2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install in accordance with manufacturer's written installation instructions.

B. Comply with applicable local building codes and requirements of authorities having jurisdiction.

C. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written recommendations using cable protection conduit and slack cable to allow movement without damage to cable.

D. Electric Heating Cable Installation for Freeze Protection for Piping:
   1. Install electric heating cables after piping has been tested and before insulation is installed.
   2. Install electric heating cables according to IEEE 515.1.
   3. Install insulation over piping with electric cables according to Division 22 Section "Plumbing Insulation."
   4. Install warning tape on piping insulation where piping is equipped with electric heating cables.

E. Electric Heating Cable Installation for Snow and Ice Melting on Roofs and in Gutters and Downspouts: Install on roof and in gutters and downspouts with clips furnished by manufacturer that are compatible with roof, gutters, and downspouts.

F. Electric Heating Cable Installation for Temperature Maintenance for Domestic Hot-Water:
   1. Install electric heating cables after piping has been tested and before insulation is installed.
   2. Install insulation over piping with electric heating cables according to Division 22 Section "Plumbing Insulation."
   3. Install warning tape on piping insulation where piping is equipped with electric heating cables.

G. Set field-adjustable switches and circuit-breaker trip ranges.

H. Protect installed heating cables, including non-heating leads, from damage.

3.03 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

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3.04 FIELD QUALITY CONTROL

A. Perform start-up by factory technician or factory representative as per Owner's requirements.

B. Field Testing and Inspections: Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.

1. Commission system in accordance with installation and operation manual. .
2. Inspect for sources of water entry and proper sealing.
3. Inspect weather barrier to confirm that no sharp edges are contacting the trace heating.
4. Test cables for electrical continuity and insulation integrity before energizing.
5. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously. Record results.
6. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounting cables. Record results.
7. Controls: Verify control parameters are set to the application requirements.

C. Remove and replace malfunctioning heat tracing and retest as specified above.

3.05 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 220533

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SECTION 220553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

C. Valve Schedules: For each piping system to include in maintenance manuals.

D. 1/16” = 1’-0” scale drawing showing all valve locations to include in maintenance manuals.

1.03 QUALITY ASSURANCE ***REFER TO CURRENT MCPS MECH-PLUMB DESIGN CHECKLIST***

A. **Comply with the requirements of the current MCPS Mechanical and Plumbing Design Checklist. Refer to the latest edition for applicable design, coordination, and documentation standards.**

B. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.04 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

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PART 2 PRODUCTS

2.01 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass or Aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16-inch-thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16-inch-thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.03 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

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D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as indicated below, pipe size, and indication of flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: According to and conforming with OSHA/ANSI A13.1.

2.04 VALVE TAGS

A. Valve Tags: Brass, 1.5 inch (40mm) diameter with black-filled letters/numbers not less than 0.25 inch (6mm) high. Numbering scheme approved by MCPS. Provide 5/32-inch hole for fastener.
   1. Material: Brass.

B. Valve-Tag Fasteners: Brass attachement chains.

2.05 VALVE SCHEDULE

A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws and hangers.
   2. Frame: Finished hardwood or extruded aluminum.
   3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.06 VALVE PLAN

A. Valve Plan: Prepare a scale drawing. Provide the location and identity of each valve.
   1. Valve Plan Frames: Glazed display frame for removable mounting on masonry walls for each page of valve plan. Include mounting screws and hangers.
   2. Frame: Finished hardwood or extruded aluminum.
   3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.07 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
   1. Size: 3 inches by 5-1/4 inches minimum.
   2. Fasteners: Brass grommet and wire.
   3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
   4. Color: Yellow background with black lettering.

PART 3 EXECUTION

3.01 COMMON REQUIREMENTS

A. Provide identification for plumbing piping and equipment.

B. Label valves and equipment for maintenance access.

C. Mark ceilings with permanent tags identifying valves and equipment above ceiling.

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3.02 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.03 EQUIPMENT LABEL INSTALLATION

A. Install and permanently fasten equipment nameplates on each major item of plumbing equipment that does not have nameplate or has a nameplate that is damaged or located where not easily visible. Locate nameplates where easily visible. Include nameplates for the following general categories of equipment:
   1. Fuel-burning units.
   2. Pumps, compressors, and other motor-driven equipment.
   3. Heat exchangers and similar equipment.
   4. Water heaters and storage tanks.

B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
   1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
   3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
      a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
      b. Meters, gages, and thermometers.
      c. Fuel-burning units.
      d. Pumps, compressors, and other motor-driven equipment.
      e. Heat exchangers and similar equipment.
      f. Water heaters and storage tanks.

C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where easily visible.
   1. Identify mechanical equipment with equipment markers in the following color codes:
      a. Green: For cooling equipment and components.
      b. Yellow: For heating equipment and components.
      c. Orange: For combination cooling and heating equipment and components.
      d. Brown: For energy-reclamation equipment and components.
      e. Blue: For equipment not listed in a through d
   2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.

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D. Install access panel markers with screws on equipment access panels.

E. Tags installed on curved surfaces shall be brass or aluminum.

3.04 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in other sections.

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced at maximum intervals of 25 feet.
   7. On piping above removable acoustical ceilings.

C. Pipe Label Color Schedule: (All piping to be labeled. Owner to confirm color if not provided in specifications or drawings.)
   1. Domestic Cold Water Piping (Potable):
      a. System Abbreviation: POTABLE WATER
      b. Background Color: Green.
      c. Letter Color: White.
   2. Domestic Hot Water Piping (Potable):
      a. System Abbreviation: HW
      b. Background Color: Red.
      c. Letter Color: White.
   3. Domestic Hot Water Return Piping (Potable):
      a. System Abbreviation: HWR
      b. Background Color: Red.
      c. Letter Color: White.
   4. Sanitary Waste Piping:
      a. System Abbreviation: WASTE
      b. Background Color: Green.
      c. Letter Color: White.
   5. Sanitary Vent Piping:
      a. System Abbreviation: VENT
      b. Background Color: Green.
      c. Letter Color: White.
   6. Storm Drainage Piping:
      a. System Abbreviation: STORM
      b. Background Color: Green.
      c. Letter Color: White.
   7. Storm Secondary/Emergency Drainage Piping:

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a. System Abbreviation: OVERFLOW
b. Background Color: Green
c. Letter Color: White

8. Natural Gas Piping:
   a. System Abbreviation: GAS
   b. Background Color: Yellow.
   c. Letter Color: Black.

3.05 VALVE-TAG INSTALLATION

A. Provide and install tags on all valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule. Numbers shall correspond to those shown on the valve chart. Attach tags to valve shaft.
   1. Valve-Tag Size and Shape: 1 ½", round.
   2. Valve-Tag Color: Brass.
   3. Letter/Number Color: Black.

3.06 VALVE SCHEDULE INSTALLATION

A. Mount valve schedules on wall in accessible location in each major equipment room and where directed by owner.

3.07 VALVE PLAN INSTALLATION

A. Mount valve plans on wall in accessible location in each major equipment room and where directed by owner.

3.08 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.09 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.10 CLEANING

A. Clean faces of mechanical identification devices and glass fronts of valve schedules and plans.

END OF SECTION 220553

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SECTION 220700
PLUMBING INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.02 DEFINITIONS

A. Outdoor pipe: Pipe located outside the building insulation envelope.

B. Plenum: An unoccupied space or void, on the conditioned side of the building insulation and vapor barrier, being used to return conditioned air to the inlet side of a return or exhaust fan either directly or via a duct connection. An example would be a space with air handling light fixtures or openings in the ceiling used to transport air through the ceiling and then to an open duct located above the ceiling in another location.

C. Indirectly Conditioned Space: A space having no direct conditioning but, due to air movement induced by an exhaust, or return opening, is conditioned by makeup air from an adjacent space. An example would be a small toilet. Boiler rooms, fan rooms, and mechanical rooms do not qualify as indirectly conditioned spaces.

D. Inside the Building Insulation Envelope: For the purposes of this section, boiler rooms, fan rooms, and mechanical rooms are considered to be OUTSIDE the building insulation envelope.

E. Exposed: Visible from any angle without removal of building element or equipment.

F. Concealed: Enclosed in building element or above ceiling such that it is not visible from any angle without removal of building element or equipment.

1.03 SUBMITTALS

A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations. Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

B. Shop Drawings: Show fabrication and installation details for the following:
   1. Detail application of removable insulation covers.
   2. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   3. Detail attachment and covering of heat tracing inside insulation.
   4. Detail insulation application at pipe expansion joints for each type of insulation.
   5. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   6. Detail removable insulation at piping specialties, equipment connections, and access panels.
   7. Detail application of field-applied jackets.
   8. Detail application at linkages of control devices.
   9. Detail field application for each equipment type.
   10. Detail field application for each equipment type.

C. Stainless-Steel Jacket: Deep corrugated sheets of stainless steel complying with ASTM A 666, Type 304 or 316; 0.10 inch thick; and roll stock ready for shop or field cutting and forming to indicated sizes.

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1. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
2. Elbows: Gore type, for 45- and 90-degree elbows in same material, finish, and thickness as jacket.
3. Jacket Bands: Stainless steel, Type 304, 3/4 inch wide.

D. Heavy PVC Pipe Fitting Covers: Factory-fabricated fitting covers manufactured from 30-mil-thick, high-impact, ultraviolet-resistant PVC.
1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
2. Adhesive: As recommended by insulation material manufacturer.

E. Standard PVC Pipe Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil-thick, high-impact, ultraviolet-resistant PVC.
1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
2. Adhesive: As recommended by insulation material manufacturer.

1.04 QUALITY ASSURANCE ***REFER TO CURRENT MCPS MECH-PLUMB DESIGN CHECKLIST***

A. **Comply with the requirements of the current MCPS Mechanical and Plumbing Design Checklist. Refer to the latest edition for applicable design, coordination, and documentation standards.**

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

B. Packaging: Ship insulation materials in containers marked by manufacturer with type, grade, and maximum use temperature.

C. Ship Insulated Piping System Components on pallets and wood supports. Securely fasten and protect from damage. Store off the ground and cover with opaque waterproof tarp to protect materials from sunlight and rain.

1.06 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping installer for piping insulation, duct installer for duct insulation, and equipment installer for equipment insulation.

C. Maintain clearances required for maintenance.

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D. Coordinate installation and testing of heat tracing.

1.07 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers:
   1. Mineral-Fiber Insulation:
      a. CertainTeed Manson.
      b. Johns Manville
      c. Knauf FiberGlass GmbH.
      d. Owens-Corning Fiberglas Corp.
      e. Schuller International, Inc.
   2. Flexible Elastomeric Thermal Insulation:
      a. Armstrong World Industries, Inc.
      b. Rubatex Corp.
   3. Polyolefin Insulation:
      a. Armstrong World Industries, Inc.
      b. IMCOA.
   4. Closed-Cell Phenolic-Foam Insulation:
      a. Kooltherm Insulation Products, Ltd.
   5. Removable Insulation Covers:
      a. Advance Thermal Corp.

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2.02 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, with factory applied FSK Jacket. Meet the requirements of ASTM C 1290, Type III, inorganic glass fibers bonded by a thermosetting resin to maximum service temperature of 250°F. Faced insulation shall not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E84.

G. Semi-Rigid Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136, Type I, II, III, & IV with factory applied all-service jacket (ASJ) or Type II, IV with factory applied Foil Scrim Kraft (FSK) jacket.

H. Mineral-Fiber Blanket with Factory Applied FSK Jacket: Meet the requirements of ASTM C 1290, Type III, inorganic glass fibers bonded by a thermosetting resin with a multi-purpose foil-scrim kraft (FSK) jacket to maximum service temperature of 250°F. FSK shall meet the requirements of ASTM C 1136, Type II, when surface burning characteristics are determined in accordance with ASTM E 84 with the foil surface of the material exposed to the flame as it is in the final composite. Composite (insulation, facing and adhesive) shall not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E 84. Insulation properties shall be as follows:

1. Thickness: 1-1/2”
   a. Density: 0.75 pcf
   b. Minimum uncompressed R value: 5.0
   c. Minimum installed R value assuming 25% compression: 4.0
2. Thickness: 2”
   a. Density: 1.0 pcf
   b. Minimum uncompressed R value: 7.4
   c. Minimum installed R value assuming 25% compression: 6.0
3. Alternate to 2” 1.0 pcf: Thickness: 2.2”
   a. Density: 0.75 pcf
   b. Minimum uncompressed R value: 7.4
   c. Minimum installed R value assuming 25% compression: 6.0
4. Thickness: 3”
   a. Density: 0.75 pcf
   b. Minimum uncompressed R value: 10.0
   c. Minimum installed R value assuming 25% compression: 8.3

I. Medium Temperature Mineral-Fiber Blanket for Operating Temperatures from 250 to 850 deg F: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.

J. High Temperature Mineral-Fiber Blanket for Temperatures above 850 deg F: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.

K. Mineral-Fiber Pipe Insulation: Glass fibers bonded with a thermosetting resin complying with the following:

1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
2. Semi-Rigid Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136, Type I, II, III, IV with factory applied all-service jacket (ASJ) or Type II, IV with factory applied Foil Scrim Kraft (FSK) jacket.
3. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.
4. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
5. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
6. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

L. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Adhesive: As recommended by insulation material manufacturer.

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2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

M. Closed-Cell Phenolic-Foam: Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.

N. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.03 FIELD-APPLIED JACKETS

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. Glass Cloth: Woven glass-fiber fabric, plain weave, minimum 8 ounces per square yard.

C. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.

D. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.
1. Adhesive: As recommended by insulation material manufacturer.
2. PVC Duct Jacket Color: White or gray.
3. PVC Pipe Jacket Color: Color-code piping jackets based on materials contained within the piping system.

E. Aluminum Jacket: Deep corrugated sheets manufactured from aluminum alloy complying with ASTM B 209, and having an integrally bonded moisture barrier over entire surface in contact with insulation. Factory cut and rolled to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper.
1. Finish and Thickness: Stucco-embossed finish, 0.016 inch thick.
2. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.

2.04 REMOVABLE INSULATION COVERS

A. Pre-manufactured easily removable insulation cover/blanket intended for insulation of equipment and devices requiring periodic maintenance.

2.05 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz. /sq. yd.
1. Tape Width: 4 inches.

B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
2. Galvanized Steel: 0.005 inch thick.
3. Aluminum: 0.007 inch thick.
4. Brass: 0.010 inch thick.
5. Nickel-Copper Alloy: 0.005 inch thick.

C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.

D. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.
1. Welded Pin Holding Capacity: 100 lb for direct pull perpendicular to the attached surface.

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E. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct, pipe, plenum and breeching with adhesive. Pin length sufficient for insulation thickness indicated.
   1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, pipes, plenums, and breechings; and to achieve a holding capacity of 100 lb. for direct pull perpendicular to the adhered surface.

F. Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct, pipe, and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

2.06 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

2.07 REMOVABLE INSULATION COVERS

A. Pre-manufactured easily removable insulation cover/blanket intended for insulation of equipment and devices requiring periodic maintenance.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

C. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.03 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of piping, and fittings.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thickness required for each system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply multiple layers of insulation with seams staggered.

E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

F. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

G. Keep insulation materials dry at all times. Insulation that becomes wet or is otherwise damaged beyond repair shall be removed immediately and replaced. Replacement material and installation shall be in accordance with these specifications.

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H. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

I. Apply insulation with the minimum number of joints practical.

J. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

K. Refer to special instructions for applying insulation over fittings, valves, and specialties.

L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
   1. Apply insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches (300 mm) from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
   3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

M. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

N. Apply insulation with integral jackets as follows:
   1. Pull jacket tight and smooth.
   2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
   3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to pipe joints and fittings.

O. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.

P. Install vapor-retarder mastic on pipes and equipment.
   1. Pipes and equipment with vapor retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.
   2. Pipes and equipment without vapor retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.

Q. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
   1. Seal penetrations with vapor-retarder mastic.
   2. Apply insulation for exterior applications tightly joined to interior insulation ends.
   3. Seal insulation to roof flashing with vapor-retarder mastic.

R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.

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S. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.

T. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.
   1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

U. Provide plumbing insulation per specifications.

V. Provide continuously insulated piping systems.

W. Provide PVC color jacketing in mechanical rooms where insulation is installed.

X. Paint exposed piping in mechanical rooms when not insulated.

Y. Provide structural insulation inserts (Calcium Silicate, 100 PSI minimum).

3.04 MINERAL-FIBER INSULATION APPLICATION

A. Blanket Applications for Pipes: Secure blanket insulation with adhesive, and anchor pins with speed washers.
   1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of pipe surfaces.
   2. Apply adhesive to entire circumference of pipes and to all surfaces of fittings and transitions.
   3. Install anchor pins and speed washers on sides, top, and bottom of horizontal pipes.
   4. Impale insulation over anchors and attach speed washers.
   5. Cut excess portion of pins extending beyond speed washers. Cover exposed pins and washers with tape matching insulation facing.
   6. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1-inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
   7. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches o.c.
   8. Apply insulation on pipe fittings and transitions with a full insulation segment for each surface. Apply insulation on pipe elbows with individually mitered gores cut to fit the elbow.
   9. Insulate pipe hangers and flanges that protrude beyond the insulation surface with 6-inch-wide strips of the same material as insulation. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
   10. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

B. Board Applications for Equipment: Secure board insulation with adhesive and anchor pins and speed washers.
   1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct, plenum, & equipment surfaces.
   2. Apply adhesive to all surfaces of fittings and equipment.
   3. Cut excess portion of pins extending beyond speed washers. Cover exposed pins and washers with tape matching insulation facing.
   4. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent

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insulation segment with 1/2-inch staples, 1-inch o.c., and cover with pressure-sensitive tape having same facing as insulation.

5. Insulate equipment stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6” wide strips of the insulating material. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
6. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.05 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to ducts, plenums, and equipment as follows:
   1. Follow the manufacturer's written instructions for applying insulation.
   2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the duct, plenum, and equipment surface.

3.06 CLOSED-CELL PHENOLIC-FOAM INSULATION APPLICATION

A. Apply insulation as follows:
   1. Secure each layer of insulation with stainless-steel bands at 12-inch intervals and tighten without deforming the insulation materials.

B. Apply two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch, soft-annealed, stainless steel wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
   1. On exposed applications, finish insulation with a skim coat of mineral-fiber, hydraulic-setting cement to surface of installed insulation. When dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin the finish coat to achieve smooth finish.

3.07 FIELD-APPLIED JACKET APPLICATION

A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.
   1. Apply jacket smooth and tight to surface with 2-inch overlap at seams and joints.
   2. Embed glass cloth between two 0.062-inch- thick coats of jacket manufacturer's recommended adhesive.
   3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

3.08 FINISHES

A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket as indicated.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color shall be as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.09 APPLICATIONS

A. Insulation materials and thickness are specified at the end of this Section.

B. Insulate all pipe and equipment:
   1. Insulate pipe in accordance with the application schedule(s) below.

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2. Exceptions: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
   a. Vibration-control devices.
   b. Testing agency labels and stamps.
   c. Nameplates and data plates.
   d. Manholes.
   e. Handholes.
   f. Cleanouts.
   g. Plastic Condensate Drain piping.
   h. Factory-insulated equipment.
   i. Flexible connectors.

3.10 INDOOR APPLICATION SCHEDULE (ABOVE GRADE):

A. Service: Domestic cold-water, hot-water, tepid-water, and circulated water.
   1. Insulation Material: Mineral fiber preformed pipe insulation with factory-applied ASJ or FSK jacket or flexible elastomeric pipe insulation.
   2. Insulation Thickness: Apply the following insulation thicknesses:
      a. 40ºF – 60ºF Systems
         1) Less than 1" in diameter: ½"
         2) 1" through 1¼" in diameter: ½"
         3) 1½" through 3" in diameter: 1"
         4) 3" through 6" in diameter: 1"
         5) 8" in diameter: 1"
         6) Less than 1" in diameter: 1"
         7) 1" through 1¼" in diameter: 1"
         8) 1½" through 3" in diameter: 1½"
         9) 3" through 6" in diameter: 1½"
         10) 8" in diameter: 1½"
      b. 141ºF – 200ºF Systems
         1) Less than 1" in diameter: 1½"
         2) 1" through 1¼" in diameter: 1½"
         3) 1½" through 3" in diameter: 2"
         4) 3" through 6" in diameter: 2"
         5) 8" in diameter: 2"
   3. Vapor Retarder Required: Yes, for domestic cold-water systems; No, for domestic hot-water systems.
   4. Finish: Exposed = Painted; Concealed = None.

B. Service: Rainwater conductors (Including secondary roof drain conductors). Insulate first thirty linear feet of piping including vertical piping from drain body and first horizontal piping run. If a second vertical run occurs before thirty linear feet is reached, terminate insulation at end of first horizontal run.
   1. Insulation Material: Mineral fiber preformed pipe insulation or Mineral-Fiber Blanket with Factory Applied FSK Jacket.
   2. Insulation Thickness: 1"
   3. Vapor Retarder Required: Yes.

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4. Finish: Exposed = Painted; Concealed = None.

C. Service: Roof drain and overflow drain bodies.
1. Insulation Material: Semi-Rigid Mineral-Fiber Board Thermal Insulation
2. Insulation Thickness: 1½”
3. Vapor Retarder Required: Yes.
4. Finish: Exposed = Painted; Concealed = None.

D. Service: Exposed piping:
1. Mineral fiber preformed pipe insulation with Factory Applied FSK Jacket.
2. Insulation Thickness: 1”
3. Vapor Retarder Required: Yes.
4. Finish: Exposed = Painted; Concealed = None.

E. Service: Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Drainage from any Equipment. Measurement shall be pipe length.
1. Insulation Material: Mineral fiber preformed pipe insulation with Factory Applied FSK Jacket.
2. Insulation Thickness: 1”
3. Vapor Retarder Required: Yes.
4. Finish: Exposed = Painted; Concealed = None.

F. Service: Condensate Drains, and Traps.
1. Insulation Material: Mineral fiber preformed pipe insulation with Factory Applied FSK Jacket.
2. Insulation Thickness: 1”
3. Vapor Retarder Required: Yes.
4. Finish: Exposed = Painted; Concealed = None.

G. Service: Equipment Non-Condensate Drains, & Traps.
1. Insulation Material: Mineral fiber preformed pipe insulation with Factory Applied FSK Jacket.
2. Insulation Thickness: 1”
3. Vapor Retarder Required: Yes.
4. Finish: Exposed = Painted; Concealed = None.

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3.11 INDOOR APPLICATION SCHEDULE (BELOW GRADE):

A. None required.

END OF SECTION 220700

SECTION 221113
FACILITY NATURAL-GAS PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.02 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.03 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:
   1. Piping and Valves: 100 psig minimum unless otherwise indicated.
   2. Service Regulators: 65 psig minimum unless otherwise indicated.
   3. Service Meter: 65 psig minimum unless otherwise indicated.

B. Gas System Pressures: Primary pressure from the utility is more than 2.0 psig and is reduced to a secondary pressure of 2.0 psig by a pressure reducing valve installed immediately downstream of the meter and is reduced again by pressure reducing valves located at each piece of equipment.

1.04 SUBMITTALS

A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings. Pressure regulators, indicate pressure ratings and capacities.

B. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.

C. Operation and Maintenance Data: For motorized gas valves, pressure regulators, and to include in operation and maintenance manuals.

1.05 QUALITY ASSURANCE ***REFER TO CURRENT MCPS MECH-PLUMB DESIGN CHECKLIST***

A. **Comply with the requirements of the current MCPS Mechanical and Plumbing Design Checklist. Refer to the latest edition for applicable design, coordination, and documentation standards.**

B. Electrical Components and Devices: If indicated, provide electrical components and devices that are listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Applicable Codes: Perform work in accordance with applicable codes and standards. Comply with the Statewide Building Code and the International Fuel Gas Code.

D. Fuel Gas Piping: Listed and labeled as required by the International Fuel Gas Code.

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E. UL Standard: Provide components listed in UL's "Gas and Oil Equipment Directory" where UL listing is indicated.

F. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

G. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

1.07 PROJECT CONDITIONS

A. Perform site survey: Contract with utility-locating service for area where Project is located and locate utilities.

B. Design values of fuel gas supplied for these systems are as follows:
   1. Nominal Heating Value: 1000 Btu/cu.ft.
   2. Nominal Specific Gravity: 0.6.

C. Interruption of Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:
   1. Notify Owner and Architect no fewer than two days in advance of proposed interruption of natural-gas service.
   2. Do not proceed with interruption of natural-gas service without Owner and Architect's written permission.

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1.08 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces.

C. Coordinate with equipment and regulator manufacturer’s recommendations and local utility service provider for final regulator and accessory selections.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.02 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
   1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.

2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   a. Material Group: 1.1.
   b. End Connections: Threaded or butt welding to match pipe.
   c. Lapped Face: Not permitted underground.
   d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
   e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
   a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
6. Metallic Press-Connect Fittings: ASTM F 3226
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Viega, LLC. (MegaPress)
   b. NPS 2 (DN 50) and Smaller: Carbon steel press fittings conforming to ASTM F 3226 with factory-installed sealing elements (HNBR) suitable for the intended service.
   c. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Carbon steel press fittings conforming to ASTM F 3226 with factory-installed sealing elements (HNBR) suitable for the intended service.

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2.03 PROTECTIVE COATING

A. Furnish pipe and fittings with factory-applied, corrosion-resistant polyethylene coating for use in corrosive atmosphere.

2.04 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.05 VALVES

A. Refer to section “General Duty Valves for Plumbing Piping”.

B. Valves, 2” and Smaller: Ball valves with threaded ends according to ASME B1.20.1 for pipe threads.

C. Valves, 2-1/2” and Larger: Butterfly valves for use with flanged ends according to ASME B16.5 for steel flanges.

2.06 PIPING SPECIALTIES

A. Appliance Flexible Connectors:
   1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
   2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.

3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72”

B. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for 2” and smaller; flanged ends for 2 ½” and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

C. Basket Strainers:
1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for 2” and smaller; flanged ends for 2 ½” and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.07 GAS SOLENOID VALVES (SCIENCE LAB EMERGENCY SHUT OFF):

A. Available Manufacturers:
1. ASCO General Controls.
2. Automatic Switch Co.

B. ASCO Model EF8215 ¾” or approved alternative. NEMA 7 explosion proof, UL and FM approved for use with propane and natural gas. Valve shall be normally closed and shall operate on 24 volts DC.

2.08 SPECIALTY VALVES

A. Available Manufacturers:
1. ASCO General Controls.
2. Automatic Switch Co.
3. Eaton Corp.; Controls Div.
4. Honeywell, Inc.
5. Johnson Controls, Inc.

B. Automatic Gas Valves: ANSI Z21.21, with electrical or mechanical operator for actuation by appliance automatic shutoff device.

2.09 PRESSURE REGULATORS

A. Available Manufacturers:
1. Line Pressure Regulators:
a. American Meter Co.

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b. Donkin: Bryan Donkin RMG Canada, Ltd.
c. Eclipse Combustion, Inc.
d. Equimeter, Inc.
e. Fisher Controls International, Inc.
f. Maxitrol Co.
g. National Meter.
h. Richards Industries, Inc.; Jordan Valve Div.
i. Schlumberger Industries; Gas Div.

B. Description: Single stage and suitable for fuel gas service. Include steel jacket and corrosion-resistant components, elevation compensator, and atmospheric vent.
1. 2" and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
2. 2 ½" and Larger: Flanged ends according to ASME B16.5 for steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
3. Line Pressure Regulators: ANSI Z21.80 with 5-psig- minimum inlet pressure rating.
4. Appliance Pressure Regulators: ANSI Z21.18 with 2-psig minimum inlet pressure. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction. If vents are required provided piping necessary to extend to termination location outside the building as approved by the architect.

C. Pressure Regulator Vents: Factory- or field-installed, corrosion-resistant screen in opening if not connected to vent piping. Extend to exterior of building and terminate in location approved by the architect.

D. Appliance Pressure Regulators: Comply with ANSI Z21.18.
1. Available Manufacturers:
a. Canadian Meter Company Inc.
b. Eaton Corporation; Controls Div.
c. Harper Wyman Co.
d. Maxitrol Company.
e. SCP, Inc.
2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 2 psig.

2.10 CONCRETE BASES

A. Description: Reinforced concrete base formed of 3000-psi- minimum, 28-day compressive strength concrete, and measuring 6 inches thick and 6 inches larger in each dimension than equipment, unless otherwise indicated.

2.11 DIELECTRIC FITTINGS

A. Dielectric Unions:

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1. Available Manufacturers:
   a. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Hart Industries International, Inc.
   d. McDonald, A. Y. Mfg. Co.
   e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
   f. Wilkins; Zurn Plumbing Products Group.
   g. Conbraco Industries-Apollo
2. Minimum Operating-Pressure Rating: 150 psig.
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

B. Dielectric Flanges:
1. Available Manufacturers:
   a. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
   d. Wilkins; Zurn Plumbing Products Group.
2. Minimum Operating-Pressure Rating: 150 psig.
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

C. Dielectric-Flange Kits:
1. Available Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.
2. Minimum Operating-Pressure Rating: 150 psig.
3. Companion-flange assembly for field assembly.
4. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.
5. Insulating materials suitable for natural gas.
6. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.12 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Inspect natural-gas piping according to the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

B. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

3.03 SERVICE ENTRANCE PIPING

A. Extend fuel gas piping and connect to fuel gas distribution piping downstream of meter.
   1. Service meter will be provided by Local Gas Utility.

B. Install yellow brass fitting downstream from and adjacent to each service meter unless meter is supported from service-meter bar with integral yellow brass fitting. Install shutoff valve downstream from and adjacent to yellow brass fitting. Refer to Division 22 Section "Common Work Results for Plumbing" for yellow brass fittings.

3.04 CONCRETE BASE INSTALLATION

A. Locate bases at building service meters and building service regulators.

B. Excavate earth and make level beds to support bases. Form and pour concrete bases level with top surface projecting approximately 3 inches above grade.

3.05 OUTDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Section "Earth Moving" for excavating, trenching, and backfilling.
   1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Steel Piping Protective Coating:
   1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
   2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.

E. Copper Tubing Protective Coating:
   1. Apply joint cover kits over tubing to cover, seal, and protect joints.
   2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.

F. Install fittings for changes in direction and branch connections.

G. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Section "Meters and Gages for Plumbing Piping."

3.06 INDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

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B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to are accepted by architect.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms.

E. Install piping indicated to be exposed and piping in equipment rooms at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
2. In Floors: Install pre-sleeved corrugated, stainless-steel tubing systems for natural-gas. Cover with minimum of 1-1/2 inches of concrete. Jacket may not be in physical contact with metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives.
3. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
    a. Exception: Tubing passing through partitions or walls does not require striker barriers.
4. Prohibited Locations:

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a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
b. Do not install natural-gas piping in solid walls or partitions.

Q. Connect branch piping from top or side of horizontal piping.

R. Install unions in pipes 2” and smaller, adjacent to each valve, at final connection to each piece of equipment and where otherwise indicated. Unions are not required at flanged connections.

S. Do not use natural-gas piping as grounding electrode.

T. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

U. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Section "Meters and Gages for Plumbing Piping."

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section "Sleeves and Sleeve Seals for HVAC Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

Y. Install containment casings for gas piping below slabs extending minimum of 2 inches beyond point where pipe emerges from the floor. Tightly seal ends around gas piping using mechanical sleeve seals.

3.07 SERVICE-METER ASSEMBLY INSTALLATION

A. Provide concrete base for service meter.

B. Install locking shutoff valves downstream from service regulator. Shutoff valves are not required at second regulator if two regulators are installed in series.

C. Install strainer on inlet of service-pressure regulator.

D. Install service pressure regulator mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.

E. Install metal shutoff valves upstream from service meters. Install yellow brass fittings downstream from service meters.

3.08 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.09 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

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C. Threaded Joints:
   1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
   2. Cut threads full and clean using sharp dies.
   3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
   4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
   5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:
   1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
   2. Bevel plain ends of steel pipe.
   3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

3.10 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
   1. 1” and Smaller: Maximum span, 96”; minimum rod size, 3/8”.
   2. 1¼”: Maximum span, 108”; minimum rod size, 3/8”.
   3. 1½” and 2”: Maximum span, 108”; minimum rod size, 3/8”.
   4. 2½” to 3 ½”: Maximum span, 10’-0”; minimum rod size, ½”.
   5. 4” and Larger: Maximum span, 10’-0”; minimum rod size, 5/8”.

C. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
   1. 3/8”: Maximum span, 48”; minimum rod size, 3/8”.
   2. ½”: Maximum span, 72”; minimum rod size, 3/8 “.
   3. ¾” and Larger: Maximum span, 96”; minimum rod size, 3/8”.

3.11 CONNECTIONS

A. Connect to utility's gas meter according to utility's procedures and requirements.

B. Install piping adjacent to appliances to allow service and maintenance of appliances.

C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72” of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

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3.12 PIPING APPLICATIONS

A. Flanges, unions, transition, and special fittings with pressure ratings same as or higher than system pressure rating may be used in applications below, unless otherwise indicated.

B. Fitting Options:
   1. Metallic Press-Connect Fittings (MegaPress): Mechanically jointed fittings with HNBR sealing element suitable for intended service.

C. Above Ground Exposed Fuel Gas Piping:
   1. Sizes up to 2”:
      a. Steel pipe, malleable-iron threaded fittings, and threaded joints.
   2. 2-1/2” to 4”:
      a. Steel pipe, malleable-iron threaded fittings, and threaded joints, or steel pipe, steel welding fittings, and welded joints.
   3. Larger than 4":
      a. Steel pipe, steel welding fittings, and welded joints.

D. Above Ground Concealed Fuel Gas Piping:
   1. Sizes up to 2”:
      a. Steel pipe, malleable-iron threaded fittings, and threaded joints.
   2. 2½” to 4”:
      a. Steel pipe, malleable-iron threaded fittings, and threaded joints, or steel pipe, steel welding fittings, and welded joints.
   3. Larger Than NPS 4:
      a. Steel pipe, steel welding fittings, and welded joints.

3.13 LABELING AND IDENTIFYING

A. Comply with requirements in Section "Identification for Plumbing Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12” minimum below finished grade.
   1. Exception: 6 minimum below sub-grade under pavements and slabs.

3.14 PAINTING

A. Use materials and procedures in Division 9 Section "Painting," "Exterior Paint Schedule" Article, "Ferrous Metal" Paragraph, "Full-Gloss, Alkyd-Enamel Finish" Subparagraph.

B. Paint exterior service meters, pressure regulators, specialty valves, piping, and accessories.
   1. Color: Yellow

C. Paint interior exposed service meters, pressure regulators, specialty valves, piping, and accessories.
   1. Color: Yellow

3.15 FIELD QUALITY CONTROL

A. Inspect, test, and purge piping according to ANSI Z223.1, Part 4 "Inspection, Testing, and Purging," and requirements of authorities having jurisdiction and owner's representative.

B. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.

C. Report test results promptly and in writing to Architect, authorities having jurisdiction, and owner's representative.

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D. Verify capacities and pressure ratings of service meters, pressure regulators, valves, and specialties.

E. Verify correct pressure settings for pressure regulators.

F. Verify that specified piping tests are complete.

3.16 ADJUSTING

A. Adjust controls and safety devices. Replace damaged and malfunctioning controls and safety devices.

END OF SECTION 221113

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SECTION 221116
DOMESTIC WATER PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing domestic water piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
   1. Domestic Water Service Piping: 160 psig.
   2. Domestic Water Distribution Piping: 125 psig.

1.03 SUBMITTALS

A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

B. Water Samples: Specified in “Cleaning” Article.

C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
   1. Fire-suppression-water piping.
   2. Domestic water piping.
   3. Compressed air piping.
   4. HVAC hydronic piping.

D. Field quality-control reports.

1.04 QUALITY ASSURANCE ***REFER TO CURRENT MCPS MECH-PLUMB DESIGN CHECKLIST***

A. **Comply with the requirements of the current MCPS Mechanical and Plumbing Design Checklist. Refer to the latest edition for applicable design, coordination, and documentation standards.**

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. NSF/ANSI Compliance:
   1. NSF/ANSI 14, “Plastic Piping System Components and Related Materials”
   2. NSF/ANSI 61, "Drinking Water System Components – Health Effects”
   3. NSF/ANSI 372, “Drinking Water System Components – Lead Content”

D. ASTM Compliance:
   1. ASTM F 3226, “Standard Specification for Metallic Press-Connect Fittings for Piping and Tubing Systems

1.05 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

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1. Notify Architect, Construction Manager, and Owner no fewer than two days in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without Architect's, Construction Manager's, and Owner's written permission.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.02 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.
   1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
   2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
   3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
   4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
   5. Metallic Press-Connect Fittings ASTM F 3226, NSF 61, and NSF 372:
      a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
         1) Conex Banninger
         2) Elkhart Products Corporation; Industrial Division.
         3) Mueller Industries
         4) NIBCO INC.
         5) Viega, LLC.
      b. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM sealing element in each end.
      c. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Cast-bronze or wrought-copper fitting with EPDM sealing element in each end.
   6. Copper-Tube Extruded-Tee Connections:
      a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
         1) T-DRILL Industries Inc.
      b. Description: Tee formed in copper tube according to ASTM F 2014.

B. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) water tube, annealed temper.
   1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
   2. Metallic Press-Connect Fittings ASTM F 3226, NSF 61, and NSF 372:
      a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
         1) Conex Banninger
         2) Elkhart Products Corporation; Industrial Division.
         3) Mueller Industries

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4) NIBCO INC.
5) Viega, LLC.

b. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM sealing element in each end.
c. NPS 3 and NPS 4 (DN 80 and DN 100): Cast-bronze or wrought-copper fitting with EPDM sealing element in each end.

2.03 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

PART 3 EXECUTION

3.01 EXCAVATION

A. Refer to other sections for excavating, trenching, and backfilling.

3.02 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
B. Flanges may be used on aboveground piping, unless otherwise indicated.
C. Fitting Options:
1. Mechanically formed tee-branch outlets (T-Drill) and brazed joints may be used on aboveground copper tubing.
2. Metallic Press-Connect Fittings (ProPress): Mechanically joined fittings with elastomeric sealing element.
D. Underground Domestic Water Service Piping: Match civil materials to first flange.
E. Aboveground Domestic Water Piping: Use the following piping materials for each size range:
1. 2” and Smaller:
a. Hard copper tube, Type L copper pressure fittings; and soldered joints.
2. 2-1/2” and above”:
a. Hard copper tube, Type L copper pressure fittings; and brazed joints.
F. Underground Domestic Water Piping: Use the following piping materials for each size range:
1. 2” and Smaller:
a. Soft copper tube, Type K copper pressure fittings; and brazed joints with no joints permitted below concrete slabs.
2. 2-1/2” and above:
a. Soft copper tube, Type K copper pressure fittings; and brazed joints.

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3.03 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Shutoff Duty: Use bronze ball valves for all sizes.
   2. Throttling Duty: Use bronze ball or balancing valves for all sizes.
   3. Hot-Water-Piping, Balancing Duty: Use thermostatic, manually adjustable, flow control, balancing valves.
   4. Drain Duty: Hose-end drain valves.

3.04 PIPING INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend domestic water service piping to exterior water distribution piping in sizes and locations indicated.

C. Install underground ductile-iron piping according to AWWA C600, and AWWA M41. Install buried piping inside building between wall and floor penetrations and connection to water service piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
   1. Encase piping with polyethylene film according to ASTM A 674 or AWWA C105.

D. Install underground copper according to CDA's "Copper Tube Handbook."

E. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight.

F. Install water-pressure regulators downstream from shutoff valves.

G. Install aboveground domestic water piping level and plumb.

H. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.

I. Perform the following steps before operation:
   1. Close drain valves, hydrants, and hose bibbs.
   2. Open shutoff valves to fully open position.
   3. Open throttling valves to proper setting.
   4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
   5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
   6. Remove filter cartridges from housings and verify that cartridges are as specified for application, where used and that cartridges are clean and ready for use.

J. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.

K. Check plumbing specialties and verify proper settings, adjustments, and operation.
   1. Water-Pressure Regulators: Set outlet pressure at 80 psig maximum, unless otherwise indicated.

L. Energize pumps and verify proper operation.

3.05 JOINT CONSTRUCTION

A. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

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B. Mechanically Formed Outlets: Form tee in copper tube according to equipment manufacturer's written instructions. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

C. Metallic Press-Connect fittings shall be installed in accordance with manufacturer's installation instructions, installer shall have attended a manufacturer's installation training, and have current training credentials.

3.06 VALVE INSTALLATION

A. Install sectional valve close to water main on each branch and riser serving plumbing fixtures or equipment. Use ball valves for piping NPS 2 and smaller. Use butterfly valves for piping NPS 2-1/2 and larger.

B. Install shutoff valve on each water supply to equipment and on each water supply to plumbing fixtures without supply stops. Use ball valves for piping NPS 2 and smaller. Use butterfly valves for piping NPS 2-1/2 and larger.

C. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger.

3.07 HANGER AND SUPPORT INSTALLATION

A. Refer to Section 220529 "Hangers and Supports for Plumbing Piping" for pipe hanger and support devices.
   1. Install the following:
      a. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs: According to the following:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet, if indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
   2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
   3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   4. NPS 2-1/2: 108 inches with 1/2-inch rod.
   5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
   6. NPS 6: 10 feet with 5/8-inch rod.
   7. NPS 8: 10 feet with 3/4-inch rod.

E. Where hangers for piping are to be suspended from open-web steel joists, install hangers at maximum spacing that will result in hanger loads that comply with the requirements on the structural drawings.

F. Install supports for vertical copper tubing every 10 feet.

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G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

H. Where bends in the pipe occur, place hangers 1/3 of the maximum allowed spacing distance of the bend (i.e. is the maximum span is 12 feet, the hanger shall be 4 feet from the bend. Pipe shall be supported from both sides of the bend.

3.08 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water service piping. Use transition fitting to join dissimilar piping materials.

3.09 FIELD QUALITY CONTROL

A. Verify and inspect systems according to requirements by the Authority Having Jurisdiction and owner's representative. In the absence of specific test and inspection procedures proceed as indicated below.

B. Test Results: Document and certify successful results, otherwise repair, document, and retest.

C. Inspect domestic water piping as follows:

1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction and owner's representative.
2. During installation, notify authorities having jurisdiction and owner's representative at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction and owner's representative:
   a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Reinspection: If authorities having jurisdiction or owner's representative find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction and owner's representative.

D. Test domestic water piping as follows:

1. Step test for Press-Connect fittings following manufacturer’s recommendations prior to system pressure testing shall be performed to identify any unpressed connections.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
3. Leave uncovered and unconcealed new, altered, extended, or replaced domestic water piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

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3.10 ADJUSTING

A. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
   1. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow of hot water in each branch, starting at the most remote branch and working back to circulation pump. Verify and document settings and conditions at each branch and circulation pump during each round of system balancing.
   2. Repeat above balancing sequence until all balancing valve branches are maintaining desired setpoints. Verify and document final settings and conditions. Prepare and submit balancing report for each circulation system to engineer of record and owner.

3.11 CLEANING

A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

B. Clean and disinfect potable domestic water piping as follows:
   1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
   2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction and owner's representative or, if methods are not prescribed, procedures described in AWWA C651, AWWA C652 or as described below:
      a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
      b. Fill and isolate system according to either of the following:
         1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
         2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
      c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
      d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities to engineer or record, owner, and authorities having jurisdiction.

END OF SECTION 221116

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SECTION 221119
DOMESTIC WATER PIPING SPECIALTIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

1.02 PROVISIONS OF THE CONTRACT AND OF THE CONTRACT DOCUMENTS APPLY TO THIS SECTION.

1.03 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.04 SUBMITTALS

A. Product Data: Provide manufacturer's literature and data sheets for each product. Include information on materials of fabrication, assembly of components, dimensions, ratings, finishes, rough-in requirements, and installed accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE ***REFER TO CURRENT MCPS MECH-PLUMB DESIGN CHECKLIST***

A. **Comply with the requirements of the current MCPS Mechanical and Plumbing Design Checklist. Refer to the latest edition for applicable design, coordination, and documentation standards.**

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. NSF Compliance:
   1. Comply with NSF 14, “Plastic Piping System Components and Related Materials”
   2. Comply with NSF 61, “Drinking Water System Components – Health Effects”
   3. Comply with NSF 372, “Drinking Water System Components – Lead Content”

D. Water Management Installation:
   1. Installer Qualifications: An installer who is authorized by the equipment manufacturer for both installation and maintenance of submitted equipment.
   2. Provide documentation demonstrating previous experience and successfully completing projects of similar size and scope.
   3. Provide a list of installations that the Installer has specifically installed for verification by the Owner. Similar installations from other vendors and/or Installers shall be accepted. The Installer’s employees must meet these qualifications.
   4. The Installer shall demonstrate to the satisfaction of the Architect/Engineer that he has:
      a. Adequate plant and equipment to pursue the work properly and expeditiously.
      b. Adequate staff and technical experience to implement the work.
      c. Suitable financial status to meet the obligations of the work.

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d. Technical capable and factory trained service personnel at a local service facility to provide routine and emergency service for all products used in this project.

5. A contractor intending to bid on this work, not meeting the requirements of this section, may employ the services of an “Installer” meeting the requirements of this section. A “subcontractor” so employed must be acceptable to the Architect. The “Installer” shall be identified by submittal for acceptance by the Architect.

PART 2 PRODUCTS

2.01 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type (Anti-siphon) Vacuum Breakers:
   1. Available Manufacturers:
      a. Ames Co.
      b. Apollo Valves - Conbraco Industries, Inc.
      c. Watts Industries, Inc.; Water Products Div.
      d. Zurn Plumbing Products Group; Wilkins Div.
   2. Standard: ASSE 1001.
   3. Sizes: ¾” thru 3” as required to match connected piping.
   4. Body: Brass or Bronze.
   5. Inlet and Outlet Connections: Threaded.
   6. Finish: Rough bronze or chrome plated.

B. Pressure Vacuum Breakers:
   1. Available Manufacturers:
      a. Ames Co.
      b. Apollo Valves - Conbraco Industries, Inc.
      c. Watts Industries, Inc.; Water Products Div.
      d. Zurn Plumbing Products Group; Wilkins Div.
   2. Standard: ASSE 1020.
   3. Operation: Continuous-pressure applications.
   4. Accessories:
      a. Valves: Ball type, on inlet and outlet.

C. Spill-Resistant Vacuum Breakers:
   1. Available Manufacturers:
      a. Apollo Valves - Conbraco Industries, Inc.
      b. Watts Industries, Inc.; Water Products Div.
   2. Standard: ASSE 1056.
   3. Operation: Continuous-pressure applications.
   4. Sizes: ¾” thru 1” as required to match connected piping.
   5. Accessories:
      a. Valves: Ball type, on inlet and outlet.

2.02 BACKFLOW PREVENTERS

A. Reduced-Pressure-Zone (RPZ) Backflow Preventers:
   1. Available Manufacturers:
      a. Ames Co.

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b. Apollo Valves - Apollo Valves - Conbraco Industries, Inc.
c. Watts Industries, Inc.; Water Products Div.
d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 10 psig maximum, through middle 1/3 of flow range.
5. Sizes: ¾" thru 10"
6. Body: Brass or bronze for 2" and smaller; cast iron or steel with interior lining complying with AWWA C550 or that is FDA approved for 2 ½" and larger.
7. Configuration: Comply with drawing requirements.
8. Accessories:
   a. Valves: Ball type with threaded ends on inlet and outlet of 2" and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of 2 ½" and larger.
   b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Double-Check Backflow Preventers:
1. Available Manufacturers:
   a. Ames Co.
   b. Apollo Valves - Apollo Valves - Conbraco Industries, Inc.
   c. Watts Industries, Inc.; Water Products Div.
   d. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1015
3. Application: continuous-pressure, unless otherwise indicated.
4. Pressure Loss: 8 psig maximum, through middle 1/3 of flow range.
5. Size: ¾" thru 10" as required to match connected piping.
6. Body: Brass or bronze for NPS 2 and smaller; cast iron or steel with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
7. Configuration: Comply with drawing requirements.
8. Accessories:
   a. Valves: Ball type with threaded ends on inlet and outlet of 2" and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of 2 ½" and larger.

C. Dual-Check-Valve Backflow Preventers:
1. Available Manufacturers:
   a. Apollo Valves - Apollo Valves - Conbraco Industries, Inc.
   b. Mueller Co.; Water Products Div.
   c. Watts Industries, Inc.; Water Products Div.
   d. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1024.
3. Operation: Continuous-pressure applications.
4. Sizes: ¾" thru 1" as required to match connected piping.
5. Body: Bronze with union inlet.

2.03 WATER PRESSURE-REDUCING VALVES

A. Available Manufacturers:
1. CLA-VAL Automatic Control Valves.

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2. Flomatic Corporation.
3. OCV Control Valves.
4. Watts Industries, Inc.; Ames Fluid Control Systems.
5. Watts Industries, Inc.; Watts ACV.
6. Zurn Plumbing Products Group; Wilkins Div.

B. Description: Pilot-operation, diaphragm-type, single-seated main water control valve.

C. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.

D. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
1. Sizes: 1¼" thru 10" as required to match connected piping.
2. Pattern: Angle or Globe-valve design.
3. Trim: Stainless steel.

2.04 BALANCING VALVES

A. Available Manufacturers:
1. Armstrong Pumps, Inc.
2. Caleffi
3. Flow Design, Inc.
4. Griswold Controls
5. ITT Bell & Gossett; ITT Fluid Technology Corp.
6. Jomar Valves
7. Nexus Valve
8. NIBCO
9. NuTech Hydronic Specialty Products
10. Taco, Inc.
11. Watts

B. Manual Balancing Valves:
1. Valve: Brass, ball or globe valve design, with metering ports, position indicator, and memory stop.
2. Maximum Working Pressure: 150 psi.
3. Working Temperature Range: 33 to 200 degrees F.

C. Calibrated Balancing Valves and Circuit Setters:
1. Valve: Brass, factory preset and calibrated, ball valve design, with metering ports, position indicator, and memory stop.
2. Maximum Working Pressure: 150 psi.
3. Working Temperature Range: 33 to 200 degrees F.

D. Automatic Balancing Valves:
1. Valve: Brass, pressure independent, with removable cartridge.Provide with metering ports.
2. Maximum Working Pressure: 200 psi.
3. Working Temperature Range: 33 to 200 degrees F.

E. Thermostatic Balancing Valves:

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1. Valve: Brass, with thermostatic element to maintain constant temperature in domestic hot water recirculating system; provide with tamper-resistant temperature adjustment knob.
2. Accessories:
   a. Check valve.
   b. External electrically actuated disinfection control valve.
   c. Internal disinfection-control cartridge.
   d. Manufacturer's insulation shell.
   e. Temperature gauge.
3. Maximum Working Pressure: 150 psi.
4. Working Temperature Range: 22 to 200 degrees F.

2.05 MIXING VALVES

A. Thermostatic Master Mixing Valves:
   1. Available Manufacturers:
      a. Lawler Manufacturing Company, Inc.
      b. Leonard Valve Company.
      c. Powers; a Watts Company.
      d. Watts Industries, Inc.
   2. Valve: Brass or bronze body; thermostatic element; corrosion- and lime-resistant internal components; integral locking temperature adjustment.
   3. Standard: ASSE 1017.
   4. Pressure Rating: 125 psig.
   5. Accessories:
      a. Strainer check stops on hot-water and cold-water supplies.
      b. Shut-off valve on lets and outlet.
      c. Thermometer on inlets and outlet.
      d. Pressure gauges on inlets and outlet.

B. Digitally Controlled Thermostatic Master Mixing Valves:
   1. Available Manufacturers:
      a. Armstrong Inc.
      b. Lawler Manufacturing Company, Inc.
      c. Leonard Valve Company.
      d. Watts Industries, Inc.
   2. Valve: Brass or bronze body; corrosion- and lime-resistant internal components; microprocessor-control unit for temperature control and monitoring.
   3. Standard: ASSE 1017.
   4. Pressure Rating: 125 psig.
   5. Microprocessor Controller:
      a. Manufacturer-provided, packaged application-specific controller with keypad or touch-screen operator interface.
      b. Integral display of temperature, pressure, and flow.
      c. Field Programmable: Settings configurable locally at controller or remotely through building automation system.
      d. Programmable high-temperature sanitization mode.
      e. Programmable high- and low-temperature alarms.

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f. Failsafe: Upon loss of water pressure, valve ceases hot water flow.

C. Fixture Water Tempering Valves:
1. Available Manufacturers:
a. Apollo Valves - Conbraco Industries, Inc.
b. Lawler Manufacturing Company, Inc.
c. Leonard Valve Company.
d. Powers; a Watts Company.
e. Watts Industries, Inc.
f. Zurn Plumbing Products Group
2. Valve: Brass or bronze body; thermostatic element; corrosion- and lime-resistant internal components; integral locking temperature adjustment with high-temperature limit stop; integral check valves with strainer screens on inlets.
3. Standard: ASSE 1070.
4. Pressure Rating: 125 psig.
5. Accessories:
a. Mounting bracket.

2.06 STRAINERS

A. Y-Pattern
1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron or steel with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
a. Strainers NPS 2 and Smaller: 0.033 inch.
b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.
c. Strainers NPS 5 and Larger: 0.10 inch.
6. Drain: Factory-installed, hose-end drain valve.

2.07 WATER HAMMER ARRESTORS

A. Available Manufacturers:
1. AMTROL, Inc.
2. Josam Company.
3. MIFAB, Inc.
4. PPP Inc.
5. Sioux Chief Manufacturing Company, Inc.
6. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
7. Tyler Pipe; Wade Div.
8. Watts Drainage Products Inc.
9. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Standard: ASSE 1010 or PDI-WH 201.

C. Type: Metal bellows or copper tube with piston.

D. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

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2.08 TRAP GUARDS

A. ***Note:** **Trap guards may only be used in conjunction with piped trap primer systems and not as standalone trap primer devices.***

B. Available Manufacturers:
   1. ProSet Systems
   2. SureSeal Manufacturing

C. General: Smooth, soft, flexible, elastomeric PVC material molded into shape, open on top with curl closure at bottom. SureSeal: ABS plastic body with neoprene rubber diaphragm and sealing gasket with 80 durometer compression fit sealing gasket on gravity drain outlet connection.

D. Standard: ASSE 1072

E. Allows wastewater to open and adequately discharge floor drain through its interior.

F. Closes and returns to original molded shape after wastewater discharge is complete.

G. Size shall be as required to match drain in which it is installed.

2.09 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:
   1. Available Manufacturers:
      a. MIFAB, Inc.
      b. PPP Inc.
      c. Sioux Chief Manufacturing Company, Inc.
      d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      e. Watts Industries, Inc.; Water Products Div.
   2. Standard: ASSE 1018.
   3. Pressure Rating: 125 psig minimum.
   4. Body: Bronze.
   5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
   6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
   7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Valves:
   1. Available Manufacturers:
      a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
   3. Size: NPS 1-1/4 minimum.
   4. Material: Chrome-plated, cast brass.

2.10 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:
   1. Available Manufacturers:
      a. MIFAB, Inc.
      b. PPP Inc.
      c. Sioux Chief Manufacturing Company, Inc.
      d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

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e. Watts Industries, Inc.; Water Products Div.

2. Standard: ASSE 1044
3. Piping: ASTM B 88, Type L; copper, water tubing.
4. Cabinet: Unless otherwise indicated, recessed or surface-mounting steel box with stainless-steel cover.
5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
6. Vacuum Breaker: ASSE 1001.
7. Number of Outlets: Refer to drawings.
8. Size of Outlets: ½”

PART 3 EXECUTION

3.01 INSTALLATION

A. Refer to Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Prior to installation of domestic water piping specialties, flush domestic water piping of foreign material.

C. Install products in accordance with manufacturer's instructions.

D. Install products level and plumb.

E. Install products with clearance for access and maintenance.

F. Support products NPS 2-1/2" and larger independently of surrounding pipe.

G. Support products with flanged ends independently of surrounding pipe.

H. For products containing isolation or shutoff valves, locate valves in horizontal piping with stems at or above center of piping, maintaining unimpeded stem movement.

I. Install backflow preventers where indicated: If not indicated on each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air-breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

J. Install balancing valves with-in 12” of ceiling at access door or tile where they can be reached with-out obstruction.

K. Install thermostatic mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and pressure gauges.
2. Install cabinet-type units recessed in or surface mounted on wall as indicated.

L. Install strainers where indicated.

M. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Section "Rough Carpentry."

N. Install water hammer arresters in water piping according to PDI-WH 201.

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O. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1/8” per foot, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

P. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1/8” per foot, and connect to floor-drain body, trap, or inlet fitting.

Q. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1/8” per foot, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

R. Install trap guards in accordance with manufacturer’s instructions.

S. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.

T. Fasten recessed-type plumbing specialties to reinforcement built into walls.

U. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.

V. Install individual shutoff valve in each water supply to plumbing specialties. Use ball valve if specific valve is not indicated. Install shutoff valves in accessible locations. Refer to Section "Valves" for general-duty ball valves.

W. Install air vents at water piping high points. Include ball valve in inlet.

X. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

Y. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

Z. Specific trap primer assembly and primer pipe routing not always indicated on plans to provide contactor field flexibility in selecting option best suitable for field conditions, where alternative options may be acceptable. Contactor shall coordinate and provide any necessary items to facilitate proper installation and operation of the preferred and approved primer system; to include, but not limited to, electrical conduit and circuitry to the panelboard for electronic systems.

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3.02 LABELING AND IDENTIFYING

A. Indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section "Plumbing Identification"

3.03 FIELD QUALITY CONTROL

A. Inspect each product for damage and defects.

B. Repair or replace damaged products. Replace defective products.

C. For products containing isolation or shutoff valves, exercise isolation and shutoff valves from fully closed to fully open. Confirm smooth operation.

D. Backflow Preventers:
   1. Test in accordance with manufacturer's instructions.
   2. Test in accordance with requirements of authorities having jurisdiction.
   3. Test in accordance with ASSE listing of backflow preventer.
   4. Replace backflow preventers that fail testing.
   5. Provide final test report.

E. Vacuum Breakers:
   1. Test in accordance with manufacturer's instructions.
   2. Test in accordance with requirements of authorities having jurisdiction.
   3. Test in accordance with ASSE listing of vacuum breaker.
   4. Replace vacuum breakers that fail testing.
   5. Provide final test report.

F. Water Pressure Reducing Valves: Confirm outlet pressure remains steady without fluctuation.

G. Mixing Valves: Confirm outlet temperature remains steady without fluctuation.

H. Electronic Trap Primer Systems:
   1. Clean strainer.
   2. Test system following manufacturer's instructions.
   3. Visually confirm that water has reached each drain and that traps are full of water.
   4. Operate system until each trap is full.

3.04 ADJUSTING

A. Adjust pressure reducing valves to design pressure set point.

B. Adjust mixing valves to design temperature set point.

C. Adjust balancing valves to design flow.

D. Adjust thermostatic balancing valves to design temperature setpoint.

END OF SECTION 221119

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SECTION 221123
PACKAGED DOMESTIC WATER BOOSTER PUMPS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.02 ABBREVIATIONS

A. BAS: Building Automation System

B. ECM: Electronically Commutated Motor

C. VFD: Variable Frequency Drive

1.03 SUBMITTALS

A. Product Data: Include construction details, material descriptions, and dimensions of individual components. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Provide wiring diagrams for power, signal, and control wiring. Indicate interface with BAS.

C. Operation and Maintenance Data: For booster pumps to include in emergency, operation, and maintenance manuals.

1.04 QUALITY ASSURANCE ***REFER TO CURRENT MCPS MECH-PLUMB DESIGN CHECKLIST***

A. **Comply with the requirements of the current MCPS Mechanical and Plumbing Design Checklist. Refer to the latest edition for applicable design, coordination, and documentation standards.**

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ASME Compliance: Comply with ASME B31.9 for piping.

D. Certifications: Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc, as suitable for purpose specified and indicated.

E. Identification: Provide pumps with manufacturer's name, model number, and rated capacity identified by permanently attached label.

F. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

G. Booster pumps shall be listed and labeled as packaged pumping systems by testing agency acceptable to authorities having jurisdiction.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Retain or apply protective coatings and flange protective covers during storage.

B. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.06 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

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PART 2 PRODUCTS

2.01 MULTIPLEX, VARIABLE-SPEED, PACKAGED BOOSTER PUMP SYSTEMS

A. Manufacturers:
   1. Armstrong Pumps Inc.
   2. Bell & Gossett
   3. Canariis Corporation
   4. Goulds Pumps
   5. Grundfos Pumps Corporation U.S.A.
   6. Patterson Pump Company
   7. QuantumFlo
   8. SyncroFlo, Inc.
   9. Taco, Inc.
   10. TigerFlow Systems, Inc.

B. Description: Self-contained, factory-assembled, factory-tested, pump skid for domestic water with isolation valves, strainers, gauges, pipe and Class 300 fittings, system drain valve(s), component identification, signage, electrical raceway, equipment tags, instruments, and controls fitted on fabricated structural steel frame skid base; tested, adjusted, and shipped as integral unit.

C. Skid Capacity Load Distribution: Triplex; lead/lag/lag, each at 33 percent of total load.

D. Skid Vibration Isolation: See Section 220548.

E. Seal: Mechanical.

F. Pump Motor: Inverter duty, VFD-controlled. Select motors that will not overload through full-range of pump performance curve.

G. Pipe and Fittings Material: Stainless steel, Schedule 40.

H. Low-Pressure Control: Stop pump operation if incoming water pressure drops to atmospheric.

I. Isolation and Control Valves:
   1. Shutoff Valves NPS 2 and Smaller: Two-piece, full-port ball valve, in each pump's suction and discharge piping and in inlet and outlet headers.
   2. Shutoff Valves NPS 2-1/2 and Larger: Lug-type butterfly valve, in each pump's suction and discharge piping and in inlet and outlet headers.
   3. Check Valves: Silent type in each pump's discharge piping.
   4. Thermal-Relief Valve: Temperature-and-pressure relief in pump discharge header.

J. Accessories: Include automatic air vents, drain ports, and skid inlet-outlet pressure gauges.

K. Instrumentation and Controls:
   1. Provide skid-mount instruments and control devices where required with proper raceway, cables, and wires into control panel with panel-door interlocked main disconnect switch.
   2. Instrument, Device, and Control-Enclosure Rating: Matching installed environmental conditions.
   3. Controller Type: Panel-coordinated programmable logic controller (PLC) with fuse protected controls transformer and power supplies.
   4. Operating Interface per Pump:
      a. Components: HOA selector switch, suction, and discharge side pressure gauges, resettable run-time meter per pump.

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b. Indicators: Provide illuminated indicators of incandescent or LED-based pilot light type per pump; green for run status, yellow for safety, red for alarm, and black or blue for out-of-service.
c. Graphic Panel: Color touchscreen display, use graphics instead of listed components, and indicators except for pump override switches with respective indicators.

5. Minimum Control Components:
   a. Magnetic starter or variable frequency drive for motor control with overcurrent protection, overvoltage protection and current sensor per pump.
   b. Thermal Bleed Circuit with Solenoid Valve: Prevent overheating during low demand.
   c. Pump Alternating: Have pumps set for lead/lag operation. Alternate pumps based on run time or manually selected order. Use alternating relay for noncontroller system.
   d. Low- and High-Limit pressure cutout and temperature cut out switches.
   e. Pressure Control Signal: Include pressure-indicating transmitter for remote mounting.
   f. Time Delay Function or Relay: Prevent pumps short cycling on fluctuating demands.
6. BAS, BMS, SCADA, or Other Integrated Automation Link:
   a. On-Off status of each pump.
   b. Alarm status of entire skid.
   c. Operating setpoints.

2.02 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
   2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in NFPA 70.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for booster pumps to verify actual locations of piping connections before booster-pump installation.

3.02 INSTALLATION

A. Install products with related fittings, and accessories according to manufacturer instructions.

B. Potable and Drinking Water Service: Provide NSF 61 certified; comply with ICC (IPC).

C. Ensure that small pressure gauges are installed on both upstream and downstream ends.

D. ECM, VSD, or VFD Controlled Motors: Configure unit to operate within manufacturer-listed pump curve points unless factory set to do so. Then adjust to operate in automatic to maintain downstream pressure setpoint.

E. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

F. Coordinate BAS, BMS, or Integrated Automation linking between unit controller and remote software app or terminal.

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G. Equipment Mounting: Install booster pumps on concrete housekeeping pad using spring isolators.
   1. Minimum Deflection: 1 inch.
   2. Install dowel rods to connect housekeeping pad to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete housekeeping pad.
   3. Install epoxy-coated anchor bolts that extend through the housekeeping pad and anchor into structural concrete floor.

H. Support connected domestic-water piping so weight of piping is not supported by booster pumps.

3.03 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.
   1. Connect domestic-water piping to booster pump headers.
   2. Install shutoff valves on piping connections to booster-pump suction and discharge headers. Install ball, or butterfly, valves.

B. Install, flanged, or grooved-joint connections on suction and discharge headers.
   1. Install valved bypass, same size as water supply.
   2. Install flexible connectors, same size as header, on connections to booster-pump suction and discharge headers.
   3. Install piping adjacent to booster pumps to allow service and maintenance.

3.04 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.05 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:
   1. Perform visual inspection.
   2. Leak Test: After installation, charge booster pump and check for leaks. Repair leaks and recheck until no leaks exist.
   3. Operational Test: After electrical circuitry has been energized, start booster pumps to confirm proper motor rotation and booster pump operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   5. Prepare inspection reports.

C. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.

3.06 ADJUSTING

A. Adjust booster pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust pressure set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting booster pump to suit actual occupied

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conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.07 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain booster pumps.

END OF SECTION 221123

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SECTION 221125
DOMESTIC WATER CIRCULATING PUMPS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.02 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.03 ABBREVIATIONS

A. BAS: Building Automation System

B. ECM: Electronically Commutated Motor

C. VFD: Variable Frequency Drive

1.04 SUBMITTALS

A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.05 QUALITY ASSURANCE ***REFER TO CURRENT MCPS MECH-PLUMB DESIGN CHECKLIST***

A. **Comply with the requirements of the current MCPS Mechanical and Plumbing Design Checklist. Refer to the latest edition for applicable design, coordination, and documentation standards.**

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Retain or apply protective coatings and flange protective covers during storage.

B. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

C. Comply with pump manufacturer's written instructions for handling.

PART 2 PRODUCTS

2.01 CIRCULATING PUMPS

A. Manufacturers:
   1. Armstrong Pumps Inc.
   2. Bell & Gossett
   3. Grundfos Pumps Corp.
   4. Taco, Inc.

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B. Description: Factory-assembled and factory-tested, in-line, wet-rotor, system-lubricated, 100% lead-free, NSF/ANSI 61 certified, ECM or VFD controlled, circulator pump specifically designed for domestic hot water circulating systems. Pump shall incorporate integrated intelligent control capable of automatic performance adjustment to system demand, maintaining required flow and differential pressure while optimizing efficiency.

C. BMS or Other Integrated Automation Link: Provide auxiliary contacts for fault and run status.

D. Accessories: Include inlet-outlet temperature and pressure gauges with 2-way isolation valves.

2.02 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

2.03 CONTROLS

A. BAS: Electric, adjustable for control of water-supply pump.

1. Type: Start/Stop

B. Pump Operation:

1. Pump shall start and stop upon BAS command or domestic hot water system enable signal.
2. Pump shall be provided with integral ECM variable-speed control.
3. Pump shall automatically modulate speed in response to system differential pressure to maintain required circulation through domestic hot water return piping and thermostatic balancing valves.
4. Pump control shall automatically reduce flow and pump energy as system demand decreases and return branches satisfy temperature.
5. Pump shall not operate at constant speed during normal operation.
6. Control strategy shall provide automatic adjustment of pump operation to comply with applicable IECC and ASHRAE energy efficiency requirements for service hot water circulation systems.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

B. Verify installation and location of automatic flow control valve(s). Record actual location(s) on as-built drawings.

3.02 INSTALLATION

A. Install products with related fittings, and accessories according to manufacturer instructions.

B. Potable and Drinking Water Service: Provide NSF 61 certified; comply with ICC (IPC).

C. Hot Water Service: Ensure that small pressure-temperature gauges are installed on both upstream and downstream ends.

D. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

E. Coordinate BAS, BMS, or Integrated Automation linking between unit controller and remote software app or terminal.

3.03 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps.

D. Install suction and discharge piping.

E. Install indicated valves &devices.

F. Comply with Division 26 Sections for electrical connections.

G. Connect controls.

3.04 IDENTIFICATION

A. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.05 STARTUP SERVICE

A. Perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Check piping connections for tightness.
   3. Clean strainers on suction piping.
   4. Check operation of controls for automatic starting and stopping operation of pumps.
   5. Perform the following startup checks for each pump before starting:
      a. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
      b. Verify that pump is rotating in the correct direction.
   6. Prime pump.
   7. Close discharge valve.
   8. Start motor.
   9. Open discharge valve slowly.
   10. Adjust temperature settings on thermostatic mixing valves if included in design.
   11. Adjust balancing valves if required by thermostatic mixing valve manufacturer.
   12. Adjust system balancing valves and pump set points to meet system performance requirements.
   13. Check and record final pressure and flow conditions on inlet and outlet of pump.
   14. Submit report of all final setpoints and conditions to owner.

END OF SECTION 221125

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SECTION 221316
SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.02 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer.

B. LEED: Leadership in Energy and Environmental Design

C. NBR: Acrylonitrile-butadiene rubber.

D. PE: Polyethylene plastic.

E. PVC: Polyvinyl chloride plastic.

F. TPE: Thermoplastic elastomer.

G. USGBC: United States Green Building Council

1.03 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.04 SUBMITTALS

A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.05 QUALITY ASSURANCE ***REFER TO CURRENT MCPS MECH-PLUMB DESIGN CHECKLIST***

A. **Comply with the requirements of the current MCPS Mechanical and Plumbing Design Checklist. Refer to the latest edition for applicable design, coordination, and documentation standards.**

B. Perform work in accordance with applicable codes.

C. Piping materials shall bear label, stamp, or other markings of testing agency.

D. Cast iron soil pipe shall be clearly marked with the manufacturer’s name, county of origin, eight-digit date code, pipe diameter and length, relevant ASTM standard and registered trademark of third part certifier.

1. Third party certifier shall be IAPMO, ICC, NSF, UL, or other organization that is accredited as an ANSI – Guide 65 organization. Reference www.ansi.org.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

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PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Plenum-Installed Piping: Provide piping with flame spread index of 25 or less and smoke developed index of 50 or less when tested in accordance with ASTM E84 or UL 723.

B. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

C. Flexible Transition Couplings for Underground Non-Pressure Piping: ASTM C 1173 with elastomeric sleeve. Include ends of same sizes as piping to be joined and include corrosion-resistant metal band on each end.

2.02 CAST-IRON SOIL PIPING

A. Manufacturers:
   1. AB&I Foundry
   2. Charlotte Pipe & Foundry Co.
   3. Tyler Pipe & Coupling

B. Pipe and Fittings: ASTM A 888 or CISPI 301.

C. Hub-and-Spigot Gaskets: ASTM C 564, rubber.

D. Hub-less Couplings:
   1. General: CISPI 310 and ASTM C 1277 assembly of stainless-steel corrugated shield, stainless steel bands and fasteners, and ASTM C 564 rubber sleeve with integral, center pipe stop.
   2. Heavy-Duty, Type 304, Stainless-Steel Couplings: ASTM C 1540, Type 304, stainless-steel shield; stainless-steel bands; and ASTM C 564, rubber sleeve.
      a. NPS 1-1/2 to NPS 4: 3-inch- wide shield with 4 bands.
      b. NPS 5 to NPS 10: 4-inch- wide shield with 6 bands.
   3. Heavy-Duty, Cast-Iron Couplings: ASTM A 48/A 48M, 2-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.

2.03 COATED CAST-IRON SOIL PIPING

A. Manufacturers:
   1. AB&I Foundry
   2. Charlotte Pipe & Foundry Co.
   3. Tyler Pipe & Coupling

B. Pipe and Fittings: ASTM A 74, ASTM A 888, or CISPI 301.
   1. Pipe Coating: Chemically deposited zinc-phosphate pretreatment layer with second layer of electrically deposited, high-performance, cathodic epoxy coating and final coating of electrically deposited, high-performance, anodic epoxy coating.
   2. Fitting Coating: Chemically deposited zinc-phosphate pretreatment layer with second layer of electrically deposited, high-performance, cathodic epoxy coating and final coating of epoxy acrylic powder.

C. Hub-and-Spigot Gaskets: ASTM C 564, rubber.

D. Hub-less Couplings:
   1. General: CISPI 310 and ASTM C 1277 assembly of stainless-steel corrugated shield, stainless steel bands and fasteners, and ASTM C 564 rubber sleeve with integral, center pipe stop.

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2. Heavy-Duty, Type 304, Stainless-Steel Couplings: ASTM C 1540, Type 304, stainless-steel shield; stainless-steel bands; and ASTM C 564, rubber sleeve.
   a. NPS 1-1/2 to NPS 4: 3-inch- wide shield with 4 bands.
   b. NPS 5 to NPS 10: 4-inch- wide shield with 6 bands.
3. Heavy-Duty, Cast-Iron Couplings: ASTM A 48/A 48M, 2-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.

2.04 PVC PIPE AND FITTINGS

A. Manufacturers:
   1. Charlotte Pipe & Foundry Co.
   2. IPEX
   3. Westlake

B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
   1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

C. Solvent Cement and Adhesive Primer:
   1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.05 COPPER TUBE AND FITTINGS

A. Manufacturers:
   1. Mueller Streamline Co.
   2. Cerro Flow Products
   3. Weiland Copper Products

B. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

C. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

D. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

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PART 3 EXECUTION

3.01 PIPING APPLICATIONS

A. Transition fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.

B. Aboveground, Soil, Waste, and Vent Piping
   1. Inside Plenum:
      a. Hub-less cast-iron soil piping with heavy duty couplings.
   2. Outside Plenum:
      a. PVC pipe, PVC socket fittings, and solvent-cemented joints.

C. Underground, Soil, Waste, and Vent Piping:
   1. Kitchen Waste:
      a. Extra Heavy Hub and Spigot cast-iron soil piping.
      b. Coated Service Weight Hub and Spigot cast-iron soil pipe and fittings.

2. Other Than Kitchen Waste:
   a. PVC pipe and fittings.
   b. Service Weight Hub and Spigot cast iron soil pipe and fittings.

D. Food Service Equipment, Soil and Waste Piping
   1. Food Service Equipment Waste: Copper DWV pipe and fittings.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.

C. Prepare exposed, unfinished pipe, fittings, supports, and accessories for finish painting.

D. Refer to Section "Facility Sanitary Sewers" for Project-site sanitary sewer piping.

E. Refer to Section "Common Work Results for Plumbing" for basic installation.

F. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

G. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

H. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

I. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight.

J. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

L. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

M. Install soil and waste drainage and vent piping at the minimum slopes required by authorities having jurisdiction.

N. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

O. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

P. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

Q. Install all drainage pattern fittings and piping in accordance with all applicable federal, state, and local codes.

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

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S. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install sleeve seals for piping penetrations of concrete and masonry walls and slabs. Comply with requirements for sleeve seals specified in Section "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section "Escutcheons for Plumbing Piping"

W. All piping under slab shall be TV camera inspected with MCPS (Montgomery County Public Schools) representative present. Video record with mapping and verifying pipe integrity and slope maintained post-backfill shall be provided to MCPS.

3.03 JOINT CONSTRUCTION

A. Refer to section "Common Work Results for Plumbing" for basic piping joint construction.

B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

C. Join hub-less cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hub-less-coupling joints.

D. PVC Non-pressure Piping Joints: Join piping according to ASTM D 2665.

E. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

3.04 HANGER AND SUPPORT INSTALLATION

A. Refer to Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs: According to the following:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet, if indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Section " Hangers and Supports for Plumbing Piping and Equipment."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. 1 ½" and 2": 60" with 3/8"rod.
   2. 3": 60" with ½"rod.
   3. 4" and NPS 5: 60" with 5/8" rod.
   4. 6": 60" with ¾" rod.
   5. 8" to 12": 60" with 7/8" rod.

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6. 15”: 60” with 1” rod.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
   1. 1 ½” and 2”: 48” with 3/8” rod.
   2. 3”: 48” with ½” rod.
   3. 4” and 5”: 48” with 5/8” rod.
   4. 6”: 48” with ¾” rod.
   5. 8” to 12”: 48” with 7/8” rod.

H. Install supports for vertical PVC piping every 48”.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.05 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Provide new sanitary sewer services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

C. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

D. Connect drainage and vent piping.

3.06 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction and owner's representative at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction and owner's representative.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction and owner's representative to observe tests specified below and to ensure compliance with requirements.

B. Re-inspection: If authorities having jurisdiction or owner's representative find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.

C. Reports: Where required or indicated prepare inspection reports and have them signed by authorities having jurisdiction and owner's representative.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction and owner's representative or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before

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inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.07 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.08 PROTECTION

A. Protect drains, with permanent caps only, during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

B. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 221316

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SECTION 221319
SANITARY WASTE PIPING SPECIALTIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.02 ABBREVIATIONS

A. RPZ: Reduced Pressure Zone

B. FOG: Fats, oils, and greases.

1.03 SUBMITTALS

A. Product Data: Provide manufacturer's literature and data sheets for each product. Include information on fabrication materials, assembly of components, dimensions, ratings, finishes, rough-in requirements, and installed accessories.

B. Shop Drawings: Provide wiring diagrams for power, signal, and control wiring.

C. Operation and Maintenance Data: To include in emergency, operation, and maintenance manuals.

1.04 QUALITY ASSURANCE ***REFER TO CURRENT MCPS MECH-PLUMB DESIGN CHECKLIST***

A. **Comply with the requirements of the current MCPS Mechanical and Plumbing Design Checklist. Refer to the latest edition for applicable design, coordination, and documentation standards.**

B. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

C. Electrical components, devices, and accessories shall be Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

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1.05 COORDINATION

A. Coordinate size and location of roof penetrations.

B. Coordinate accessories, extensions, collars, flashing clamps, etc… for field conditions and installation requirements for roof assemblies and other construction assemblies to provide final and proper compliant installation.

PART 2 PRODUCTS

2.01 BACKWATER VALVES

A. Horizontal, Backwater Valves:
   1. Manufacturers:
      a. Josam Company; Josam Div.
      b. MIFAB, Inc.

c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.14.1.
3. Size: Same as connected piping.
4. Cover: Bolted or threaded access to check valve.
5. End Connections: Match connecting pipe.
6. Check Valve: Factory assembled to hang open for airflow unless subject to backflow condition.
7. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at grade; replaces backwater valve cover. Terminate in 4” thick square concrete slab 4” larger all around than cover (provide 1” chamfer on top edges)

2.02 CLEANOUTS

A. Manufacturers:
1. Josam Company; Josam Div.
2. MIFAB, Inc.
3. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.
6. Zurn Plumbing Products Group; Specification

B. General:
1. Standard: ASME A112.36.2M.
2. Size: Same as connected drainage piping
3. Closure Material: Match pipe, brass, PVC, or ABS

C. Floor Cleanouts:
1. Housing: threaded, adjustable.
2. Type: Threaded, adjustable housing.
3. Body: Cast iron.
4. Outlet Connection: Inside calk, Spigot, or Threaded.
5. Adjustable Housing Material: Cast iron with threads.
6. Frame and Cover Material and Finish: Satin finish nikaloy.
7. Frame and Cover Shape: Round or Square (Contractors Option).
8. Top Loading Classification: Extra Heavy Duty.
9. Riser: ASTM A 74, Service weight, cast-iron drainage pipe fitting and riser to cleanout.

D. Wall Cleanouts:
1. Wall access: Yes
2. Body: Match connected piping.
3. Closure: Countersunk or raised-head, drilled-and-threaded plug.
4. Closure Plug Size: Same as cleanout size but not larger than four inches in diameter.
5. Wall Access: Round, flat, chrome-plated brass, nickel-bronze, copper-alloy, or stainless-steel cover plate with screw.

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2.03 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:
   1. Manufacturers:
      a. 3M Fire Protection Products
      b. Hilti
      c. ProSet Systems Inc.
      d. RectorSeal / Metacaulk
      e. Specified Technologies Inc. (STI)
   2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
   3. Size: Same as connected soil, waste, or vent stack.
   4. Sleeve: Length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.

2.04 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings:
   1. Manufacturers:
      a. PPP
      b. Josam
      c. Smith
      d. Zurn
   2. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
   3. Size: Same as floor drain inlet.

B. Air-Gap Fittings:
   1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
   2. Body: Bronze or cast iron.
   3. Inlet: Opening in top of body.
   4. Outlet: Larger than inlet.
   5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

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2.05 GREASE INTERCEPTORS

A. Manufacturers:
   1. Adamson Tank
   2. Clawson Tank
   3. FOG Enforcer
   4. Green Turtle
   5. Highland Tank
   6. Schier Products

B. Design: Interceptor shall be designed to remove from wastewater free oil, grease, and other floatable materials, and sediment, sand and other settleable materials.

C. Equivalent interceptors constructed of fiberglass or steel by other manufacturers will be considered. Interceptor manufacturer must document compliance with all requirements of this

specification. Capacity information must be from the manufacturer's catalog. Site constructed concrete interceptors are not acceptable.

D. Interceptor shall meet the requirements of the International Association of Plumbing and Mechanical Officials (IAPMO) Material and Property Standard for Grease Interceptors and Clarifiers ANSI/IAPMO Z1001.

E. Steel Interceptors shall be in accordance with Underwriters Laboratories Inc. Subject UL-1746 Standard for External Corrosion Protection Systems for Steel Underground Storage Tanks.

F. Interceptor shall consist of inlet and outlet connections with internal influent nozzle, non-clogging flow diffusion and energy dissipater baffle. If distributed pipe configuration is proposed pipe diameter shall be twice the diameter of the inlet pipe and shall direct flow across the entire cross-sectional area. Straight pipe is not acceptable.

G. Interceptor shall be designed to prevent large amounts of pipe-clogging fats, oil, and grease (FOG) and solid waste materials from entering the sanitary sewer system. Interceptor shall have compartments to minimize turbulence and promote separation. Interceptor shall retain wastewater long enough to allow liquefied grease to cool down, separate, and congeal.

H. Interceptor shall be suitable for underground installation and shall be installed per the manufacturer's recommendations.

I. Provide interceptor with cleanouts, sample, and ventilation ports together with extension collars, frames, and covers to allow access for removal of oil, grease and solids.

J. Accessories:
   1. Basin manways with extensions to grade and heavy duty covers.
   2. Full line-size connections.
   3. Vertical tee fitting on discharge outlet with pipe to surface with cast iron frame and cover for effluent sampling.
   4. Traffic rated components accessories and relieving slabs where installation subject to vehicular traffic.
   5. Grease level monitoring and alarm system

K. Warranty: 30 years against leakage, corrosion, and structural failure.

2.06 MOTORS

A. General requirements for motors are specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
   2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

C. Install all cleanouts, sampling ports, venting, and accessories required.

D. Install cleanout deck plates with top flush with finished floor.

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E. For wall cleanouts located in concealed piping, install cleanout access covers, with cover tight to finished wall.

F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains as indicated. If indication is not clear, position for easy access and maintenance.
   2. Set floor drains at elevations indicated.
   3. Install floor-drain flashing flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
   4. Install individual traps for floor drains connected to sanitary building drain.

G. Install through-penetration firestop assemblies in plastic conductors and stacks at rated penetrations.

H. Install floor-drain, trap-seal primer fittings on inlet to floor drains indicated to receive trap-seal primer.

I. Install air-gap fittings on RPZ backflow preventers and where indicated.

J. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

K. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction, manufacturer's recommendations/instructions, and as indicated. In case of a conflict, consult architect.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Grease Interceptors: Connect inlet and outlet to unit and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.

D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.03 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Grease interceptors.

B. Distinguish among multiple units, inform operator of operational requirements, and refer to Division 22 Section "Identification for Plumbing Piping and Equipment."

3.04 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect grease interceptors and their installation, including piping and electrical connections, and to assist in testing.

B. Checks and Inspections:

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1. Leak Check: After installation, charge system and check for leaks. Repair leaks and recheck until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.05 PROTECTION

A. Protect drains, with permanent caps only, during construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of open pipes at end of each day or when work stops.

END OF SECTION 221319

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SECTION 221413
FACILITY STORM DRAINAGE PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.02 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. LEED: Leadership in Energy and Environmental Design

C. PE: Polyethylene plastic.

D. PVC: Polyvinyl chloride plastic.

E. USGBC: United States Green Building Council

1.03 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:

1. Storm Piping: 10-foot head of water.

1.04 SUBMITTALS

A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.05 QUALITY ASSURANCE ***REFER TO CURRENT MCPS MECH-PLUMB DESIGN CHECKLIST***

A. **Comply with the requirements of the current MCPS Mechanical and Plumbing Design Checklist. Refer to the latest edition for applicable design, coordination, and documentation standards.**

B. Perform work in accordance with applicable codes.

C. Piping materials shall bear label, stamp, or other markings of the testing agency.

D. Cast iron soil pipe shall be clearly marked with the manufacturer's name, county of origin, eight-digit date code, pipe diameter and length, relevant ASTM standard and registered trademark of third part certifier.

1. Third party certifier shall be IAPMO, ICC, NSF, UL, or other organization that is accredited as an ANSI – Guide 65 organization. Reference www.ansi.org

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Plenum-Installed Piping: Provide piping with flame spread index of 25 or less and smoke developed index of 50 or less when tested in accordance with ASTM E84 or UL 723.

B. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

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C. Flexible Transition Couplings for Underground Non-Pressure Piping: ASTM C 1173 with elastomeric sleeve. Include ends of same sizes as piping to be joined and include corrosion-resistant metal band on each end.

2.02 CAST-IRON SOIL PIPE AND FITTINGS

A. Manufacturers:
   1. AB&I Foundry
   2. Charlotte Pipe & Foundry Co.
   3. Tyler Pipe & Coupling

B. Pipe and Fittings: ASTM A 888 or CISPI 301.

C. Hub-and-Spigot Gaskets: ASTM C 564, rubber.

D. Hub-less Couplings:
   1. General: CISPI 310 and ASTM C 1277 assembly of stainless-steel corrugated shield, stainless steel bands and fasteners, and ASTM C 564 rubber sleeve with integral, center pipe stop.
   2. Heavy-Duty, Type 304, Stainless-Steel Couplings: ASTM C 1540, Type 304, stainless-steel shield; stainless-steel bands; and ASTM C 564, rubber sleeve.
      a. NPS 1-1/2 to NPS 4: 3-inch- wide shield with 4 bands.
      b. NPS 5 to NPS 10: 4-inch- wide shield with 6 bands.
   3. Heavy-Duty, Cast-Iron Couplings: ASTM A 48/A 48M, 2-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.

2.03 PVC PIPE AND FITTINGS

A. Manufacturers:
   1. Charlotte Pipe & Foundry Co.
   2. IPEX
   3. Westlake

B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
   1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

C. Solvent Cement and Adhesive Primer:
   1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 EXECUTION

3.01 PIPING APPLICATIONS

A. Transition fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.

B. Aboveground Storm Drainage Piping:
   1. Inside Plenum:
      a. Service class, cast-iron soil piping; gaskets; and gasketed joints.
      b. Hub-less, cast-iron soil piping; heavy-duty, Type 304, stainless steel.

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2. Outside Plenum:
   a. Service class, cast-iron soil piping; gaskets; and gasketed joints.
   b. Hub-less, cast-iron soil piping; heavy-duty, Type 304, stainless steel.

C. Underground Storm Drainage Piping:
   1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
   2. Hub-less, cast-iron soil piping; heavy-duty, Type 304, stainless steel.
   3. Schedule 40 PVC pipe, PVC socket fittings, and solvent-cemented joints

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Prepare exposed, unfinished pipe, fittings, supports, and accessories for finish painting.

C. Refer to Section "Storm Utility Drainage Piping" for Project site storm sewer and drainage piping.

D. Refer to Section "Common Work Results for Plumbing" for basic piping installation.

E. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Section "Storm Drainage Piping Specialties".

F. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
   1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

G. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

H. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

I. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

J. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

K. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

M. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

N. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section "Sleeves and Sleeve Seals for Plumbing Piping."

O. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section "Escutcheons for Plumbing Piping."

P. All piping under slab shall be TV camera inspected with MCPS (Montgomery County Public Schools) representative present. Video record with mapping and verifying pipe integrity and slope maintained post-backfill shall be provided to MCPS.

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3.03 JOINT CONSTRUCTION

A. Refer to Section "Common Work Results for Plumbing" for basic piping joint construction.

B. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

C. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

D. PVC Non-pressure Piping Joints: Join piping according to ASTM D 2665.

3.04 VALVE INSTALLATION

A. Backwater Valves: Install backwater valves in piping subject to backflow.
   1. Horizontal Piping: Horizontal backwater valves.
   2. Install backwater valves in accessible locations.
   3. Refer to Section "Storm Drainage Piping Specialties" for backwater valves.

3.05 HANGER AND SUPPORT INSTALLATION

A. Refer to Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs: According to the following:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Section "Hangers and Supports for Plumbing Piping and Equipment."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. 1 ½” and 2”: 60” with 3/8” rod.
   2. 3”: 60” with ½” rod.
   3. 4” and 5”: 60” with 5/8” rod.
   4. 6”: 60” with ¾” rod.
   5. 8” to 12”: 60” with 7/8” rod.
   6. 15”: 60” inches with 1” rod.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
   1. 1 ½” and 2”: 48” with 3/8” rod.
   2. 3”: 48” with ½” rod.
   3. 4” and 5”: 48” with 5/8” rod.
   4. 6”: 48” with ¾” rod.

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5. 8” to 12”: 48” with 7/8” rod.

H. Install supports for vertical PVC piping every 48”.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.06 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Provide new stormwater services. Before commencing work, check invert elevations required for stormwater connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

C. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

D. Connect storm drainage piping to roof drains and storm drainage specialties.

3.07 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction and owner's representative at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction and owner's representative to observe tests specified below and to ensure compliance with requirements.

B. Re-inspection: If authorities having jurisdiction or owner's representative find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction and owner's representative.

D. Test storm drainage piping according to procedures of authorities having jurisdiction and owner's representative or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.08 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Place plugs in ends of uncompleted piping at end of day and when work stops.

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3.09 PROTECTION

A. Protect drains, with permanent caps only, during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

B. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 221413

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SECTION 221423
STORM DRAINAGE PIPING SPECIALTIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.02 ABBREVIATIONS

A. AFF: Above Finished Floor

B. AFG: Above Finished Grade

1.03 SUBMITTALS

A. Product Data: Provide manufacturer's literature and data sheets for each product. Include information on fabrication materials, assembly of components, dimensions, ratings, finishes, rough-in requirements, and installed accessories.

B. Shop Drawings:
   1. Provide Wiring Diagrams: Power, signal, and control wiring.

C. Operation and Maintenance Data: To include in emergency, operation, and maintenance manuals.

1.04 QUALITY ASSURANCE ***REFER TO CURRENT MCPS MECH-PLUMB DESIGN CHECKLIST***

A. **Comply with the requirements of the current MCPS Mechanical and Plumbing Design Checklist. Refer to the latest edition for applicable design, coordination, and documentation standards.**

B. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.05 COORDINATION

A. Coordinate size and location of roof penetrations.

B. Coordinate accessories, extensions, collars, flashing clamps, and associated items for field conditions and installation requirements for roof assemblies and other construction assemblies to provide final and proper compliant installation.

PART 2 PRODUCTS

2.01 ROOF DRAINS

A. Manufacturers:
   1. Josam Company
   2. J.R. Smith Mfg. Co.
   3. MiFab
   4. Tyler Pipe
   5. Watts, Inc.
   6. Zurn Plumbing Products Group

B. General-Purpose Roof Drains:

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1. Standard: ASME A112.6.4, for general-purpose roof drains.
2. Body Material: Cast iron.
3. Combination Flashing Ring and Gravel Stop: Required.
4. Underdeck Clamp: Required.
5. Sump Receiver Plate: Not required.
6. Dome Material: Aluminum or Cast Iron
7. Extension Collar: As Required.

C. General-Purpose Overflow Roof Drains:
1. Standard: ASME A112.6.4, for general-purpose roof drains.
2. Body Material: Cast iron.
3. Combination Flashing Ring and Gravel Stop: Required.
4. Underdeck Clamp: Required.
5. Sump Receiver Plate: Not required.
6. Dome Material: Aluminum or Cast Iron
7. Extension Collar: As Required.
8. Internal Water Dam: Required.

D. Canopy Drains:
1. Standard: ASME A112.6.4, for canopy roof drains.
2. Body Material: Cast Iron.
3. Combination Flashing Ring and Gravel Stop: Required.
4. Underdeck Clamp: Required.
5. Sump Receiver Plate: Not required.
6. Dome Material: Aluminum, Cast Iron, or Bronze.
7. Extension Collar: As Required.

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2.02 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Manufacturers:
1. Josam Company
2. J.R. Smith Mfg. Co.
3. MiFab
4. Tyler Pipe
5. Watts, Inc.
6. Zurn Plumbing Products Group

B. Downspout Boots:
1. Description: Manufactured, ASTM A 48/A 48M, gray-iron casting or steel, integral cleanout, and strap or anchorage for attaching to building; inlet matching downspout dimensions with galvanic isolator; outlet matching that of downstream pipe size serve based on downspout loading; factory-applied coating.
2. Provide final termination height coordinated with building exterior features and requirements.
3. Size: Inlet size to match downspout, outlet matching downstream pipe connection. 24" minimum extension above finished grade.

C. Storm Drain and Storm Drain Overflow Nozzles:

1. Description: Bronze body with threaded inlet, bugscreen, and bronze wall flange with mounting holes.
2. Size: Same as connected conductor
3. Product is for use where storm drain piping or secondary storm drain piping exits the building above grade and shall be provided where indicated on the drawings.

2.03 BACKWATER VALVES

A. Manufacturers:
   1. Josam Company
   2. J.R. Smith Mfg. Co.
   3. MiFab
   4. Tyler Pipe
   5. Watts, Inc.
   6. Zurn Plumbing Products Group

B. Standard: ASME A112.14.1.

C. Size: Same as connected piping.

D. Cover: Bolted or threaded access to check valve.

E. End Connections: Match connecting pipe.

F. Check Valve: Factory assembled to hang open for airflow unless subject to backflow condition.

G. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at grade; replaces backwater valve cover. Terminate in 4” thick square concrete slab 4” larger all around than cover (provide 1” chamfer on top edges).

2.04 CLEANOUTS

A. Manufacturers:
   1. Josam Company
   2. J.R. Smith Mfg. Co.
   3. MiFab
   4. Tyler Pipe
   5. Watts, Inc.
   6. Zurn Plumbing Products Group

B. Standard: ASME A112.36.2M.

C. Size: Same as connected drainage piping

D. Floor Cleanouts:
   1. Housing: threaded, adjustable.
   2. Type: Threaded, adjustable housing.
   3. Body: Cast iron.
   4. Outlet Connection: Inside calk, Spigot, or Threaded.
   5. Adjustable Housing Material: Cast iron with threads.
   6. Frame and Cover Material and Finish: Satin finish nikaloy.
   7. Frame and Cover Shape: Round or Square (Contractors Option).
   8. Top Loading Classification: Extra Heavy Duty.
   9. Riser: ASTM A 74, Service weight, cast-iron drainage pipe fitting and riser to cleanout.

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E. Wall Cleanouts:
   1. Wall access: Yes
   2. Body: Match connected piping.
   3. Closure: Countersunk or raised-head, drilled-and-threaded plug.
   4. Closure Plug Size: Same as cleanout size but not larger than four inches in diameter.
   5. Wall Access: Round, flat, chrome-plated brass, nickel-bronze, copper-alloy, or stainless-steel cover plate with screw.

2.05 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:
   1. Manufacturers:
      a. 3M Fire Protection Products
      b. Hilti
      c. ProSet Systems Inc.
      d. RectorSeal / Metacaulk
      e. Specified Technologies Inc. (STI)
   2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
   3. Size: Same as connected soil, waste, or vent stack.
   4. Sleeve: Length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Maintain continuity of waterproofing membranes. Secure waterproofing membranes to drain clamping collars.

C. Install roof drains where indicated. Create low points in roof areas according to roof membrane manufacturer's written installation instructions. Install flashing ring, collar, or flange to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.

D. Install downspout boots at grade. Secure to building wall.

E. Install storm drain and storm drain overflow nozzles at exposed bottom of storm drain and storm drain overflow conductors where they spill onto grade.

F. Install cleanouts in aboveground piping and building drain piping according to the International Plumbing Code.

G. Install cleanouts for piping below floors.

H. Install cleanout deck plates with top flush with finished floor.

I. For wall cleanouts located in concealed piping, install cleanout wall access covers with cover tight to finished wall.

J. Install horizontal backwater valves where indicated.

K. Install concrete slabs at backwater valves.

L. Install cleanouts in vertical conductors at 18” AFF.

M. Install access door in wall if required to access cleanout.

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N. Install through-penetration firestop assemblies at penetrations of rated assemblies.

3.02 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

3.03 PROTECTION

A. Protect drains, with permanent caps only, during construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of open piping at end of each day or when work stops.

END OF SECTION 221423

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SECTION 221429
SUMP PUMPS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.02 ABBREVIATIONS

A. BAS: Building Automation System

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, furnished specialties and accessories. Provide wiring diagrams for power, signal, and control wiring including interface with BAS.

B. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1. Operation and maintenance data for elevator sump pumps shall state that they shall be tested for proper operation as required by “Field Quality Control” “Checks & Inspections” below each time the elevator inspector inspects the elevator or every 6 months whichever occurs more frequently.

1.04 QUALITY ASSURANCE ***REFER TO CURRENT MCPS MECH-PLUMB DESIGN CHECKLIST***

A. **Comply with the requirements of the current MCPS Mechanical and Plumbing Design Checklist. Refer to the latest edition for applicable design, coordination, and documentation standards.**

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. UL Compliance: Comply with UL 778 for motor-operated water pumps.

D. ANSI Compliance: Comply with ANSI/HI: 1.4 for installation of centrifugal pumps.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

PART 2 PRODUCTS

2.01 ELEVATOR SUMP PUMP

A. Submersible Elevator Sump Pumps:

1. Manufacturers:
   a. Ebara International Corporation
   b. Grundfos Pump Corporation
   c. Stancor, Inc.

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d. Weil Pump Company, Inc.
e. Zoeller Company

2. Description: Factory-assembled and -tested sump-pump unit.
3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
4. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
5. Impeller: Cast iron. Must handle up to ½" diameter spherical solid.
6. Shaft: Stainless steel or steel.
7. Seal: Mechanical.
8. Motor: Hermetically sealed, capacitor-start type, with built-in overload protection.
9. Lifting eye or lug: Required
10. Power/sensor cable: Length as required to reach junction box in elevator pit. Neatly rout cables and group together using self-extinguishing black UVB resistant 0.1" wide nylon zip ties.

B. Controls:
1. Oil-sensing pump controller with audible and visual alarm.
2. Oil-sensing alarm linked to building automation system.

C. Hardware:
1. Switch Type: Float switch.
2. Oil Sensor: Required
3. Probe Material: Stainless Steel.
4. Power/sensor cable: 25 feet minimum, 25 foot increments up to 250 feet in length, waterproof. Route in conduit and make connection to control box mounted in elevator equipment room and junction box adjacent to pump.

D. Control Interface With BAS: Auxiliary contacts in pump controls for interface to BAS. Provide alarm status.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of piping connections prior to sump pump installation.

3.02 INSTALLATION

A. Install products with related fittings and accessories according to manufacturer instructions.

B. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

C. Elevator Sump Pumps:
1. Install system in accordance with manufacturer's written instructions.
2. Provide empty conduit between elevator sump and panel under Division 26. Size shall be as required by system manufacturer to pull control cable through conduit.
3. Pipe the sump pump discharge to location indicated.

3.03 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.04 FIELD QUALITY CONTROL

A. Checks and Inspections:
   1. Perform visual inspection of each sump pump.
   2. Operational Check: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   3. Check and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   4. Leak check: During operational test while sump pump is running, check piping, valves and piping accessories for leaks. Repair leaks and recheck until no leaks exist.
   5. Elevator Sump Pump Additional Check:
      a. With pump active place 25 gallons of water into sump and allow pump to run until it is stopped by controls.
      b. Deactivate the pump by using the disconnect switch if installed, or turning off at the control panel.
      c. Add 25 gallons of water to the sump. This will be over and above any water remaining in the sump after the controls stopped the pump.
      d. Start the pump and ensure it stops automatically within thirty (30) seconds. Intent is to indicate the pump assembly pumps a minimum of forty (50) gallons per minute.

3.05 STARTUP SERVICE

A. Engage a factory-authorized service representative to complete installation and startup checks according to manufacturer's written instructions.

3.06 ADJUSTING

A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust control set points.

3.07 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 221429

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SECTION 223300
ELECTRIC WATER HEATERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.02 ABBREVIATIONS

A. AFF: Above Finished Floor

B. EWH: Electric Water Heater

C. WC: Water Column

1.03 SUBMITTALS

A. Product Data: For each type and size of water heater. Include electrical data, rated capacities, operating weights, furnished specialties, and accessories.

B. Shop Drawings: Detail water heater assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

C. Maintenance Data: For water heaters to include in maintenance manuals specified in Div. 1.

D. Warranties: Special warranties specified in this Section.

1.04 QUALITY ASSURANCE ***REFER TO CURRENT MCPS MECH-PLUMB DESIGN CHECKLIST***

A. **Comply with the requirements of the current MCPS Mechanical and Plumbing Design Checklist. Refer to the latest edition for applicable design, coordination, and documentation standards.**

B. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. ASME Compliance: Fabricate and label water heater, hot-water storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1 unless otherwise indicated.

F. ASHRAE Compliance: Fabricate and label domestic-water heaters to comply with ASHRAE 90.1.

G. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

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1.05 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of water heaters that fail in materials or workmanship within specified warranty period.

C. Failures include, but are not limited to, the following:
   1. Structural failures including storage tank and supports.
   2. Faulty operation of controls.
   3. Deterioration of metals, metal finishes, and other materials beyond normal use.

D. Warranty Periods: From date of Substantial Completion.
   1. Heating Elements: One year.
   2. Storage Tanks: Three years.
   3. Heat Exchangers: Three Years
   4. Controls: One year.
   5. Compression Tanks: Five years.

PART 2 PRODUCTS

2.01 TANKLESS ELECTRIC WATER HEATERS

A. Manufacturers:
   1. Bosch
   2. Chronomite Laboratories, Inc.
   3. Eemax, Inc.
   4. Hubbell
   5. PVI
   6. Stiebel Eltron

B. Description: Commercial point of use domestic water heater with little or no storage.

C. Standards:
   1. Comply with UL 499 or ETL.
   2. Listed by manufacturer for commercial applications.

D. Storage Tank Construction: N/A.
   1. Working-Pressure Rating: 150 psig.
   2. Pipe Connections: ASME B1.20.1, pipe thread.
   3. Interior Finish: Materials complying with NSF 61, barrier materials for potable-water tank linings.
   4. Jacket: Aluminum or steel, with enameled finish, or plastic.

E. Heating System: Electric-resistance type.
   1. Temperature Control: Adjustable, microprocessor based thermostat.
   2. Safety: Automatic, high-temperature-limit cutoff device or system.

F. Mounting: Bracket or device for wall mounting.

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2.02 SMALL-CAPACITY ELECTRIC TANK-TYPE WATER HEATERS

A. Manufacturers:
   1. A.O. Smith
   2. Bradford White
   3. Eemax
   4. Hubbell
   5. Lochinvar
   6. PVI
   7. Rheem
   8. Ruud
   9. State Industries

B. Description: Small storage capacity units (approximately 2.50-50.00 Gallons) with limited heating capacity.

C. Standards:
   1. Comply with UL 174.
   2. ASHRAE 90.1
   3. Listed by manufacturer for commercial applications.

D. Storage Tank Construction: Steel or corrosion-resistant metal with 150-psig working-pressure rating.
   1. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, drain, anode rod, and controls. Attach tappings to tank before testing and labeling.
   2. Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
   3. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
   4. Jacket: Steel, with enameled finish.

E. Pipe Thread: ASME B1.20.1

F. Heating Element: Electric, replaceable, immersion type.
   1. Temperature Control: Adjustable thermostat.

G. Anode Rod: Factory installed.

H. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed.

2.03 MEDIUM-CAPACITY ELECTRIC TANK-TYPE WATER HEATERS

A. Manufacturers:
   1. A.O. Smith
   2. Bradford White
   3. Lochinvar
   4. PVI
   5. Rheem
   6. Ruud
   7. State Industries

B. Description: Comply with UL 174 or UL 1453 and listed by manufacturer for commercial applications.

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C. Storage Tank Construction: ASME-code steel with 150-psig working-pressure rating.
   1. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, pressure gage, thermometer, drain, anode rod, and controls. Attach tappings to tank before testing and labeling.
   2. Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
   3. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
   4. Jacket: Steel, with enameled finish.

D. Heating Elements: Electric, replaceable, immersion type.
   1. Temperature Control: Adjustable thermostat with wiring arrangement for simultaneous operation.

E. Pipe Thread: ASME B1.20.1

F. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed.

G. Anode Rod: Factory installed.

H. Dip Tube: Factory installed.
   1. Not required if cold-water inlet is within 18” of bottom of storage tank.

2.04 LARGE-CAPACITY ELECTRIC TANK-TYPE WATER HEATERS

A. Manufacturers:
   1. A.O. Smith
   2. Bradford White
   3. Lochinvar
   4. PVI
   5. Rheem
   6. Ruud
   7. State Industries

B. Description: Comply with UL 1453 and listed by manufacturer for commercial applications.

C. Storage Tank Construction: ASME-code steel with 150-psig working-pressure rating.
   1. Tappings: Factory fabricated of materials compatible with tank for pipe, relief valve, pressure gage, thermometer, drain, anode rod, and control, connections. Attach tappings to tank shell before testing and labeling.
   2. Pipe Connections:
      a. 2” and Smaller: Threaded according to ASME B1.20.1
      b. 2 ½” and Larger: Flanged according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
   3. Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
   4. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
   5. Jacket: Steel, with enameled finish.

D. Heating Elements: Electric, screw-in or bolt-on, immersion type arranged in multiples of three.
   1. Staging: Do not exceed 18 kW per stage (step).
   2. Temperature Control: Adjustable thermostat.

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3. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.

E. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed and piped to nearest floor drain.

F. Anode Rods: Factory installed when cement lining is provided.

G. Dip Tube: Factory installed.
1. Not required if cold-water inlet is within 24” of bottom of storage tank.

2.05 ASME COMPRESSION TANKS

A. Manufacturers:
1. Amtrol, Inc.
2. State Industries.
3. Taco, Inc.
4. Wessels Co.
5. Zurn Industries, Inc.

B. Description: ASME-code Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm.

C. Diaphragm: Butyl-rubber FDA approved for use with potable (domestic) water.

D. ASME Rated: Yes.

E. Working Pressure: 150 psig.

F. Tappings: Factory-fabricated steel, welded to tank before testing and labeling.

G. Pipe Thread: ASME B1.20.1

H. Tank Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.

I. Tank Exterior Finish: Manufacturer's standard, unless indicated otherwise.

J. Air Pre-Charge Valve: Factory installed Schrader type (standard tire valve).

2.06 WATER HEATER ACCESSORIES

A. Combination Temperature and Pressure Relief Valves: ASME rated, ASME stamped, and complying with ASME PTC 25.3.
1. Exception: Omit combination temperature and pressure relief valve for tankless water heater, and furnish pressure relief valve for installation in piping
2. Minimum Relieving Capacity: Equal to heat input.
3. Minimum Pressure Setting: Equal to water heater working pressure rating.
4. Sensing Element: Extends into tank.
5. Temperature Setting: 20°F Higher than water heater set point temp

B. Vacuum Relief Valves: Comply with ASME PTC 25.3. Furnish for installation in piping.
1. Exception: Omit if water heater has integral vacuum-relieving device.

C. Water Heater Mounting Brackets: Steel bracket for wall mounting and capable of supporting water heater and water.

D. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater plus four (4) inches, dimensions not

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less than two to four (2-4) inches vertical, and include drain outlet not less than NPS ¾ in diameter with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

E. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE 90.1.

F. Manifold Piping Arrangements: For multiple, grouped, domestic-water heater installations, ensure equalized and balanced distribution to each water heater. Include ball or butterfly shutoff valves and unions to isolate each domestic-water heater. Coordinate with manufacturer's written installation instructions and recommendations.
   1. Acceptable Balancing Arrangements:
      a. Manufacturer provided factory-fabricated manifold kit.
      b. Field-fabricated, mechanically balanced, piping arrangement with calibrated balancing valves.
      c. Field-Fabricated equal-leg piping arrangement.
      d. Reverse-return manifold piping arrangement.

G. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.

H. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

I. Plug and cord:
   1. Where water heaters require 120 volt single phase power, provide a plug and cord, for connection to a standard grounded outlet.
   2. Cord length: As required to reach outlet, 6'-0" maximum.
   3. Plug and cord ampacity shall be approved by the water heater manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install water heaters on housekeeping pads unless otherwise indicated.

C. Install water heaters, level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

D. Install temperature and pressure relief valves in top portion of storage tanks. Extend relief valve outlet with water piping in continuous downward pitch. Discharge in the following order:
   1. Closest floor drain.
   2. Mop sink.
   3. Drain Pan.

E. Install vacuum relief valves in cold-water-inlet piping.

F. Install thermometers on inlet and outlet piping of water heaters. Comply with requirements for thermometers specified in Division 22 Section "Meters and Gages for Plumbing Piping."

G. Install pressure gauges on inlet and outlet piping of water heaters. Comply with requirements for pressure gauges specified in Division 22 Section "Meters and Gages for Plumbing Piping."

H. Provide inlet and outlet piping manifolds for multiple water heaters. Arrange manifolds for balanced water flow through each water heater. Include a union, shutoff valve, pressure gauge and thermometer in each water heater outlet, and a union, and shutoff valve on each water heater inlet. Provide an additional valve with memory stop, and test plug on inlet of valve for throttling in each water heater outlet. Refer to Division 22 Section "General-Duty Valves for

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Plumbing Piping." for valves and Division 22 Section "Meters and Gages for Plumbing Piping." for thermometers, pressure gauges, and test plugs.

I. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks.

J. Fill water heaters with water.

K. Charge compression tanks to indicated pressure.

3.02 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Section "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.03 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.04 FIELD QUALITY CONTROL

A. Engage a factory-authorized service representative to perform startup service.

B. In addition to manufacturer's written installation and startup checks, perform the following:

1. Verify that piping system tests are complete.
2. Check for piping connection leaks.
3. Operate relief valve and confirm proper operation of relief valve, outlets, and drain piping.
4. Check operation of circulating pumps.
5. Energize electric circuits.
6. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
7. Adjust temperature settings to indicated temperature.
8. Balance water flow through manifolds of multiple water heater installations by adjusting the pressure drop across each additional full-sized valve with memory stop to be equal to barely closed full sized valve. Establish hot water flow through fixtures to establish flow necessary to make this adjustment. Circulating pump may be running or off.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water heaters.

1. Train Owner's maintenance personnel on procedures for starting and stopping, troubleshooting, servicing, and maintaining equipment.
2. Review data in maintenance manuals.

END OF SECTION 223300

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SECTION 223400
FUEL-FIRED DOMESTIC WATER HEATERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.02 ABBREVIATIONS

A. AFF: Above Finished Floor

B. GWH: Gas Water Heater

C. WC: Water Column

1.03 SUBMITTALS

A. Product Data: For each type and size of water heater. Include electrical data, rated capacities, operating weights, furnished specialties, and accessories.

B. Product Certificates: For each type of commercial, gas-fired, domestic-water heater, from manufacturer.

C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

D. Shop Drawings: Detail water heater assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

E. Maintenance Data: For water heaters to include in maintenance manuals specified in Div. 1.

F. Warranties: Special warranties specified in this Section.

1.04 QUALITY ASSURANCE ***REFER TO CURRENT MCPS MECH-PLUMB DESIGN CHECKLIST***

A. **Comply with the requirements of the current MCPS Mechanical and Plumbing Design Checklist. Refer to the latest edition for applicable design, coordination, and documentation standards.**

B. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. ASME Compliance:

1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

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2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.

F. ASHRAE Compliance: Fabricate and label domestic-water heaters to comply with ASHRAE 90.1.

G. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

1.05 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of water heaters that fail in materials or workmanship within specified warranty period.

C. Failures include, but are not limited to, the following:
1. Structural failures including storage tank and supports.
2. Faulty operation of controls.
3. Deterioration of metals, metal finishes, and other materials beyond normal use.

D. Warranty Periods: From date of Substantial Completion.
1. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:
a. Storage Tank: Three years.
b. Controls and Other Components: One year.
2. Compression Tanks: Five years.

PART 2 PRODUCTS

2.01 DOMESTIC WATER HEATERS

A. Manufacturers:
1. A.O. Smith
2. Bradford White
3. Lochinvar
4. PVI
5. Rheem
6. Ruud
7. State Industries

B. Neutralization: Provide all condensing, gas-fired, domestic, water heaters with condensate neutralization kits from water heater manufacturer. Coordinate location and drain requirements with drains and equipment indicated on plans.

2.02 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

A. Commercial, Gas-Fired, High-Efficiency, Storage, Domestic-Water Heaters:
1. Standard: ANSI Z21.10.3/CSA 4.3.

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2. Description: Manufacturer's proprietary design to provide at least 95 percent combustion efficiency at optimum operating conditions.
3. Storage-Tank Construction: ASME-code steel with 150-psig minimum working-pressure rating.
    a. Tappings: Factory fabricated materials compatible with tank. Attach tappings to tank before testing.
        1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
        2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
    b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
4. Factory-Installed Storage-Tank Appurtenances:
    a. Anode Rod: Replaceable magnesium.
    b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
    c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
    d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
    e. Jacket: Steel with enameled finish.
    f. Burner or Heat Exchanger: Comply with UL 795 or approved testing agency requirements for gas-fired, high-efficiency, domestic-water heaters and natural-gas fuel.
    g. Temperature Control: Adjustable thermostat.
    h. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
    i. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
5. Draft Hood: Draft diverter, complying with ANSI Z21.12.
6. Capacity and Characteristics: Refer to Plumbing drawings and schedules.
7. Minimum Vent Diameter: Refer to and coordinate with manufacturer’s written installation recommendations and Mechanical drawings and schedules.

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2.03 ASME COMPRESSION TANKS

A. Manufacturers:
    1. Amtrol, Inc.
    2. State Industries.
    3. Taco, Inc.
    4. Wessels Co.
    5. Zurn Industries, Inc.

B. Description: ASME-code Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm.

C. Diaphragm: Butyl-rubber FDA approved for use with potable (domestic) water.

D. ASME Rated: Yes.

E. Working Pressure: 150 psig.

F. Tappings: Factory-fabricated steel, welded to tank before testing and labeling.

G. Pipe Thread: ASME B1.20.1

H. Tank Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.

I. Tank Exterior Finish: Manufacturer's standard, unless indicated otherwise.

J. Air Pre-Charge Valve: Factory installed Schrader type (standard tire valve).

2.04 DOMESTIC-WATER HEATER ACCESSORIES

A. Combination Temperature and Pressure Relief Valves: ASME rated, ASME stamped, and complying with ASME PTC 25.3.
   1. Exception: Omit combination temperature and pressure relief valve for tankless water heater, and furnish pressure relief valve for installation in piping
   2. Minimum Relieving Capacity: Equal to heat input.
   3. Minimum Pressure Setting: Equal to water heater working pressure rating.
   4. Sensing Element: Extends into tank.
   5. Temperature Setting: 20°F Higher than water heater set point temp

B. Vacuum Relief Valves: Comply with ASME PTC 25.3. Furnish for installation in piping.
   1. Exception: Omit if water heater has integral vacuum-relieving device.

C. Water Heater Mounting Brackets: Steel bracket for wall mounting and capable of supporting water heater and water.

D. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater plus four (4) inches, dimensions not less than two to four (2-4) inches vertical and include drain outlet not less than NPS ¾ in diameter with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

E. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE 90.1.

F. Manifold Piping Arrangements: For multiple, grouped, domestic-water heater installations, ensure equalized and balanced distribution to each water heater. Include ball or butterfly shutoff valves and unions to isolate each domestic-water heater. Coordinate with manufacturer’s written installation instructions and recommendations.
   1. Acceptable Balancing Arrangements:
      a. Manufacturer provided factory-fabricated manifold kit.
      b. Field-fabricated, mechanically balanced, piping arrangement with calibrated balancing valves.
      c. Field-Fabricated equal-leg piping arrangement.
      d. Reverse-return manifold piping arrangement.

G. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1-M, manually operated. Furnish for installation in piping.

H. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include pressure rating as required to match gas supply.

I. Automatic Gas Valves: ANSI Z21.21/CSA 6.5, appliance, electrically operated, on-off automatic valve.

J. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
   1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.

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K. Pressure Relief Valves: Include pressure settings less than domestic-water heater working-pressure rating.
   1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.

L. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4-M.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install water heaters on housekeeping pads unless otherwise indicated.

C. Install water heaters, level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

D. Install temperature and pressure relief valves in top portion of storage tanks. Extend relief valve outlet with water piping in continuous downward pitch. Discharge in the following order:
   1. Closest floor drain.
   2. Mop sink.
   3. Drain Pan.

E. Install vacuum relief valves in cold-water-inlet piping.

F. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
   1. Exception: Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
   2. Maintain manufacturer's recommended clearances.
   3. Arrange units so controls and devices that require servicing are accessible.
   4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
   5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   7. Install anchor bolts to elevations required for proper attachment to supported equipment.
   8. Anchor domestic-water heaters to substrate.

G. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section "General Duty Valves for Plumbing Piping".

H. Install gas-fired, domestic-water heaters according to NFPA 54.
   1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
   2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
   3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.

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4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Section 221113 "Facility Natural-Gas Piping."

I. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping full size and same as domestic-water piping material in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

J. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

K. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

L. Assemble and install inlet and outlet piping manifold kits for multiple domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each domestic-water heater outlet. Comply with requirements for valves specified in Section 220523 "General Duty Valves for Plumbing Piping," and comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

M. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.

N. Fill domestic-water heaters with water.

O. Charge domestic-water compression tanks with air.

3.02 CONNECTIONS

A. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements for gas piping specified in Section 221113 "Facility Natural-Gas Piping."

C. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.03 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.04 FIELD QUALITY CONTROL

A. Engage a factory-authorized service representative to perform startup service.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.

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4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section "Quality Requirements" for retesting and reinspection requirements and Section "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water heaters.
   1. Train Owner's maintenance personnel on procedures for starting and stopping, troubleshooting, servicing, and maintaining equipment.
   2. Review data in maintenance manuals.

END OF SECTION 223400

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SECTION 224000
PLUMBING FIXTURES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.02 ABBREVIATIONS

A. ABS: Acrylonitrile-Butadiene-Styrene.

B. CPVC: Chlorinated Polyvinyl Chloride.

C. FRP: Fiberglass-Reinforced.

D. PE: Polyethylene.

E. PMMA: Polymethyl Methacrylate (Acrylic).

F. PP: Polypropylene.

G. PVC: Polyvinyl chloride plastic.

H. PVDF: Polyvinylidene Fluoride.

I. SS: Stainless-Steel.

1.03 DEFINITIONS

A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

C. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

D. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, showerheads and tub spouts, drains and tailpieces, and traps and waste pipes.

E. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.04 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and security anchors for security plumbing fixtures.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Performance Submittals:

1. Product Data:
   a. Documentation indicating flow and water consumption requirements.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For security plumbing fixtures and components to include in maintenance manuals.

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B. Faucet Cartridges, washers, aerators, and O-Rings: Equal to five percent (5%) of amount of each type and size installed but not less than five (5) of each type and size.

C. Water-Closet Tank, Repair Kits: Equal to ten percent (10%) of quantity of each type installed, or six (6), whichever is less.

D. Flushometer Valve Repair Kits: Equal to ten percent (10%) of quantity of each type installed, or six (6), whichever is less.

E. Provide Minimum number of key operators (wrenches/tools) for loose key stops, wall hydrants, aerators, security fasteners and any fixture where a key, security fastener, or special tool is required:
   1. One (1) for ten percent (10%) of each size or ten (10), whichever is less.

1.06 QUALITY ASSURANCE ***REFER TO CURRENT MCPS MECH-PLUMB DESIGN CHECKLIST***

A. **Comply with the requirements of the current MCPS Mechanical and Plumbing Design Checklist. Refer to the latest edition for applicable design, coordination, and documentation standards.**

B. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
   1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

C. Electrical Components, Devices, and Accessories: Electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities. Comply with requirements in Public Law 102-486, "Energy Policy Act," regarding water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. EPA WaterSense: Provide fixtures with WaterSense labeling for all applicable and eligible fixtures and accessories.

G. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

H. Comply with the following standards and other requirements where applicable:
   1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
   2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
   3. Slip-Resistant Bathing Surfaces: ASTM F 462.
   4. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
   5. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
   6. Stainless-Steel Residential Sinks: ASME A112.19.3.
   7. Vitreous-China Fixtures: ASME A112.19.2M.
   8. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
   9. Water-Closet, Flushometer Tank Trim: ASSE 1037.
   10. Whirlpool Bathtub Fittings: ASME A112.19.8M.
   11. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.

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12. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
13. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
14. Faucets: ASME A112.18.1.
15. Hose-Connection Vacuum Breakers: ASSE 1011.
16. Hose-Coupling Threads: ASME B1.20.7.
17. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
18. NSF Potable-Water Materials: NSF 61.
19. Pipe Threads: ASME B1.20.1.
20. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
21. Supply Fittings: ASME A112.18.1.
22. Brass Waste Fittings: ASME A112.18.2.
23. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
24. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
25. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.
26. Faucets: ASME A112.18.1.
27. Hand-Held Showers: ASSE 1014.
28. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
29. Hose-Coupling Threads: ASME B1.20.7.
30. Manual-Control Antiscald Faucets: ASTM F 444.
31. Pipe Threads: ASME B1.20.1.
32. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
33. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
34. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
35. Atmospheric Vacuum Breakers: ASSE 1001.
36. Brass and Copper Supplies: ASME A112.18.1.
37. Dishwasher Air-Gap Fittings: ASSE 1021.
38. Manual-Operation Flushometers: ASSE 1037.
39. Plastic Tubular Fittings: ASTM F 409.
40. Brass Waste Fittings: ASME A112.18.2.
41. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
42. Disposers: ASSE 1008 and UL 430.
43. Dishwasher Air-Gap Fittings: ASSE 1021.
44. Flexible Water Connectors: ASME A112.18.6.
45. Floor Drains: ASME A112.6.3.
46. Grab Bars: ASTM F 446.
47. Hose-Coupling Threads: ASME B1.20.7.
48. Hot-Water Dispensers: ASSE 1023 and UL 499.
49. Off-Floor Fixture Supports: ASME A112.6.1M.
50. Pipe Threads: ASME B1.20.1.
51. Plastic Shower Receptors: ANSI Z124.2.
52. Plastic Toilet Seats: ANSI Z124.5.
53. Supply and Drain Protective Shielding Guards: ICC A117.1.
54. Whirlpool Bathtub Equipment: UL 1795.

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1.07 COORDINATION

A. Coordinate all accessories. Ensure items fit and work together as an assembly. Provide additional accessories to accommodate final installed field conditions; to include, but not limited to, offsets and other items required for ADA compliance. Provide necessary accessories and components for complete installation.

B. Coordinate roughing-in and final plumbing fixture locations and verify that fixtures can be installed to comply with design.

C. Model numbers are intended to identify families of fixtures and may be incomplete. Refer to other contract documents for hand.

D. Where fixtures or associated components are installed in rated floors, walls, or ceilings; provide rated fixtures, accessories, and components of equal rating.

E. Where the flush valve assembly height would conflict with the rear grab bar installation (including the minimum 1-1/2" clearance to the bottom of the grab bar), the vacuum breaker flush tube shall be shortened. Shortening of the vacuum breaker flush tube shall not exceed the manufacturer's requirements for maintaining proper operation, including the CL (critical line) markings on the flush tube if provided by the manufacturer to indicate shortening limitations.

F. Coordinate final fixture mounting heights and configurations with Owner and Architect requirements and ensure all applicable codes and standards are maintained.

PART 2 PRODUCTS

2.01 (EWC-1) SINGLE-LEVEL WATER COOLER (ACCESSIBLE)

A. Fixture: Oasis PG8AC
   1. Self-contained wall hung electric refrigerated water cooler.
   2. Push bar activation on frotn, left, & right of unit.
   3. Built-in flow regulator.
   4. Connect to water supply using yellow brass fitting.
   5. Polyester elastomer flexible bubbler.
   6. Provide non-metallic strainer.
   7. Provide quick-connect fittings.
   8. Do NOT provide or install fountain with filters.
   9. Material: Stainless steel.
   10. Color: Stainless steel.
   11. Electrical: 115V, 1 PH, 60 HZ, 4.0 Full load amps, 370 Watts.
   12. Mounting Height:
      a. 34" rim for Adult height installations.
      b. 28" rim for Child height installations.

B. Supply:
   1. ½" IPS x 3/8" OD
   2. Compression-type, tamper-proof, loose-key stops.
   3. ½" x 3" chrome plated brass nipple.
   4. Heavy brass chrome plated wall flange with set-screw.
   5. Provide yellow brass connection.

C. Provide 1½" diameter plastic tailpiece extension. Electrically isolate cooler from drainage and vent system.

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D. Trap:
   1. Size: 1-1/2” x 1-1/2”
   2. Material: Polished chrome plated cast brass.
   3. Cleanout plug: Yes
   4. Nuts: Polished chrome plated brass.
   5. Wall bend: 17-gauge seamless tubular chrome plated brass.
   6. Wall flange: Chrome plated brass with setscrew. Where drainpipe connection protrudes from wall contractor may provide deep flange.

E. Manufacturers:
   1. Drinking Fountain:
      a. Elkay
      b. Halsey Taylor
      c. Oasis
   2. Trap:
      a. Kohler
      b. Cambridge Brass

2.02 (EWC-2) BI-LEVEL WATER COOLER (ACCESSIBLE)

A. Fixture: Oasis PG8ACSL
   1. Self-contained wall hung electric refrigerated water cooler.
   2. Push bar activation on frotn, left, & right of unit.
   3. Built-in flow regulator.
   4. Connect to water supply using yellow brass fitting.
   5. Polyester elastomer flexible bubbler.
   6. Provide non-metallic strainer.
   7. Provide quick-connect fittings.
   8. Provide cane apron on upper fountain.
   9. Do NOT provide or install fountain with filters.
   10. Material: Stainless steel.
   11. Color: Stainless steel.
   12. Electrical: 115V, 1 PH, 60 HZ, 4.0 Full load amps, 370 Watts.
   13. Mounting Height:
      a. 34" rim for Adult nstallations.
      b. 28" rim for Child height installations.

B. Supply:
   1. ½” IPS x 3/8” OD
   2. Compression-type, tamper-proof, loose-key stops.
   3. ½” x 3” chrome plated brass nipple.
   4. Heavy brass chrome plated wall flange with set-screw.
   5. Provide yellow brass connection.

C. Provide 1½” diameter plastic tailpiece extension. Electrically isolate cooler from drainage and vent system.

D. Trap:
   1. Size: 1-1/2” x 1-1/2”

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2. Material: Polished chrome plated cast brass.
3. Cleanout plug: Yes
4. Nuts: Polished chrome plated brass.
5. Wall bend: 17-gauge seamless tubular chrome plated brass.
6. Wall flange: Chrome plated brass with setscrew. Where drainpipe connection protrudes from wall contractor may provide deep flange.

E. Manufacturers:
1. Drinking Fountain:
a. Elkay
b. Halsey Taylor
c. Oasis
2. Trap:
a. Kohler
b. Cambridge Brass

2.03 (EWC-3) BI-LEVEL WATER COOLER (ACCESSIBLE) WITH BOTTLE FILLING STATION

A. Fixture: Oasis PG8FEBFSL
1. Self-contained wall hung electric refrigerated water cooler.
2. Push bar activation on front, left, & right of unit.
3. Built-in flow regulator.
4. Connect to water supply using yellow brass fitting.
5. Polyester elastomer flexible bubbler.
6. Provide non-metallic strainer.
7. Provide quick-connect fittings.
8. Provide cane apron on upper fountain.
9. Provide bottle filling station.
10. Do NOT provide or install fountain with filters.
11. Material: Stainless steel.
12. Color: Stainless steel.
13. Electrical: 115V, 1 PH, 60 HZ, 4.0 Full load amps, 370 Watts.
14. Mounting Height:
a. 34" rim for Adult height installations.
b. 28" rim for Child height installations.

B. Supply:
1. ½” IPS x 3/8” OD
2. Compression-type, tamper-proof, loose-key stops.
3. ½” x 3” chrome plated brass nipple.
4. Heavy brass chrome plated wall flange with set-screw.
5. Provide yellow brass connection.

C. Provide 1½” diameter plastic tailpiece extension. Electrically isolate cooler from drainage and vent system.

D. Trap:
1. Size: 1-1/2” x 1-1/2”
2. Material: Polished chrome plated cast brass.

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3. Cleanout plug: Yes
4. Nuts: Polished chrome plated brass.
5. Wall bend: 17-gauge seamless tubular chrome plated brass.
6. Wall flange: Chrome plated brass with setscrew. Where drainpipe connection protrudes from wall contractor may provide deep flange.

E. Manufacturers:
1. Drinking Fountain:
a. Elkay
b. Halsey Taylor
c. Oasis
2. Trap:
a. Kohler
b. Cambridge Brass

2.04 (HB-1) HOSE BIBB

A. Fixture: Zurn Z1341XL
1. Vacuum Breaker: Yes (separate).
2. Outlet: ASME B1.20.7, garden-hose threads.
3. ¾" Inlet.
4. Ball valve ¼ turn or compression.
5. Brass Construction.
6. Aluminum, brass, stainless steel, or steel handle.

B. Manufacturers:
1. Apollo
2. Arrowhead Brass
3. Chicago
4. T&S Brass
5. Zurn

2.05 (LA-1) LAVATORY WALL-HUNG CARRIER-MOUNTED WITH METERING FAUCET (ADULT STANDARD)

A. Fixture: Kohler Kingston K-2006
1. Material: Vitreous China
2. Color: White
3. Mounting Height:
a. 31" rim for Adult standard height installations.
b. 34" rim for Adult ADA height installations.
c. 31" rim for Child (6-12) ADA height installations.
d. 24" rim for Child (Pre-K, 5 and under) height installations.

B. Metering Faucet: Chicago 404-V765E39ABCP
1. 5" Spout with angled throw.
2. 0.35 GPM maximum flow.
3. Chrome plated.
4. All brass body.

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5. Renewable seat and washers.
6. ADA-compliant metering handles.
7. ASSE-1070 Thermostatic Mixing Valve: Watts-Powers LFG480

C. Grid Strainer & Tail Piece:
1. Material: Forged brass, chrome plated.
2. Tailpiece: 1-1/2” x 4” 20-gauge seamless brass, chrome plated.
3. Nuts: Cast brass lock, slip, and coupling, chrome plated.

D. Trap:
1. 1-1/4” x 1-1/2” cast brass polished chrome trap with cleanout plug and brass slip nuts.
2. 17-gauge seamless tubular chrome plated brass wall bend.
3. Forged brass chrome plated wall flange with setscrew.

E. Supplies:
1. ½” IPS x 3/8” OD
2.
3. ½” x 3” chrome plated brass nipple.
4. Heavy brass chrome plated wall flange with set-screw.
5. Contractor shall coordinate supply connection to faucet.

F. Insulation:
1. Color: White
2. Insulate P-trap, hot and cold angle valves, hot and cold risers.

G. Carrier:
1. Floor mounted with rectangular uprights.

H. Manufacturers:
1. Fixture:
   a. American Standard
   b. Eljer
   c. Kohler
   d. Sloan
   e. Zurn
2. Faucet:
   a. American Standard
   b. Chicago
   c. Speakman
   d. Zurn
3. Supplies, Traps, Drains, and Miscellaneous Trim:
   a. Acorn Engineering
   b. Bradley Corp.
   c. Brass-Craft
   d. Chicago
   e. Elkay
   f. Engineered Brass
   g. Guy Gray / IPS Corp.
   h. McGuire

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i. T&S Brass and Bronze Works

4. Fixture Supports and Carriers:
   a. J.R. Smith
   b. Josam
   c. Zurn

2.06 (LA-2) LAVATORY WALL-HUNG CARRIER-MOUNTED WITH METERING FAUCET (ADULT-ACCESSIBLE)

A. Fixture: Kohler Kingston K-2006
   1. Material: Vitreous China
   2. Color: White
   3. Mounting Height:
      a. 31" rim for Adult standard height installations.
      b. 34" rim for Adult ADA height installations.
      c. 31" rim for Child (6-12) ADA height installations.
      d. 24" rim for Child (Pre-K, 5 and under) height installations.

B. Metering Faucet: Chicago 404-V765E39ABCP
   1. 5" Spout with angled throw.
   2. 0.35 GPM maximum flow.
   3. Chrome plated.
   4. All brass body.
   5. Renewable seat and washers.
   6. ADA-compliant metering handles.
   7. ASSE-1070 Thermostatic Mixing Valve: Watts-Powers LFG480

C. Grid Strainer & Tail Piece:
   1. Material: Forged brass, chrome plated.
   2. Tailpiece: 1-1/2” x 4” 20-gauge seamless brass, chrome plated.
   3. Nuts: Cast brass lock, slip, and coupling, chrome plated.

D. Trap:
   1. 1-1/4” x 1-1/2” cast brass polished chrome trap with cleanout plug and brass slip nuts.
   2. 17-gauge seamless tubular chrome plated brass wall bend.
   3. Forged brass chrome plated wall flange with setscrew.

E. Supplies:
   1. ½” IPS x 3/8” OD
   2. Compression-type, tamper-proof, loose-key stops.
   3. ½” x 3” chrome plated brass nipple.
   4. Heavy brass chrome plated wall flange with set-screw.
   5. Contractor shall coordinate supply connection to faucet.

F. Insulation:
   1. Color: White
   2. Insulate P-trap, hot and cold angle valves, hot and cold risers.

G. Carrier:
   1. Floor mounted with rectangular uprights.

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H. Manufacturers:
   1. Fixture:
      a. American Standard
      b. Eljer
      c. Kohler
      d. Sloan
      e. Zurn
   2. Metering Faucet:
      a. American Standard
      b. Chicago
      c. Speakman
      d. Zurn
   3. Supplies, Traps, Drains and Miscellaneous Trim:
      a. Acorn Engineering
      b. Bradley Corp.
      c. Brass-Craft
      d. Chicago
      e. Elkay
      f. Engineered Brass
      g. Guy Gray / IPS Corp.
      h. McGuire
      i. T&S Brass and Bronze Works
   4. Fixture Supports and Carriers:
      a. J.R. Smith
      b. Josam
      c. Zurn

2.07 (LA-3) LAVATORY WALL-HUNG CARRIER-MOUNTED WITH METERING FAUCET (CHILD-ACCESSIBLE, AGES 6-12)

A. Fixture: Kohler Kingston K-2006
   1. Material: Vitreous China
   2. Color: White
   3. Mounting Height:
      a. 31" rim for Adult standard height installations.
      b. 34" rim for Adult ADA height installations.
      c. 31" rim for Child (6-12) ADA height installations.
      d. 24" rim for Child (Pre-K, 5 and under) height installations.

B. Metering Faucet: Chicago 404-V765E39ABCP
   1. 5" Spout with angled throw.
   2. 0.35 GPM maximum flow.
   3. Chrome plated.
   4. All brass body.
   5. Renewable seat and washers.
   6. ADA-compliant metering handles.

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7. ASSE-1070 Thermostatic Mixing Valve: Watts-Powers LFG480

C. Grid Strainer & Tail Piece:
   1. Material: Forged brass, chrome plated.
   2. Tailpiece: 1-1/2” x 4” 20-gauge seamless brass, chrome plated.
   3. Nuts: Cast brass lock, slip, and coupling, chrome plated.

D. Trap:
   1. 1-1/4” x 1-1/2” cast brass polished chrome trap with cleanout plug and brass slip nuts.
   2. 17-gauge seamless tubular chrome plated brass wall bend.
   3. Forged brass chrome plated wall flange with setscrew.

E. Supplies:
   1. ½” IPS x 3/8” OD
   2. Compression-type, tamper-proof, loose-key stops.
   3. ½” x 3” chrome plated brass nipple.
   4. Heavy brass chrome plated wall flange with set-screw.
   5. Contractor shall coordinate supply connection to faucet.

F. Insulation:
   1. Color: White
   2. Insulate P-trap, hot and cold angle valves, hot and cold risers.

G. Carrier:
   1. Floor mounted with rectangular uprights.

H. Manufacturers:
   1. Fixture:
      a. American Standard
      b. Eljer
      c. Kohler
      d. Sloan
      e. Zurn
   2. Faucet:
      a. American Standard
      b. Chicago
      c. Speakman
      d. Zurn
   3. Supplies, Traps, Drains, and Miscellaneous Trim:
      a. Acorn Engineering
      b. Bradley Corp.
      c. Brass-Craft
      d. Chicago
      e. Elkay
      f. Engineered Brass
      g. Guy Gray / IPS Corp.
      h. McGuire
      i. T&S Brass and Bronze Works
   4. Fixture Supports and Carriers:

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a. J.R. Smith
b. Josam
c. Zurn

2.08 (LA-4) LAVATORY WALL-HUNG CARRIER-MOUNTED WITH METERING FAUCET (CHILD, AGES 5 AND UNDER)

A. Fixture: Kohler Kingston K-2006
1. Material: Vitreous China
2. Color: White
3. Mounting Height:
a. 31" rim for Adult standard height installations.
b. 34" rim for Adult ADA height installations.
c. 31" rim for Child (6-12) ADA height installations.
d. 24" rim for Child (Pre-K, 5 and under) height installations.

B. Metering Faucet: Chicago 404-V765E39ABCP
1. 5" Spout with angled throw.
2. 0.35 GPM maximum flow.
3. Chrome plated.
4. All brass body.
5. Renewable seat and washers.
6. ADA-compliant metering handles.
7. ASSE-1070 Thermostatic Mixing Valve: Watts-Powers LFG480

C. Grid Strainer & Tail Piece:
1. Material: Forged brass, chrome plated.
2. Tailpiece: 1-1/2" x 4" 20-gauge seamless brass, chrome plated.
3. Nuts: Cast brass lock, slip, and coupling, chrome plated.

D. Trap:
1. 1-1/4" x 1-1/2" cast brass polished chrome trap with cleanout plug and brass slip nuts.
2. 17-gauge seamless tubular chrome plated brass wall bend.
3. Forged brass chrome plated wall flange with setscrew.

E. Supplies:
1. ½" IPS x 3/8" OD
2. Compression-type, tamper-proof, loose-key stops.
3. ½" x 3" chrome plated brass nipple.
4. Heavy brass chrome plated wall flange with set-screw.
5. Contractor shall coordinate supply connection to faucet.

F. Insulation:
1. Color: White
2. Insulate P-trap, hot and cold angle valves, hot and cold risers.

G. Carrier:
1. Floor mounted with rectangular uprights.

H. Manufacturers:
1. Fixture:

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a. American Standard
b. Eljer
c. Kohler
d. Sloan
e. Zurn

2. Faucet:
   a. American Standard
   b. Chicago
   c. Speakman
   d. Zurn
3. Supplies, Traps, Drains, and Miscellaneous Trim:
   a. Acorn Engineering
   b. Bradley Corp.
   c. Brass-Craft
   d. Chicago
   e. Elkay
   f. Engineered Brass
   g. Guy Gray / IPS Corp.
   h. McGuire
   i. T&S Brass and Bronze Works
4. Fixture Supports and Carriers:
   a. J.R. Smith
   b. Josam
   c. Zurn

2.09 (MB-1) MOP BASIN (32" X 32")

A. Fixture: Fiat TSB3001
   1. Dimensions: 32" x 32" x 12".
   2. Cap: Stainless steel on 4 sides.
   3. Tiling Flange: Yes, on two sides.
   4. Material: Terrazzo.
   5. Color: Manufacturer's standard.

B. Faucet: Chicago 445-897SRXKCCP
   1. 8" centers.
   2. Vacuum breaker spout.
   3. Threaded male hose outlet.
   4. Lever handles.
   5. Integral supply check stops.
   6. Pail hook.
   7. Wall support.

C. Drain: Cast brass with stainless steel strainer or equal as furnished with sink.

D. Trap: 3" (Provide additional pipe and material transition as required to make connection to basin/sink.)

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E. Stainless steel utility shelf with mop/broom holders and rag hooks: Bobrick B-239.

F. Provide the following other Accessories:
   1. Hose Hook
   2. 36" Long Hose

G. Manufacturers:
   1. Fixture:
      a. Fiat
      b. Florestone
      c. Just
      d. Stern-Williams
   2. Faucet:
      a. American Standard
      b. Chicago
      c. Fiat
      d. Speakman

2.10 (MB-2) MOP BASIN (36" X 24")

A. Fixture: Fiat MSB3624
   1. Dimensions: 36" x 24" x 12".
   2. Cap: Stainless steel on 4 sides.
   3. Tiling Flange: Yes, on two sides.
   4. Material: Molded Stone.
   5. Color: Manufacturer's standard.

B. Faucet: Chicago 445-897SRXKCCP
   1. 8" centers.
   2. Vacuum breaker spout.
   3. Threaded male hose outlet.
   4. Lever handles.
   5. Integral supply check stops.
   6. Pail hook.
   7. Wall support.

C. Drain: Cast brass with stainless steel strainer or equal as furnished with sink.

D. Trap: 3" (Provide additional pipe and material transition as required to make connection to basin/sink.)

E. Stainless steel utility shelf with mop/broom holders and rag hooks: Bobrick B-239.

F. Provide the following other Accessories:
   1. Hose Hook
   2. 36" Long Hose

G. Manufacturers:
   1. Fixture:
      a. Fiat
      b. Florestone
      c. Just

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d. Stern-Williams

2. Faucet:
   a. American Standard
   b. Chicago
   c. Fiat
   d. Speakman

2.11 (MS-1) MOP SINK WALL-MOUNTED CAST-IRON

A. Fixture: Kohler Bannon K6716
   1. Dimensions: 24" x 20" x 13".
   2. Mounting: Wall-mounted with floor-mounted trap support arm.
   3. Material: Enameled cast-iron.
   4. Color: White.

B. Faucet: Chicago 305-RXKCCP
   1. 8" centers.
   2. Vacuum breaker spout.
   3. Threaded male hose outlet.
   4. Lever handles.
   5. Integral supply check stops.
   6. Pail hook.
   7. Wall support.

C. Drain: Cast brass with stainless steel strainer or equal as furnished with sink.

D. Trap: 3" (Provide additional pipe and material transition as required to make connection to basin/sink.)

E. Stainless steel utility shelf with mop/broom holders and rag hooks: Bobrick B-239.

F. Provide the following other Accessories:
   1. Hose Hook
   2. 36” long hose

G. Manufacturers:
   1. Fixture:
      a. Fiat
      b. Florestone
      c. Just
      d. Stern-Williams
   2. Faucet:
      a. American Standard
      b. Chicago
      c. Fiat
      d. Speakman

2.12 (RH-1) ROOF HYDRANT FREEZE-RESISTANT

A. Description: Exposed, lead-free, non-freeze, roof hydrant with coated cast-iron head and lift handle with lock, integral vacuum breaker/backflow preventer, galvanized steel casing, bronze

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and stainless-steel interior components, coated cast-iron roof support sleeve with wide anchor flange and clamp collar.

B. Fixture: Woodford SRH-MS
   1. Inlet: ¾" Threaded or soldered joint.
   2. Outlet: ASME B1.20.7, garden-hose threads.
   3. Drain Port: Drainless type unit with self-draining internal reservoir.
   4. Variable flow plunger and large easy open handle.

C. Manufacturers:
   1. Apollo
   2. Arrowhead Brass
   3. Chicago
   4. T&S Brass
   5. Woodford
   6. Zurn

2.13 (SH-1) INDIVIDUAL SHOWER PANEL

A. Enclosure: By others, refer to architectural.

B. Fixture: Bradley WS-1WCA - 6'-0"-HD-SF-LHV-ST-NSD-SHV-VS
   1. Wall-mounted packaged shower assembly.
   2. 1.50 GPM controlled flow.
   3. Provided ASSE-1016 thermostatic shower valve with integral supply check stops.
   4. Material: Stainless steel.
   5. Equa-Flo HD pressure balancing valve.
   6. Deluxe showerhead with ball joint.
   7. Lever handle volume control.
   8. Vertical stainless-steel shroud.
      a. Extension to ceiling as required for each installed location.
   9. Vandal-resistant screws.

C. Provide one (1) outside white cotton shower curtain and one (1) inside vinyl curtain liner.

D. Provide chrome plated brass curtain rod and flanges.

E. Provide two (2) sets of rollerball type shower curtain hooks.

F. Provide self-sealing brass drain and strainer.

G. Manufacturers:
   1. Acorn Engineering
   2. Bradley Corp.

2.14 (SH-2) INDIVIDUAL SHOWER PANEL (ACCESSIBLE)

A. Enclosure: By others, refer to architectural.

B. Fixture: Bradley HN250 - 6'-0"-HD-SF-HS-LHV-SB-SHV-RSS-CRH-GB-VS
   1. Wall-mounted packaged ADA shower assembly.
   2. 1.50 GPM controlled flow.
   3. Provide ASSE-1016 thermostatic shower valve with integral supply check stops.
   4. Material: Stainless steel.

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5. Equa-Flo HD pressure balancing valve.
6. Deluxe showerhead with ball joint.
7. Lever handle volume control.
8. Vertical stainless-steel shroud.
    a. Extension to ceiling as required for each installed location.
9. Vandal-resistant screws.

C. Provide one (1) outside white cotton shower curtain and one (1) inside vinyl curtain liner.

D. Provide chrome plated brass curtain rod and flanges.

E. Provide two (2) sets of rollerball type shower curtain hooks.

F. Provide self-sealing brass drain and strainer.

G. Manufacturers:
1. Acorn Engineering
2. Bradley Corp.

2.15 (SK-1) SINK - SINGLE BOWL (ACCESSIBLE) GENERAL / BREAKROOM / CLASSROOM

A. Fixture: Elkay LRAD221955
1. Overall Length (left to right): 22"
2. Overall Width (front to back): 19-1/2"
3. Inside Bowl Depth: 5-1/2"
4. Material: 18-Gauge Stainless Steel.
5. Number of Bowls: 1
6. Drain Location: Off-Center, Rear.
7. Mounting: Counter-mounted, self-rimming, inside hole ratchet mounting system.
8. Deck Hole Drilling Configuration:
    a. 3 Holes, 4" apart, centered.

B. Faucet: Chicago 201-RSGN2AE35VAB
1. Hole Configuration: 3 Hole installation, 8" centers.
2. Spout: 5-1/4" Gooseneck limited/restricted swing spout.
3. Handles: Levers
4. Aerator: Vandal-resistant, pressure compensating, 0.50 gpm.
5. Cartridges: Ceramic or compression 1/4 turn.
6. Meets ADA Requirements: Yes.
7. Red and Blue Temperature Indicators: Red = Hot, Blue = Cold
8. ASSE-1070 Thermostatic Mixing Valve: Watts-Powers LFG480

C. Basket Strainer & Tail Piece:
1. Material: Forged brass, chrome plated.
2. Tailpiece: 1-1/2” x 4” 20-gauge seamless brass, chrome plated.
3. Nuts: Cast brass lock, slip, and coupling, chrome plated.

D. Trap:
1. Size: 1-1/2” x 1-1/2”.
2. Material: Polished chrome plated cast brass.
3. Cleanout plug: Yes.
4. Nuts: Polished chrome plated brass.

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5. Wall bend: 17-gauge seamless tubular chrome plated brass.
6. Wall flange: Chrome plated brass with setscrew. Where pipe protrudes from wall contractor may provide deep flange.

E. Supplies:
1. ½" IPS x 3/8" OD
2. Compression-type, tamper-proof, loose-key stops.
3. Nipple: ½" x 3" chrome plated brass.
4. Wall flange: Heavy brass chrome plated with set-screw.

F. Insulation:
1. Insulate P-trap, hot and cold angle valves, hot and cold risers.

G. Manufacturers:
1. Fixture:
a. Acorn
b. Elkay
c. Just
d. Kohler
2. Faucet:
a. Chicago
b. Elkay
c. Speakman
d. T&S Brass
3. Supplies, Traps, Drains, and Miscellaneous Trim:
a. Acorn Engineering
b. Bradley Corp.
c. Brass-Craft
d. Chicago
e. Elkay
f. Engineered Brass
g. Guy Gray / IPS Corp.
h. McGuire
i. T&S Brass and Bronze Works

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2.16 (SK-2) SINK - SINGLE BOWL WITH EYEWASH (ACCESSIBLE) CLINIC

A. Fixture: Elkay LRAD221955
1. Overall Length (left to right): 22"
2. Overall Width (front to back): 19-1/2"
3. Inside Bowl Depth: 5-1/2"
4. Material: 18-Gauge Stainless Steel.
5. Number of Bowls: 1
6. Drain Location: Off-Center, Rear.
7. Mounting: Counter-mounted, self-rimming, inside hole ratchet mounting system.
8. Deck Hole Drilling Configuration:
a. 3 Holes, 4" apart, centered.

B. Faucet: Chicago 201-RSGN2AE35VAB
   1. Hole Configuration: 3 Hole installation, 8" centers.
   2. Spout: 5-1/4" Gooseneck limited/restricted swing spout.
   3. Handles: Levers
   4. Aerator: Vandal-resistant, pressure compensating, 0.50 gpm.
   5. Cartridges: Ceramic or compression 1/4 turn.
   6. Meets ADA Requirements: Yes.
   7. Red and Blue Temperature Indicators: Red = Hot, Blue = Cold
   8. ASSE-1070 Thermostatic Mixing Valve: Watts-Powers LFG480

C. Eyewash: Haws 8904
   1. Deck-mounted emergency eye/face wash.
   2. Chrome-plated brass stay-open valve.
   3. ANSI/ISEA Z358.1 compliant.
   4. Internal flow control.
   5. 8'-0" 250psi hose with chrome-plated swivel fitting.
   6. Deck flange with key slot for proper positioning of unit.
   7. Universal signage.
   8. 1/2" NPT inlet.
   9. Provide unit with vacuum breaker accessory. Haws SP212
   10. Provide unit with ASSE-1071 emergency thermostatic mixing valve. Haws 9201EW
   11. Coordinate deck-mounting location with Owner and Architect.

D. Basket Strainer & Tail Piece:
   1. Material: Forged brass, chrome plated.
   2. Tailpiece: 1-1/2” x 4” 20-gauge seamless brass, chrome plated.
   3. Nuts: Cast brass lock, slip, and coupling, chrome plated.

E. Trap:
   1. Size: 1-1/2” x 1-1/2”.
   2. Material: Polished chrome plated cast brass.
   3. Cleanout plug: Yes.
   4. Nuts: Polished chrome plated brass.
   5. Wall bend: 17-gauge seamless tubular chrome plated brass.
   6. Wall flange: Chrome plated brass with setscrew. Where pipe protrudes from wall contractor may provide deep flange.

F. Supplies:
   1. ½” IPS x 3/8” OD
   2. Compression-type, tamper-proof, loose-key stops.
   3. Nipple: ½” x 3” chrome plated brass.
   4. Wall flange: Heavy brass chrome plated with set-screw.

G. Insulation:
   1. Insulate P-trap, hot and cold angle valves, hot and cold risers.

H. Manufacturers:
   1. Fixture:
      a. Acorn

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b. Elkay
c. Just
d. Kohler

2. Faucet:
   a. Chicago
   b. Elkay
   c. Speakman
   d. T&S Brass
3. Eyewash:
   a. Bradley
   b. Guardian
   c. Haws
4. Supplies, Traps, Drains, and Miscellaneous Trim:
   a. Acorn Engineering
   b. Bradley Corp.
   c. Brass-Craft
   d. Chicago
   e. Elkay
   f. Engineered Brass
   g. Guy Gray / IPS Corp.
   h. McGuire
   i. T&S Brass and Bronze Works

2.17 (SK-3) SINK - SINGLE BOWL WITH SOLIDS INTERCEPTOR (ACCESSIBLE) MUSIC/ART

A. Fixture: Elkay LRAD221955
   1. Overall Length (left to right): 22"
   2. Overall Width (front to back): 19-1/2"
   3. Inside Bowl Depth: 5-1/2"
   4. Material: 18-Gauge Stainless Steel.
   5. Number of Bowls: 1
   6. Drain Location: Off-Center, Rear.
   7. Mounting: Counter-mounted, self-rimming, inside hole ratchet mounting system.
   8. Deck Hole Drilling Configuration:
      a. 3 Holes, 4" apart, centered.

B. Faucet: Chicago 201-RSGN2AE35VAB
   1. Hole Configuration: 3 Hole installation, 8" centers.
   2. Spout: 5-1/4" Gooseneck limited/restricted swing spout.
   3. Handles: Levers
   4. Aerator: Vandal-resistant, pressure compensating, 0.50 gpm.
   5. Cartridges: Ceramic or compression 1/4 turn.
   6. Meets ADA Requirements: Yes.
   7. Red and Blue Temperature Indicators: Red = Hot, Blue = Cold
   8. ASSE-1070 Thermostatic Mixing Valve: Watts-Powers LFG480

C. Trap-Type Solids Interceptor: Zurn ZA-1180-SS

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1. Acid resistant coated interior and exterior.
2. Top access cover with gasket.
3. Trap-type interceptor.
4. 1-1/2” threaded inlet, 1-1/2” threaded side outlet.
5. Removable sediment bucket with stainless-steel screen.
6. Provide offset unit where required to maintain ADA clearance requirements.

D. Basket Strainer & Tail Piece:
1. Material: Forged brass, chrome plated.
2. Tailpiece: 1-1/2” x 4” 20-gauge seamless brass, chrome plated.
3. Nuts: Cast brass lock, slip, and coupling, chrome plated.

E. Supplies:
1. ½” IPS x 3/8” OD
2. Compression-type, tamper-proof, loose-key stops.
3. Nipple: ½” x 3” chrome plated brass.
4. Wall flange: Heavy brass chrome plated with set-screw.

F. Insulation:
1. Insulate P-trap, hot and cold angle valves, hot and cold risers.

G. Manufacturers:
1. Fixture:
   a. Acorn
   b. Elkay
   c. Just
   d. Kohler
2. Faucet:
   a. Chicago
   b. Elkay
   c. Speakman
   d. T&S Brass
3. Trap-Type Solids Interceptor:
   a. J.R. Smith
   b. Josam
   c. Zurn
4. Supplies, Traps, Drains, and Miscellaneous Trim:
   a. Acorn Engineering
   b. Bradley Corp.
   c. Brass-Craft
   d. Chicago
   e. Elkay
   f. Engineered Brass
   g. Guy Gray / IPS Corp.
   h. McGuire
   i. T&S Brass and Bronze Works

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2.18 (SK-4) SINK - LARGE SINGLE BOWL WITH SOLIDS INTERCEPTOR MUSIC

A. Fixture: Elkay DLR221910
   1. Overall Length (left to right): 22"
   2. Overall Width (front to back): 19-1/2"
   3. Inside Bowl Depth: 10-1/8"
   4. Material: 18-Gauge Stainless Steel.
   5. Number of Bowls: 1
   6. Drain Location: Off-Center, Rear.
   7. Mounting: Counter-mounted, self-rimming, inside hole ratchet mounting system.
   8. Deck Hole Drilling Configuration:
      a. 3 Holes, 4" apart, centered.

B. Faucet: Chicago 201-RSGN2AE35VAB
   1. Hole Configuration: 3 Hole installation, 8" centers.
   2. Spout: 5-1/4" Gooseneck limited/restricted swing spout.
   3. Handles: Levers
   4. Aerator: Vandal-resistant, pressure compensating, 0.50 gpm.
   5. Cartridges: Ceramic or compression 1/4 turn.
   6. Meets ADA Requirements: Yes.
   7. Red and Blue Temperature Indicators: Red = Hot, Blue = Cold
   8. ASSE-1070 Thermostatic Mixing Valve: Watts-Powers LFG480

C. Trap-Type Solids Interceptor: Zurn ZA-1180-SS
   1. Acid resistant coated interior and exterior.
   2. Top access cover with gasket.
   3. Trap-type interceptor.
   4. 1-1/2” threaded inlet, 1-1/2” threaded side outlet.
   5. Removable sediment bucket with stainless-steel screen.
   6. Coordinate final installation and placement of unit with ADA clearance requirements.

D. Basket Strainer & Tail Piece:
   1. Material: Forged brass, chrome plated.
   2. Tailpiece: 1-1/2” x 4” 20-gauge seamless brass, chrome plated.
   3. Nuts: Cast brass lock, slip, and coupling, chrome plated.

E. Supplies:
   1. ½” IPS x 3/8” OD
   2.
   3. Nipple: ½” x 3” chrome plated brass.
   4. Wall flange: Heavy brass chrome plated with set-screw.

F. Manufacturers:
   1. Fixture:
      a. Acorn
      b. Elkay
      c. Just
      d. Kohler
   2. Faucet:

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a. Chicago
b. Elkay
c. Speakman
d. T&S Brass

3. Trap-Type Solids Interceptor:
   a. J.R. Smith
   b. Josam
   c. Zurn
4. Supplies, Traps, Drains, and Miscellaneous Trim:
   a. Acorn Engineering
   b. Bradley Corp.
   c. Brass-Craft
   d. Chicago
   e. Elkay
   f. Engineered Brass
   g. Guy Gray / IPS Corp.
   h. McGuire
   i. T&S Brass and Bronze Works

2.19 (SK-5) SINK - LARGE SINGLE BOWL WITH SOLIDS INTERCEPTOR ART

A. Fixture: Elkay

B. Faucet: Chicago

2.20 (SK-SC) SCIENCE SINK

A. Fixture:
   1. Fixture by Division 12, provide rough-in and accessories as necessary and provide complete installation.

B. Faucet:
   1. Faucet by Division 12, provide rough-in and accessories as necessary and provide complete installation.

C. Tail Piece: Provide piping and system from sink outlet to trap-type acid neutralizer with suitable acid-resistant material. Confirm acceptance with owner prior to final approval.
   1. Material: PP, PE, PVDF, or CPVC Chem
   2. Tailpiece: 1-1/2” x 4”.
   3. Provide offset as required for ADA installation to ensure approach path is maintained.

D. Acid Neutralization Trap (Acid Neutralizer): Striem Lab Rat LB-2-ADA
   1. Top Access.
   2. Fixture trap type.
   3. 1-1/2” threaded inlet, 1-1/2” threaded side outlet.
   4. Polyethylene body.
   5. Cover with gasket.
   6. Limestone media.
   7. Integral trap.

E. Supplies:

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1. ½" IPS x 3/8" OD
2. Compression-type, tamper-proof, loose-key stops.
3. Nipple: ½" x 3" chrome plated brass.
4. Wall flange: Heavy brass chrome plated with set-screw.

F. Manufacturers:
1. Fixture:
a. By Division 12.
2. Faucet:
a. By Division 12.
3. Acid Neutralizer:
a. Orion
b. Striem
c. Zurn
4. Supplies, Traps, Drains, and Miscellanous Trim:
a. Acorn Engineering
b. Bradley Corp.
c. Brass-Craft
d. Chicago
e. Elkay
f. Engineered Brass
g. Guy Gray / IPS Corp.
h. McGuire
i. T&S Brass and Bronze Works

2.21 (UR-1) URINAL WITH MANUAL FLUSH VALVE (ADULT STANDARD)

A. Fixture: Kohler Bardon K-4991-ET (0.125 GPF)
1. Material: Vitreous China
2. Color: White
3. Consumption: Suitable and matching flush rate of valve provided.
4. Mounting Height:
a. 24" rim for Adult standard height installations.
b. 16" rim for Adult ADA height installations.
c. 15" rim for Child (K-5th Grade, 6-10) ADA height installations.
d. 12" rim for Child (Pre-K, 5 and under) height installations.

B. Flush Valve: Sloan Royal 186-0.125 (0.125 GPF)
1. Supply Rough-in Elevation: 11-1/2" above spud connection
2. Accessible handle located on wide side of approach.
3. Sweat Solder Adapter and Cast Wall Flange with Set Screw.
4. Vandal Resistant Stop Cap with Set Screw.

C. Carrier: Josam Series 17560-UR.
1. Provide components for thicker walls when required.
2. Provide valve plate for attaching to upright.
3. Provide sleeved pass through where side-by-side configuration or similar is required to allow piping to pass horizontally at carrier support.

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D. Manufacturers:
   1. Fixture:
      a. American Standard
      b. Crane
      c. Eljer
      d. Kohler
      e. Zurn
   2. Flush Valve:
      a. Sloan
      b. Zurn
   3. Carrier :
      a. J.R. Smith
      b. Josam
      c. Zurn

2.22 (UR-2) URINAL WITH MANUAL FLUSH VALVE (ADULT-ACCESSIBLE)

A. Fixture: Kohler Bardon K-4991-ET (0.125 GPF)
   1. Material: Vitreous China
   2. Color: White
   3. Consumption: Suitable and matching flush rate of valve provided.
   4. Mounting Height:
      a. 24” rim for Adult standard height installations.
      b. 16” rim for Adult ADA height installations.
      c. 15” rim for Child (K-5th Grade, 6-10) ADA height installations.
      d. 12” rim for Child (Pre-K, 5 and under) height installations.

B. Flush Valve: Sloan Royal 186-0.125 (0.125 GPF)
   1. Supply Rough-in Elevation: 11-1/2” above spud connection
   2. Accessible handle located on wide side of approach.
   3. Sweat Solder Adapter and Cast Wall Flange with Set Screw.
   4. Vandal Resistant Stop Cap with Set Screw.

C. Carrier: Josam Series 17560-UR.
   1. Provide components for thicker walls when required.
   2. Provide valve plate for attaching to upright.
   3. Provide sleeved pass through where side-by-side configuration or similar is required to allow piping to pass horizontally at carrier support.

D. Manufacturers:
   1. Fixture:
      a. American Standard
      b. Crane
      c. Eljer
      d. Kohler
      e. Zurn
   2. Flush Valve:
      a. Sloan

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b. Zurn

3. Carrier :
   a. J.R. Smith
   b. Josam
   c. Zurn

2.23 (UR-3) URINAL WITH MANUAL FLUSH VALVE (CHILD-ACCESSIBLE, GRADE K-5TH, AGES 6-10)

A. Fixture: Kohler Bardon K-4991-ET (0.125 GPF)
   1. Material: Vitreous China
   2. Color: White
   3. Consumption: Suitable and matching flush rate of valve provided.
   4. Mounting Height:
      a. 24” rim for Adult standard height installations.
      b. 16” rim for Adult ADA height installations.
      c. 15” rim for Child (K-5th Grade, 6-10) ADA height installations.
      d. 12” rim for Child (Pre-K, 5 and under) height installations.

B. Flush Valve: Sloan Royal 186-0.125 (0.125 GPF)
   1. Supply Rough-in Elevation: 11-1/2” above spud connection
   2. Accessible handle located on wide side of approach.
   3. Sweat Solder Adapter and Cast Wall Flange with Set Screw.
   4. Vandal Resistant Stop Cap with Set Screw.

C. Carrier: Josam Series 17560-UR.
   1. Provide components for thicker walls when required.
   2. Provide valve plate for attaching to upright.
   3. Provide sleeved pass through where side-by-side configuration or similar is required to allow piping to pass horizontally at carrier support.

D. Manufacturers:
   1. Fixture:
      a. American Standard
      b. Crane
      c. Eljer
      d. Kohler
      e. Zurn
   2. Flush Valve:
      a. Sloan
      b. Zurn
   3. Carrier :
      a. J.R. Smith
      b. Josam
      c. Zurn

2.24 (UR-4) URINAL WITH MANUAL FLUSH VALVE (CHILD, GRADE PRE-K, AGES 5 AND UNDER)

A. Fixture: Kohler Bardon K-4991-ET (0.125 GPF)

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1. Material: Vitreous China
2. Color: White
3. Consumption: Suitable and matching flush rate of valve provided.
4. Mounting Height:
   a. 24” rim for Adult standard height installations.
   b. 16” rim for Adult ADA height installations.
   c. 15” rim for Child (K-5th Grade, 6-10) ADA height installations.
   d. 12” rim for Child (Pre-K, 5 and under) height installations.

B. Flush Valve: Sloan Royal 186-0.125 (0.125 GPF)
1. Supply Rough-in Elevation: 11-1/2” above spud connection
2. Accessible handle located on wide side of approach.
3. Sweat Solder Adapter and Cast Wall Flange with Set Screw.
4. Vandal Resistant Stop Cap with Set Screw.

C. Carrier: Josam Series 17560-UR.
1. Provide components for thicker walls when required.
2. Provide valve plate for attaching to upright.
3. Provide sleeved pass through where side-by-side configuration or similar is required to allow piping to pass horizontally at carrier support.

D. Manufacturers:
1. Fixture:
   a. American Standard
   b. Crane
   c. Eljer
   d. Kohler
   e. Zurn
2. Flush Valve:
   a. Sloan
   b. Zurn
3. Carrier :
   a. J.R. Smith
   b. Josam
   c. Zurn

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2.25 (WB-1) WASHER BOX CONNECTION

A. Fixture: GuyGray SSWB-1
1. General: Recessed-mounting, reversible, metal washing machine outlet box with ½” IPS or copper sweat supply fittings complying with ASME A112.18.1M. Include box with faceplate, services indicated for equipment connections, and reinforcement.
2. ¼” turn ball valves.
3. Long shank adapters.
4. 2” drain.
5. Integral or field-installed water hammer arrestors.

B. Manufacturers:
1. Acorn

2. Bradley
3. Guy Gray
4. Oatey

2.26 (WC-1) FLOOR-MOUNTED WATER CLOSET WITH MANUAL DUAL-FLUSH VALVE (ADULT STANDARD)

A. Fixture: Kohler Wellcomme Ultra K-96053 (Dual-Flush 1.10/1.60 GPF)
   1. Material: Vitreous China
   2. Color: White
   3. Consumption: Suitable and matching flush rate of valve provided.
   4. Mounting Height:
      a. 15” rim for Adult standard height installations.
      b. 16” rim for Adult ADA height installations.
      c. 15” rim for Child (K-5th Grade, 6-10) ADA height installations.
      d. 10.50” rim for Child (Pre-K, 5 and under) height installations.

B. Flush Valve: Sloan WES-111-1.6/1.1-CP (Dual-Flush 1.10/1.60 GPF)
   1. Supply Rough-in Elevation: 11-1/2” above spud connection
   2. Accessible handle located on wide side of approach.
   3. Sweat Solder Adapter and Cast Wall Flange with Set Screw.

C. Seat: Church-Bemis 295SSCT
   1. Color: White
   2. Elongated, open-front, extra heavy weight seat with stainless-steel, self-sustaining, check hinge.

D. Manufacturers:
   1. Fixture:
      a. American Standard
      b. Crane
      c. Eljer
      d. Kohler
      e. Zurn
   2. Flush Valve:
      a. Sloan
      b. Zurn
   3. Seat :
      a. Beneke
      b. Church-Bemis
      c. Olsonite
      d. Sperzel

2.27 (WC-2) FLOOR-MOUNTED WATER CLOSET WITH MANUAL DUAL-FLUSH VALVE (ADULT-ACCESSIBLE)

A. Fixture: Kohler Highcliff Ultra K-96057 (Dual-Flush 1.10/1.60 GPF)
   1. Material: Vitreous China
   2. Color: White

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3. Consumption: Suitable and matching flush rate of valve provided.
4. Mounting Height:
   a. 15” rim for Adult standard height installations.
   b. 16” rim for Adult ADA height installations.
   c. 15” rim for Child (K-5th Grade, 6-10) ADA height installations.
   d. 10.50” rim for Child (Pre-K, 5 and under) height installations.

B. Flush Valve: Sloan WES-111-1.6/1.1-CP (Dual-Flush 1.10/1.60 GPF)
1. Supply Rough-in Elevation: 11-1/2” above spud connection
2. Accessible handle located on wide side of approach.
3. Sweat Solder Adapter and Cast Wall Flange with Set Screw.

C. Seat: Church-Bemis 295SSCT
1. Color: White
2. Elongated, open-front, extra heavy weight seat with stainless-steel, self-sustaining, check hinge.

D. Manufacturers:
1. Fixture:
   a. American Standard
   b. Crane
   c. Eljer
   d. Kohler
   e. Zurn
2. Flush Valve:
   a. Sloan
   b. Zurn
3. Seat :
   a. Beneke
   b. Church-Bemis
   c. Olsonite
   d. Sperzel

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2.28 (WC-3) FLOOR-MOUNTED WATER CLOSET WITH MANUAL DUAL-FLUSH VALVE (CHILD-ACCESSIBLE, GRADE K-5TH, AGES 6-10)

A. Fixture: Kohler Wellcomme Ultra K-96053 (Dual-Flush 1.10/1.60 GPF)
1. Material: Vitreous China
2. Color: White
3. Consumption: Suitable and matching flush rate of valve provided.
4. Mounting Height:
   a. 15” rim for Adult standard height installations.
   b. 16” rim for Adult ADA height installations.
   c. 15” rim for Child (K-5th Grade, 6-10) ADA height installations.
   d. 10.50” rim for Child (Pre-K, 5 and under) height installations.

B. Flush Valve: Sloan WES-111-1.6/1.1-CP (Dual-Flush 1.10/1.60 GPF)
1. Supply Rough-in Elevation: 11-1/2” above spud connection
2. Accessible handle located on wide side of approach.

3. Sweat Solder Adapter and Cast Wall Flange with Set Screw.

C. Seat: Church-Bemis 295SSCT
1. Color: White
2. Elongated, open-front, extra heavy weight seat with stainless-steel, self-sustaining, check hinge.

D. Manufacturers:
1. Fixture:
a. American Standard
b. Crane
c. Eljer
d. Kohler
e. Zurn
2. Flush Valve:
a. Sloan
b. Zurn
3. Seat :
a. Beneke
b. Church-Bemis
c. Olsonite
d. Sperzel

2.29 (WC-4) FLOOR-MOUNTED WATER CLOSET WITH MANUAL DUAL-FLUSH VALVE (CHILD, GRADE PRE-K, AGES 5 AND UNDER)

A. Fixture: Kohler Primary K-96064 (Dual-Flush 1.10/1.60 GPF)
1. Material: Vitreous China
2. Color: White
3. Consumption: Suitable and matching flush rate of valve provided.
4. Mounting Height:
a. 15” rim for Adult standard height installations.
b. 16” rim for Adult ADA height installations.
c. 15” rim for Child (K-5th Grade, 6-10) ADA height installations.
d. 10.50” rim for Child (Pre-K, 5 and under) height installations.

B. Flush Valve: Sloan WES-111-1.6/1.1-CP (Dual-Flush 1.10/1.60 GPF)
1. Supply Rough-in Elevation: 11-1/2” above spud connection
2. Accessible handle located on wide side of approach.
3. Sweat Solder Adapter and Cast Wall Flange with Set Screw.

C. Seat: Church-Bemis 295SSCT
1. Color: White
2. Elongated, open-front, extra heavy weight seat with stainless-steel, self-sustaining, check hinge.

D. Manufacturers:
1. Fixture:
a. American Standard
b. Crane

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c. Eljer
d. Kohler
e. Zurn

2. Flush Valve:
a. Sloan
b. Zurn

3. Seat :
a. Beneke
b. Church-Bemis
c. Olsonite
d. Sperzel

2.30 (WH-1) WALL HYDRANT FREEZE-RESISTANT

A. Fixture: Zurn Z1320XL-EZ
1. General: Non-freeze wall hydrant with recessed, flush-mounted, wall box, hinged latching cover, control key, and integral vacuum breaker/backflow preventer. Pressure rating shall be 125 psig. Comply with ASME A112.21.3M, ASSE 1011, and ASSE 1019. Provide self-draining integral non-removable hose-connection, and wall clamp.
2. Inlet: 3/4” threaded or solder joint.
3. Outlet: ASME B1.20.7, garden-hose threads.
4. Operating Keys: One with each hydrant.

B. Manufacturers:
1. J.R. Smith
2. Josam
3. Woodford
4. Zurn

2.31 (WSB-1) WATER SUPPLY OUTLET BOX

A. Fixture: GuyGray MIB1AB
1. General: Recessed-mounting, powder-coated, 20-gauge steel, water outlet box and faceplate with supply fittings complying with ASME A112.18.1M. Include box with faceplate, services indicated for equipment connections, and reinforcement.
2. Inlet: (DN 20 or DN 25) 1/2” threaded or solder joint x 3/8” OD.
3. 1/4” turn, lead-free, ball valves.

B. Manufacturers:
1. Acorn
2. Bradley
3. Guy Gray
4. Oatey

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those

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indicated, before plumbing fixture installation. Manufacturer's roughing-in data overrides all other indicated data.

B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 FIXTURE INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install components level and plumb.

C. Secure fixtures in place.

D. Install rigid or flexible supplies to fixtures. Provide supply stops, reducers, and escutcheons.

E. For wall-hanging fixtures, install off-floor supports affixed to building substrate.

F. Install back-outlet, wall hanging fixtures onto waste fitting seals and attach to supports.

G. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

H. Install wall-hanging fixtures with tubular waste piping attached to supports.

I. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.

J. Install counter-mounted fixtures in and attached to casework.

K. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.

L. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball valve if stops are not specified with fixture. Refer to Section "Valves".

M. Install trap and waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

N. Install waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

O. Core-drill all toilet penetrations and seal appropriately according to all specifications and owner requirements.

P. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

Q. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

R. Install toilet seats on water closets.

S. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

T. Install water supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.

U. Install faucet, flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

V. Install shower, flow-control fittings with specified maximum flow rates in shower arms.

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W. Install traps on fixture outlets.
   1. Exception: Omit trap on fixtures with integral traps.
   2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

X. Install disposer in outlet of sinks indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

Y. Install hot-water dispensers in back top surface of sink or in counter with spout over sink.

Z. Install escutcheons at piping wall-ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Refer to Division 22 Section “Common Work Results for Plumbing" for escutcheons.

AA. Set shower receptors and service basins in leveling bed of cement grout. Refer to Division 22 Section “Common Work Results for Plumbing" for grout.

BB. Refer to Section "Joint Sealants" for sealant and installation requirements.

CC. Provide connection to automatic lavatories & flush valves as required via low-voltage transformer(s). Mount transformer(s) above accessible ceiling. Connect to local 120V receptacle circuit with disconnect switch adjacent to transformer. All circuitry (including low voltage) shall be run concealed & in conduit. Coordinate connection requirements.

DD. Shutoff valves shall be provided and located on each floor, on takeoffs from all vertical risers, branch lines from the mains, and at the branch connections to each fixture.

3.03 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect water supplies from water distribution piping to fixtures.

C. Connect drain piping from fixtures to drainage piping.

D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use sizes required to match fixtures. Connect to plumbing piping.

E. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.

F. Ground equipment: Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 FIELD QUALITY CONTROL

A. Verify that installed fixtures are categories and types specified for locations where installed.

B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.05 ADJUSTING

A. Replace washers and seals or cartridges of leaking and dripping faucets, stops, and valves.

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3.06 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
   1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
   2. Remove sediment and debris from drains.

3.07 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

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SECTION 230130.51
HVAC AIR-DISTRIBUTION SYSTEM CLEANING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cleaning of HVAC duct system, equipment, and related components.

B. Testing and inspection agency employed by **<<Owner>>**.

1.02 RELATED REQUIREMENTS

A. Section **<< 014000 - Quality Requirements>>**: Additional requirements for testing and inspection agencies.

B. Section **<< 015719 - Temporary Environmental Controls>>**.

C. Section **<< 019113 - General Commissioning Requirements>>**: Commissioning requirements that apply to all types of work.

D. Section **<< 230800 - Commissioning of HVAC>>**.

1.03 DEFINITIONS

A. HVAC System: For purposes of this section, the surfaces to be cleaned include all interior surfaces of the heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system, including the inside of air distribution equipment, coils, and condensate drain pans; see **<<NADCA ACR>>** for more details.

1. Above-ceiling plenum for supply air **<< is not required; is required; or _____>>** to be cleaned.
2. Above-ceiling plenum for return air **<< is not required; is required; or _____>>** to be cleaned.
3. Makeup air system **<< is not required; is required; or _____>>** to be cleaned.
4. Exhaust-only system **<< is not required; is required; or _____>>** to be cleaned.

1.04 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. NADCA ACR - The NADCA Standard for Assessment, Cleaning, and Restoration of HVAC System.

C. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.

D. UL 181A - Closure Systems for Use with Rigid Air Ducts.

1.05 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>**, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used.

C. Qualifications Statement: Submit qualifications of proposed cleaning contractor for approval.

D. Qualifications Statement: Submit qualifications of proposed testing and inspection agency for approval.

E. Project Cleanliness Evaluation and Cleaning Plan, as specified.

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F. Material Safety Data Sheets (MSDS): For all chemical products proposed to be used in the cleaning process; submit directly to **<<Owner>>**.

G. Project Closeout Report: Include field quality control reports, evidence of satisfactory cleaning, and documentation of items needing further repair.

1.06 QUALITY ASSURANCE

A. Information Available to **<<Contractor>>**: Upon request, **<<Owner>>** will provide the following:
   1. One copy of **<< original construction; project record; facility manager's updated; or _____>>** drawings of HVAC system.
   2. One copy of **<< original construction; project record; facility manager's updated; or _____>>** specifications of HVAC system.
   3. **Hazardous material report performed by separate contractor.**

B. Cleaning Contractor Qualifications: Company specializing in the cleaning and restoration of HVAC systems as specified in this section.
   1. Certified by one of the following:
      a. NADCA, National Air Duct Cleaners Association: www.nadca.com.
      b. Nationally recognized certification program and organization dedicated to the cleaning of HVAC systems.
   2. Having minimum of **<< three; or _____>>** years documented experience.
   3. Employing for this project a supervisor certified by same organization that certified the cleaning contractor.

C. Testing and Inspection Agency Qualifications: Experienced in inspection and testing using methods defined in **<<NADCA ACR>>**.

PART 2 PRODUCTS<< - NOT USED; - _____; OR NONE - N/A>>

2.01 TOOLS AND EQUIPMENT

A. Vacuum Devices and Other Tools: Exceptionally clean, in good working order, and sealed when brought into the facility.

B. Vacuum Devices That Exhaust Air Inside Building, Including Hand-Held and Wet Vacuums: Equipped with HEPA filtration with 99.97 percent collection efficiency for minimum 0.3-micron size particles and DOP test number.

C. Vacuum Devices That Exhaust Air Outside Building, Including Truck- and Trailer-Mounted Types: Equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system; exhausted in manner that prevents contaminant re-entry to building; compliant with applicable regulations as to outdoor environmental contamination.

2.02 REPLACEMENT PRODUCTS

A. Fibrous Glass Insulation: Provide material complying with **<<UL 181>>** equivalent to existing material in quality and thickness.

2.03 SURFACE TREATMENTS

A. Anti-Microbial Materials: EPA registered specifically for use on non-porous HVAC system surfaces and applied per manufacturer's instructions.

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B. Surface Coating for Fibrous Glass Materials: Water-based, zero VOC; flame spread index less that 25, smoke developed index less than 450, Class A, when tested in accordance with **<<ASTM E84>>**.

PART 3 EXECUTION

3.01 PROJECT CONDITIONS

A. Comply with applicable federal, state, and local requirements.

B. Perform cleaning, inspection, and remediation in accordance with the recommendations of NADCA "Assessment, Cleaning and Restoration of HVAC Systems" (ACR) and as specified herein.

C. Where **<<NADCA ACR>>** uses the terms "recommended", "highly recommended", or "ideally" in regard to a certain procedure or activity, do that unless it is clearly inapplicable to the project.

D. Take precautions to prevent introduction of additional hazards into occupied spaces.

E. Comply with requirements of Section **<< 015719>>**.

F. Obtain **<<Owner>>**'s approval of proposed temporary locations for large equipment.

G. Designate a decontamination area and obtain **<<Owner>>**'s approval.

H. When portions of the facility are to remain occupied or in operation during cleaning activities, provide adequate controls or containment to prevent access to spaces being cleaned by unauthorized persons and provide detailed instructions to **<<Owner>>** as to these controls or containment.

I. If unforeseen mold or other biological contamination is encountered, notify **<<Architect>>** immediately, identifying areas affected and extent and type of contamination.

3.02 EXAMINATION

A. Prior to the commencement of any cleaning work, prepare and submit to **<<Architect>>** a project evaluation and plan for this project, including considerations recommended in **<<NADCA ACR>>**.

B. Coordinate cleaning plan with indoor air quality control plan specified in Section **<< 015719>>**.

C. Inspect the system as required to determine appropriate methods, tools, equipment, and protection.

D. Start of cleaning work constitutes acceptance of existing conditions.

E. When concealed spaces are later made accessible, examine and document interior conditions prior to beginning cleaning.

F. Document all instances of mold growth, rodent droppings, other biological hazards, and damaged system components.

3.03 PREPARATION

A. When cleaning work might adversely affect life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.

B. Ensure that electrical components that might be adversely affected by cleaning are de-energized, locked out, and protected prior to beginning work.

C. Air-Volume Control Devices: Mark the original position of dampers and other air-directional mechanical devices inside the HVAC system prior to starting cleaning.

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D. Access to Concealed Spaces: Use existing service openings and make additional service openings as required to accomplish cleaning and inspection.
   1. Do not cut openings in non-HVAC components without obtaining the prior approval of **<<Owner>>**.
   2. Make new openings in HVAC components in accordance with NADCA Standard 05; do not compromise the structural integrity of the system.
   3. Do not cut service openings into flexible duct; disconnect at ends for cleaning and inspection.

E. Ceiling Tile: Lay-in ceiling tile may be removed to gain access to HVAC systems during the cleaning process; protect tile from damage and reinstall upon completion; replace damaged tile.

3.04 CLEANING

A. Use any cleaning method recommended by **<<NADCA ACR>>** unless otherwise specified; do not use methods prohibited by **<<NADCA ACR>>**, or that will damage HVAC components or other work, or that will significantly alter the integrity of the system.

B. Obtain **<<Owner>>**'s approval before using wet cleaning methods; ensure that drainage is adequate before beginning.

C. Ducts: Mechanically clean all portions of ducts.

D. Hoses, Cables, and Extension Rods: Clean using suitable sanitary damp wipes at the time they are being removed or withdrawn from their normal position.

E. Registers, Diffusers, and Grilles: When removing, take care to prevent containment exposure due to accumulated debris.

F. Coils: Follow **<<NADCA ACR>>** completely including measuring static pressure drop before and after cleaning; do not remove refrigeration coils from system to clean; report coils that are permanently impacted.

G. Fibrous Glass Material: Use HEPA vacuuming equipment, under constant negative pressure, do not permit to get wet, and do not damage surfaces; replace material damaged by cleaning operations.

H. Existing Damaged Fibrous Glass Material: Report to **<<Architect>>** all evidence of damage, deterioration, delaminating, friable material, mold or fungus growth, or moisture that cannot be remedied by cleaning or resurfacing with an acceptable insulation repair coating.
   1. Material with active fungal growth is considered unremediable.
   2. Remove unremediable material and clean underlying surfaces.

I. Collect debris removed during cleaning; ensure that debris is not dispersed outside the HVAC system during the cleaning process.

J. Store contaminated tools and equipment in polyethylene bags until cleaned in the designated decontamination area.

3.05 REPAIR

A. Repair openings cut in the ventilation system so that they do not significantly alter the airflow or adversely impact the facility's indoor air quality.

B. At insulated ducts and components, accomplish repairs in such a manner as to achieve the equivalent thermal value.

C. Reseal new openings in accordance with NADCA Standard 05.

D. Reseal rigid fiber glass duct systems using closure techniques that comply with **<<UL 181>>** or **<<UL 181A>>**.

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E. When new openings are intended to be capable of being re-opened in the future, clearly mark them and report their locations to **<<Owner>>** in project report documents.

3.06 FIELD QUALITY CONTROL

A. Ensure that the following field quality control activities are completed prior to application of any treatments or coatings and prior to returning HVAC system to normal operation.

B. Visually inspect all portions of the cleaned components; if not visibly clean as defined in **<<NADCA ACR>>**, re-clean and reinspect.

C. Coils: Cleaning must restore the coil pressure drop to within 10 percent of the coil's original installed pressure drop; if original pressure drop is not known, coil will be considered clean if free of foreign matter and chemical residue based on visual inspection.

D. Notify **<<Architect>>** when cleaned components are ready for inspection.

E. Notify **<<Owner>>**'s testing and inspection agency when cleaned components are ready for inspection.

F. **<<Owner>>** reserves the right to verify cleanliness using **<<NADCA ACR>>** Surface Comparison Testing or NADCA Vacuum Test.

G. When directed, re-clean components until they pass.

H. **<<Contractor>>** shall bear the costs of retesting due to inadequate cleaning.

I. Submit evidence that all portions of the system required to be cleaned have been cleaned satisfactorily.

3.07 ANTI-MICROBIAL TREATMENT

A. When directed, apply anti-microbial treatment to internal surfaces.

B. Apply anti-microbial agent after removal of surface deposits and debris.

C. Apply anti-microbial treatments and coatings in strict accordance with the manufacturer's written recommendations and EPA registration listing.

D. Spray coatings directly onto interior ductwork surfaces; do not "fog" into air stream.

3.08 ADJUSTING

A. After satisfactory completion of field quality control activities, restore adjustable devices to original settings, including, but not limited to, dampers, air directional devices, valves, fuses, and circuit breakers.

3.09 WASTE MANAGEMENT

A. Double-bag waste and debris in **<< 6 mil, 0.006 inch>>** thick polyethylene plastic bags.

B. Dispose of debris off-site in accordance with applicable federal, state and local requirements.

END OF SECTION 230130.51

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SECTION 230513
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General construction and requirements.

B. Unless otherwise specified in a particular section or required for a particular application, motors shall conform to the following requirements, whether factory-installed or field-installed.

C. Single phase electric motors.

D. Three phase electric motors.

E. Electronically Commutated Motors (ECM).

1.02 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators.

C. NEMA MG 00001 - Motors and Generators.

D. NFPA 70 - National Electrical Code.

1.03 SUBMITTALS

A. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.

B. Test Reports: Indicate test results verifying nominal efficiency and power factor for**<< three phase; _____; or None - N/A>>** motors larger than **<< 1/2; 5; 20; or __>>** horsepower.

C. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.

D. Operation Data: Include instructions for safe operating procedures.

E. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacture of electric motors for **<< commercial>>** use, and their accessories, with minimum **<< three; or _____>>** years documented product development, testing, and manufacturing experience.

B. Comply with **<< applicable electrical code; NFPA 70; local energy code; or _____>>**.

C. Provide certificate of compliance from **<< Authority Having Jurisdiction; or _____>>** indicating approval of high efficiency motors.

D. Products Requiring Electrical Connection: Listed and classified by **<< Underwriters Laboratories Inc.; testing firm acceptable to the Authority Having Jurisdiction; or _____>>** as suitable for the purpose specified and indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

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A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering.**<< For extended outdoor storage, remove motors from equipment and store separately.; _____ .; or None - N/A>>**

1.06 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Provide **<< five; or ____>>** year manufacturer warranty for motors larger than 1 horsepower.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. A.O. SmithBaldor Electric Company/ABB Group

B. Baldor Electric Company/ABB Group

C. Leeson Electric Corporation

D. Marathon

E. Rockwell

F. Siemens

G. Toshiba

H. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.02 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Electrical Service: Refer to Section **<< 260583>>** for required electrical characteristics.

B. Nominal Efficiency: All motors shall be NEMA premium efficiency.

C. Construction:

1. Open drip-proof type except where specifically noted otherwise.
2. Design for continuous operation in **<< 104 degrees F>>** environment.
3. Design for temperature rise in accordance with **<<NEMA MG 00001>>** limits for insulation class, service factor, and motor enclosure type.
4. Motors with frame sizes **<< 254T; or _____>>** and larger: Energy efficient type.

D. Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.

E. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor**<< , efficiency; , _____; or None - N/A>>**.

F. Wiring Terminations:

1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to **<<NFPA 70>>**, threaded for conduit.
2. For fractional horsepower motors where connection is made directly, provide **<< threaded; None - N/A; or _____>>** conduit connection in end frame.

2.03 APPLICATIONS

A. Single phase motors for **<< shaft mounted fans; oil burners; centrifugal pumps; and _____>>**: Split phase type.

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B. Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type.

C. Single phase motors for **<< fans; pumps; blowers; air compressors; and _____>>**: Capacitor start type.

D. Single phase motors for **<< fans; blowers; pumps; and _____>>**: Capacitor start, capacitor run type.

E. Motors located in **<< exterior locations; wet air streams downstream of sprayed coil dehumidifiers; draw through cooling towers; air cooled condensers; humidifiers; direct drive axial fans; roll filters; explosion proof environments; dust collection systems; and _____>>**: Totally enclosed type.

2.04 SINGLE PHASE POWER - SPLIT PHASE MOTORS

A. Starting Torque: Less than 150 percent of full load torque.

B. Starting Current: Up to seven times full load current.

C. Breakdown Torque: Approximately 200 percent of full load torque.

D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.

E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.05 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

A. Starting Torque: Exceeding one fourth of full load torque.

B. Starting Current: Up to six times full load current.

C. Multiple Speed: Through tapped windings.

D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.06 SINGLE PHASE POWER - CAPACITOR START MOTORS

A. Starting Torque: Three times full load torque.

B. Starting Current: Less than five times full load current.

C. Pull-up Torque: Up to 350 percent of full load torque.

D. Breakdown Torque: Approximately 250 percent of full load torque.

E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated **<< sleeve; ball; or ____>>** bearings.

G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.07 THREE PHASE POWER - SQUIRREL CAGE MOTORS

A. Starting Torque: Between 1 and 1-1/2 times full load torque.

B. Starting Current: Six times full load current.

C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.

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D. Design, Construction, Testing, and Performance: Comply with **<<NEMA MG 00001>>** for Design B motors.

E. Insulation System: NEMA Class B or better.

F. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

G. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum **<<ABMA STD 9>>**, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

H. Sound Power Levels: To **<<NEMA MG 00001>>**.

I. Nominal Efficiency: As indicated at full load and rated voltage when tested in accordance with **<<IEEE 112>>**.

J. Nominal Power Factor: As indicated at full load and rated voltage when tested in accordance with **<<IEEE 112>>**.

K. Provide AEGIS shaft grounding rings on all three phase motors.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION 230513

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SECTION 230516
EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flexible pipe connectors.

B. Expansion joints and compensators.

C. Pipe loops, offsets, and swing joints.

1.02 RELATED REQUIREMENTS

A. Section **<< 232113 - Hydronic Piping>>**.

B. Section **<< 232300 - Refrigerant Piping>>**.

1.03 REFERENCE STANDARDS

A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

B. ASTM A536 - Standard Specification for Ductile Iron Castings.

C. FM (AG) - FM Approval Guide.

D. UL (DIR) - Online Certifications Directory.

1.04 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Product Data:

1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per **<< foot>>** and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

C. Design Data: Indicate selection calculations.

D. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.

E. Maintenance Data: Include adjustment instructions.

F. Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Comply with **<< UL (DIR); FM (AG); ITS (DIR) or Warnock Hersey; or ___>>** requirements.

2.02 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

A. Manufacturers:

1. Flex-Hose Inc.

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2. Flex-Weld, Inc**<< ; _____; or None - N/A>>**:
3. Mercer Rubber Company**<< ; _____; or None - N/A>>**:
4. The Metraflex Company**<< ; _____; or None - N/A>>**:

B. Inner Hose: **<< Stainless Steel; Bronze; or _____>>**.

C. Exterior Sleeve: **<< Single braided; Double braided; None; or _____>>**, **<< stainless steel; or bronze>>**.

D. Pressure Rating: **<< 125 psi up to 12 inch; 200 psi up to 6 inch; 350 psi up to 3 inch; or ____ psi up to ___ inch>>**.

E. Maximum Service Temperature: **<< 450 degrees F; 250 degrees F; or ____ degrees F>>**.

F. End Connections: **<< Flanged; Threaded; Threaded with union; Welded or sweat; As specified for pipe joints; or _____>>**.

G. Maximum offset: **<< 3/4 inch; 1 inch; or _____ inch>>** on each side of installed center line.

2.03 EXPANSION JOINTS - METAL BELLOWS TYPE

A. Manufacturers:
1. Flex-Weld, Inc**<< ; _____; or None - N/A>>**:
2. **<< Metraflex Company>>**.
3. **<< US Bellows>>**.

B. Provide shroud to protect from external damage and allows for the application of external insulation.

C. Provide with tie rods to prevent over-compression or over-elongation.

D. Pressure Rating: **<< 125 psi and 400 degrees F; 200 psi and 250 degrees F; or _____ psi and _____ degrees F>>**.

E. Maximum Compression: **<< 1-3/4 inches; 3 inches; or ____ inches>>**.

F. Maximum Extension: **<< 1/4 inch>>**.

G. End Connections: **<< Flanged; Threaded; Welded; As specified for pipe joints; or _____>>**.

H. Size: Use pipe sized units.

I. Application: Steel piping **<< 2 inches>>** and larger.

2.04 EXPANSION JOINTS - STAINLESS STEEL BELLOWS TYPE

A. Manufacturers:
1. Flex-Weld, Inc**<< ; Keflex 308/311 Series; ; Keflex 3150 Series Compact Expansion Joint; ; _____; or None - N/A>>**:
2. Mercer Rubber Company**<< ; _____; or None - N/A>>**:
3. The Metraflex Company**<< ; _____; or None - N/A>>**:

B. Pressure Rating: **<< 125 psi and 400 degrees F; 200 psi and 250 degrees F; or _____ psi and _____ degrees F>>**.

C. Maximum Compression: **<< 1-3/4 inches; 3 inches; or ____ inches>>**.

D. Maximum Extension: **<< 1/4 inch>>**.

E. End Connections: **<< Externally; Internally; or _____>>** pressurized **<< as specified for pipe joints; with flanged ends; with threaded ends; with welded ends; or _____>>**.

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F. Size: Use pipe sized units.

2.05 EXPANSION JOINTS - << SINGLE; DOUBLE; OR _____>> SPHERE, << FLEXIBLE; ELBOW; OR _____>> CONNECTOR

A. Manufacturers:
1. Flex-Hose Co. Inc**<< ; _____; or None - N/A>>**:
2. Flex-Weld, Inc**<< ; Rubber Expansion Joints; ; _____; or None - N/A>>**:
3. Mercer Rubber Company**<< ; _____; or None - N/A>>**:
4. The Metraflex Company**<< ; Cablesphere; ; _____; or None - N/A>>**:
5. Unisource Manufacturing, Inc**<< ; Series 301, Single Sphere Connectors; ; Series 302, Double Sphere Connectors; ; _____; or None - N/A>>**:

B. Body Construction: **<< EPDM; Butyl; Nitrile; Neoprene; Neoprene and nylon; Nylon-reinforced rubber tube; or _____>>**.

C. Cover and Tube Elastomer: **<< Chlorobutyl and Chlorobutyl; CSM and CSM; EPDM and EPDM; EPDM and FDA EPDM; Neoprene and Neoprene; Neoprene and Nitrile; Neoprene and FDA Nitrile; or _____>>**.

D. End Connections: **<< Tapped steel flanges; Galvanized flanges; Galvanized unions; Carbon steel flanges; or _____>>**.

E. Maximum Compression: **<< 1/2 inch; 3/4 inch; 1 inch; 1-1/8 inches; or ____ inch>>**.

F. Maximum Elongation: **<< 1/8 inch; 3/8 inch; 1/2 inch; 5/8 inch; 7/8 inch; or __ inch>>**.

G. Maximum Offset: **<< 3/8 inch; 1/2 inch; 3/4 inch; 7/8 inch; or __ inch>>**.

H. Maximum Angular Movement: **<< 15; 30; or 45>>** degrees.

I. Accessories: **<< Control rods; Control cables; or _____>>**.

J. Service Rating: Up to **<< 35 psi at 220 degrees F; 95 psi at 200 degrees F; 100 psi at 220 degrees F; 105 psi at 250 degrees F; 125 psi at 170 degrees F; 150 psi at 200 degrees F; 150 psi at 210 degrees F; 180 psi at 170 degrees F; 200 psi at 250 degrees F; 225 psi at 170 degrees F; 300 psi at 170 degrees F; or ___ psi at ___ degrees F>>**.

2.06 EXPANSION JOINTS - COMPENSATORS

A. Manufacturers:
1. Flex-Hose Co. Inc**<< ; _____; or None - N/A>>**:
2. Flex-Weld, Inc**<< ; Keflex 7Q Series - Quadra-Side; ; _____; or None - N/A>>**:
3. Mercer Rubber Company**<< ; _____; or None - N/A>>**:
4. The Metraflex Company**<< ; _____; or None - N/A>>**:
5. Unisource Manufacturing, Inc**<< ; Series 416, Expansion Compensators; ; _____; or None - N/A>>**:
6. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Type: Two-ply **<< 304 stainless steel; bronze; or _____>>** bellows with carbon steel shroud.

C. Maximum Working Pressure: **<< 75 psi; 80 psi; 200 psi; or __ psi>>**.

D. Maximum Working Temperatures: **<< 250 degrees F; 400 degrees F; 750 degrees F; or ___ degrees F>>**.

E. Maximum Compression: **<< 1/2 inch>>**.

F. Maximum Extension: **<< 5/32 inch>>**.

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G. End Connections: **<< Threaded; Soldered; Flanged; Female copper sweat; Carbon steel male thread; or _____>>**.

H. Application: Copper piping up to **<< 3 inches>>** in size or steel piping up to **<< 4 inches>>** in size.

2.07 EXPANSION << JOINTS; LOOPS; JOINTS AND LOOPS; OR _____>> - HOSE AND BRAID

A. Manufacturers:

1. Flex-Hose Co. Inc**<< ; U-Loop; ; V-Loop; ; _____; or None - N/A>>**:
2. Flex-Weld, Inc**<< ; Keflex Ke-Loop; ; _____; or None - N/A>>**:
3. The Metraflex Company**<< ; Metraloop; ; _____; or None - N/A>>**:
4. Unisource Manufacturing, Inc**<< ; V-Loop; ; V-Loop Copper; ; _____; or None - N/A>>**:

B. Provide flexible loops with two flexible sections of hose and braid, two 90 degree elbows, and 180 degree return with support brackets**<< and air release valve; and plugged drain port for steam service; , air release valve, and plugged drain port; _____; or None - N/A>>**.

C. Maximum Allowable Motion: **<< 2 inch; 3 inch; 4 inch; or ___ inch>>** in the x, y, and z planes with no thrust loads to the building structure

D. Maximum Working Pressure: **<< 300 psi; 175 psi; 150 psi; or _____ psi>>** at **<< 120 degrees F; 800 degrees F; or ___ degrees F>>**.

E. Construction: Class **<< 125; 150; 300; or _____>>**, schedule **<< 40; 80; or _____>>**, **<< stainless steel; copper; bronze; or _____>>** hose and**<< single; double; _____; or None - N/A>>** braid assembly with **<< carbon steel; ductile iron; or _____>>** fittings, including elbows and **<< flanged; grooved; threaded; welded; female copper sweat; or _____>>** end connections sized to match pipe segment

1. Selected Product to Accommodate:
   a. **<< Compression; Expansion; Compression and Expansion; or _____>>** Axial Deflection: **<< _____ inch>>**.
   b. Angular Rotation: **<< 15; or _____>>** degrees.
   c. Force developed by **<< 1.5; or _____>>** times specified maximum allowable operating pressure.
2. Provide necessary accessories including, but not limited to, **<< swivel joints; limit stops; internal guides; anti-torque device; internal flow liners; control rods; control cables; and _____>>**.

2.08 EXPANSION JOINTS - EXTERNALLY PRESSURIZED

A. Manufacturers:

1. Flex-Hose Co. Inc**<< ; _____; or None - N/A>>**:
2. Flex-Weld, Inc**<< ; Keflex Externally-Pressurized Expansion Joints; ; _____; or None - N/A>>**:
3. The Metraflex Company**<< ; Metragator; ; _____; or None - N/A>>**:
4. Unisource Manufacturing, Inc**<< ; Series EP; ; _____; or None - N/A>>**:

B. Bellows Type: **<< Two-ply; Multi-ply; or _____>>**, **<< single; dual; or _____>>** bellows constructed of **<< 321 stainless steel; 316 stainless steel; 304 stainless steel; inconel 600; inconel 625; or _____>>**.

C. Internal Liner: Carbon steel with internal and external guides.

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D. Specialty: Carbon steel anchor base, lifting lugs, and drain port with tapered plug.

E. End Connections: Class **<< 150; 300; or _____>>**, carbon steel, **<< welded; grooved; flanged; welded flange; or _____>>**.

F. Maximum Axial Compression: **<< 4 inch; 6 inch; 8 inch; 16 inch; or __ inch>>**.

G. Maximum Working Pressure: **<< 300 psi; 175 psi; 150 psi; or ___ psi>>** at **<< 700 degrees F; or _____ degrees F>>**.

2.09 ACCESSORIES

A. Pipe Alignment Guides:
   1. Manufacturers:
      a. Flex-Weld, Inc**<< ; _____; or None - N/A>>**:
      b. The Metraflex Company**<< ; PGQ Glide Riser Guide; ; _____; or None - N/A>>**:
   2. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum **<< 1 inch>>** thick insulation, minimum **<< 3 inches>>** travel.

B. Engineered Riser Anchor Clamps:
   1. Manufacturers:
      a. The Metraflex Company**<< ; Engineered Riser Anchor Clamp; ; _____; or None - N/A>>**:
   2. Applications:
      a. Provide one clamp to serve as a riser clip.
         1) Verify the total load of filled pipe to be supported will be a safety factor of **<< one; two; or _____>>** less than the maximum loading of the clamp per the manufacturer's instructions.
      b. Provide one clamp above and one clamp below the slab to anchor pipe.
         1) Coordinate with the structural engineer to determine the maximum thrust loading calculated for the slab or floor structure. Use the maximum thrust loading calculations to verify the clamps will be a safety factor of **<< one; two; or _____ >>** less than the maximum loading of clamp per the manufacturer's instructions.
   3. Provide two piece, ductile iron in compliance with **<<ASTM A536>>**. Use with metal pipes with an outer diameter of **<< 2.5 inches>>** to **<< 8 inches>>**.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with **<< manufacturer's instructions; or _____>>**.

B. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.

C. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.

D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

E. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

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F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where **<< required; indicated; or _____>>**.

G. Substitute grooved piping for vibration isolated equipment instead of flexible connectors. Grooved piping need not be anchored.

END OF SECTION 230516

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SECTION 230517
SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

B. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).

C. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

D. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.

E. FM (AG) - FM Approval Guide.

F. UL (DIR) - Online Certifications Directory.

1.02 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Product Data: Provide manufacturer's product data for sleeves, stack sleeve fittings, sleeve seal systems, and grout.

C. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

D. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.

1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
2. Extra Valve Stem Packings: **<< One; Two; or ____>>** for each type and size of valve.

PART 2 PRODUCTS

2.01 PIPE SLEEVES

A. Vertical Piping:

1. Sleeve Length: 2 inches above finished floor.
2. Provide sealant for watertight joint.
3. Blocked Out Floor Openings: Provide 1-1/2 angle set in silicon adhesive around opening.
4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.

B. Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.

C. Pipe Passing Through Below Grade Exterior Walls:

1. Zinc coated or cast iron pipe.
2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.

D. Pipe Passing Through Mechanical Floors above Basement:

1. Galvanized steel pipe or black iron pipe with asphalt coating.

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2. Connect sleeve with floor plate except in mechanical rooms.

E. Clearances:
1. Provide allowance for insulated piping.
2. Wall, Floor, Partitions, and Beam Flanges: **<< 1 inch; or _____ inch>>** greater than external pipe diameter.
3. All Rated Openings: Caulked tight with fire stopping material in compliance with **<<ASTM E814>>** in accordance with Section **<< 078400>>** - Firestopping to prevent the spread of fire, smoke, and gases.

F. Components:
1. Cast Iron Wall Pipes: Plain ends and integral waterstop.
2. Steel Pipes: **<<ASTM A53/A53M>>**, galvanized, Schedule 40, plain ends and welded steel collar.
3. Steel Pipe Sleeves: **<<ASTM A53/A53M>>**, galvanized, Type E, Grade B, Schedule 40, plain ends.
4. Steel Sheet Sleeves: 0.0239 inch thick, round tube, welded closed.
5. Stack Sleeve Fittings: Cast iron with integral clamping flange and ring, bolts, and nuts for membrane flashing. Clamping ring with set screws for underdeck clamp.
   a. Manufacturers:
      1) Jay R. Smith Mfg. Co.
      2) Wade.
      3) Zurn Water LLC.
6. Grout: **<<ASTM C1107/C1107M>>**, Grade B, nonshrink, post hardening, volume adjusting, premixed and factory packaged, hydraulic cement grout with compressive strength of 5000 psi.

2.02 PIPE-SLEEVE SEALS

A. Manufacturers:
1. Advance Products & Systems, LLC.
2. CALPICO, Inc.
3. LINK-SEAL, by Garlock, an Enpro Company.
4. The Metraflex Company.
5. Proco Products, Inc.
6. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Modular Mechanical Sleeve-Seal:
1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
3. Size and select seal component materials in accordance with service requirements.
4. Service Requirements:
   a. Corrosion resistant.
   b. Oil, fuel, gas, and solvent resistant.
   c. Underground, buried, and wet conditions.
   d. Fire Resistant: **<< 1 hour; 3 hour; or _____>>**, **<< FM (AG); UL (DIR); and _____>>** approved.
   e. High Temperature, up to **<< 400 degrees F; or _____ degrees F>>**.

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5. Stainless steel pressure end plates.
6. Anchors: Stainless steel nuts and bolts.

C. Sealing Compounds:
1. Provide packing and sealing compound to fill pipe to sleeve thickness.
2. Combined packing and seal compound is to match partition fire-resistance hourly rating.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. **<< Bevel plain end ferrous pipe.; None - N/A; or _____ .>>**

B. Remove scale and foreign material, from inside and outside, before assembly.

3.02 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

B. Install piping to conserve building space, to not interfere with use of space and other work.

C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

D. Extend all floor sleeves through floors 2” above finished caulk sleeves full depth and provide floor plate.

E. All Rated Openings: Caulk tight with fire stopping material in compliance with **<<ASTM E814>>** in accordance with Section **<< 078400>>** Firestopping to prevent the spread of fire, smoke, and gases.

F. Inserts:
1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over **<< 4 inches>>**.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut **<< above; flush with top of; recessed into and grouted flush with; or _____>>** slab.

G. Structural Considerations:
1. Do not penetrate building structural members unless indicated.

H. Provide sleeves when penetrating floors, partitions, roofs, and walls or in concrete floors, concrete roof slabs, and concrete walls as they are constructed. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
1. In-Slab and In-Wall Piping: Seal pipe sleeve watertight with grout.
2. Piping Passing through Penetraions:
a. Pack solid using mineral fiber in compliance with **<<ASTM C592>>**.
b. Fill space with an elastomer caulk to a depth of **<< 0.50 inch; or _____ inch>>** where penetrations occur between conditioned and unconditioned spaces.
3. Seal exterior wall sleeves watertight with grout where no sleeve seal system is indicated.

I. Stack Sleeve Fittings:

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1. Install stack sleeve fittings in concrete slabs as they are constructed.
2. Provide 1/4 inch clear space between sleeve and pipe or pipe insulation.
3. Pipes Penetrating Floors: Secure flashing between clamping flanges with membrane waterproofing in accordance with Section **<< 076200 - Sheet Metal Flashing and Trim>>**.
4. Extend sleeve fittings below floor slab to secure clamping ring.
5. Seal space around stack sleeve fittings watertight with grout.

J. Manufactured Sleeve-Seal Systems:
1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
3. Locate piping in center of sleeve or penetration.
4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
5. Tighten bolting for a water-tight seal.
6. Install in accordance with manufacturer's recommendations.

K. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

END OF SECTION 230517

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SECTION 230519
METERS AND GAUGES FOR HVAC PIPING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments.

B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers.

C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.

D. AWWA C700 - Cold-Water Meters -- Displacement Type, Metal Alloy Main Case.

E. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

F. UL 393 - Indicating Pressure Gauges for Fire-Protection Service.

1.02 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>**, for submittal procedures.

B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

C. Wiring Diagrams: Provide diagrams that indicate power, signal, and control wiring.

D. Project Record Documents: Record actual locations of components and instrumentation.

E. Operation and Maintenance Data.

F. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.

1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
2. Extra Gauge Oil for Inclined Manometers: **<< One bottle; Two bottles; or _____>>**.
3. Extra Pressure Gauges: **<< One; Two; or _____>>** of each type and size.

1.03 FIELD CONDITIONS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.01 POSITIVE DISPLACEMENT METERS (LIQUID)

A. Manufacturers:

1. Dwyer Instruments, Inc**<< ; _____; or None - N/A>>**: ~~www.dwyer-inst.com/#sle.~~**Carrier Products.**

B. **<< AWWA C700; AWWA C701; AWWA C702; or _____>>**, positive displacement disc type suitable for fluid with**<< metal alloy; _____; or None - N/A>>** main case and cast iron**<< frost-proof, breakaway; _____; or None - N/A>>** bottom cap, hermetically sealed register**<< , remote reading; , _____; or None - N/A>>**.

2.02 ELECTROMAGNETIC FLOW METERS

A. Liquid Flow Capacity Range: **<< From ___ to ___ gpm; or As indicated on drawings>>**.

B. Construction: Sensor with integral **<<NEMA EN 10250>>** Type 4 or 4X stainless steel or aluminum enclosure to hold thermal mass sensor and circuits**<< with numeric display for**

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consumption reading; with numeric display for demand and consumption readings; with numeric display for demand, consumption, and other parameter readings; _____; or None - N/A>>.

1. Electrode: **<< Stainless steel; Hastelloy C; or _____>>**.

C. Liquid Conductivity: 5 mS/cm, minimum.

D. Accuracy: Within **<< 0.1 percent; 0.1 percent, NIST; 0.2 percent; 0.2 percent, NIST; 1 percent; 1 percent, NIST; or _____>>** of value applied to manufacturer-specified velocity range.

E. Output: **<< Two-wire; Three-wire; Four-wire; or _____>>**, **<< 0 to 20 mA; 4 to 20 mA; 0 to 10 VDC; 2 to 10 VDC; pulse; or _____>>**, non-loop powered.

F. Service Pressure and Temperature: Up to **<< 400 psi; _____ psi; or _____>>** and **<< 15 to 250 degrees F; or _____ degrees F>>** liquid side, **<< 150 degrees F; or _____ degrees F>>** ambient.

2.03 PRESSURE GAUGES

A. Manufacturers:
1. Ernst Flow Industries.
2. Flo Fab Inc.
3. Palmer Wahl Instrumentation Group.
4. Tel Tru Manufacturing Company.
5. Watts Regulator Company.
6. Weiss Instruments.
7. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Pressure Gauges: **<<ASME B40.100>>**, **<< UL 393; UL 404; or _____>>** drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
1. Case: **<< Steel with brass bourdon tube; Cast aluminum with phosphor bronze bourdon tube; or _____>>**.
2. Size: 6 inch diameter.
3. Mid-Scale Accuracy: **<< One; Two; 1/2; or ____>>** percent.
4. Scale: **<< Psi; KPa; and _____>>**.

2.04 PRESSURE GAUGE TAPPINGS

A. Gauge Cock: Tee or lever handle, brass for maximum **<< 150 psi>>**.

B. Needle Valve: Brass for copper pipes, stainless steel for steel pipes, **<< 1/4 inch>>** or 1/2 inch NPT for minimum **<< 150 psi>>**.

C. Pulsation Damper: Pressure snubber, brass with **<< 1/4 inch>>**to 1/2 inch threaded connections.

D. Syphon: Looped, brass for copper pipes, stainless steel for steel pipes, **<< 1/4 inch>>**or 1/2 inch threads.

2.05 DIGITAL STEM TYPE THERMOMETERS

A. Manufacturers:
1. FNW.
2. Weiss Instruments, Inc.

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3. Weksler Glass Thermometer Corp.
4. Winters Instruments
5. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Thermometers - Adjustable Angle: ASME B40.3; Red- or blue-appearing non-toxic liquid in glass in accordance with **<<ASTM E1>>**; lens front tube, high impace ABS case, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane; solar powered.
1. Size: **<< 12 inch; 9 inch; 7 inch; or ___ inch>>** scale.
2. Sensor: Glass passivated thermistor.
3. Display: 1/2 inch LCD digits.
4. Stem: Ventilated aluminum for duct installation; brass for pipe installation.
5. Pipe Installation: 1-1/4 inch thermowell connector with threads in accordance with ASME B1.1.
6. Accuracy: 1% percent or 1 degree F, whichever is greater.
7. Calibration: **<< Degrees F; Degrees C; and _____>>**.

2.06 ANANLOG DIAL THERMOMETERS

A. Manufacturers:
1. Flo Fab Inc.
2. Miljoco Corporation.
3. Palmer Wahl Instrumentation Group.
4. Tel-Tru Manufacturing Company.
5. Trerise, H. O. Co.
6. Weiss Instruments, Inc.
7. Winters Instruments.

B. Thermometer: **<<ASTM E1>>**, cast aluminum case, adjustable angle with front recalibration, bimetallic helix actuated with silicone fluid damping in accordance with ASME B40.200, white with black markings and black pointer hermetically sealed lens, ventilated aluminum stem for duct installation and brass stem for pipe installation.
1. Size: **<< 3 inch; 5 inch; or 9 inch inch>>** diameter dial.
2. Lens: Clear **<< glass; Lexan; or _____>>**.
3. Pipe Installation: 1-1/4 inch thermowell connector with threads in accordance with ASME B1.1.
4. Accuracy: 1 percent.
5. Calibration: **<< Degrees F; Degrees C; and _____>>**.

2.07 THERMOMETER SUPPORTS

A. Flange: **<< 3 inch>>** outside diameter reversible flange with screw holes, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.08 THERMOWELLS

A. Thermowell: ASME B40.200, pressure tight socket for inserting into piping tee, brass for copper pipes, Type 316 stainless steel for steel pipes, stepped or tapered shank in accordance with manufacturer's standard, bore wide enough to match thermometer stem, lagging extension for insulated piping.
1. Size: Match thermometer length and reach center of pipe.

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2. Heat transfer medium: Manufacturer's standard.

B. Single Source Responsibility: Provide thermowell and thermometer products by the same manufacturer.

2.09 TEST PLUGS

A. Manufacturers:
1. Flow Design, Inc.
2. H.O. Trerice Company.
3. Watts Water Technologies, Inc.
4. Weiss Instruments, LLC.
5. Weksler Glass Thermometer Corp.
6. Winters Instruments.
7. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Test Plug: **<< 1/2 inch>>**brass or stainless steel fitting and cap for receiving **<< 1/8 inch>>** outside diameter pressure or temperature probe with neoprene core for temperatures up to **<< 200 degrees F>>**.

C. Test Kit: Carrying case, internally padded and fitted containing **<< one; two; or (_____)>><< 2-1/2 inch; 3-1/2 inch; or ___ inch (___ mm)>>** diameter pressure gauge, **<< one; two; or _____>>** gauge adapters with **<< 1/8 inch>>** probes, two **<< 1 inch; 1-1/2 inch; or ___ inch (___ mm)>>** dial thermometers.
1. Low Range Thermometer: Bimetallic insertion with tapered sensing element and 1 inch to 2 inch diamater dial for temperatures ranging from 25 degress F to 125 degrees F.
2. High Range Thermometer: Bimetallic insertion with tapered sensing element and 1 inch to 2 inch diamater dial for temperatures ranging from 0 degrees F to 220 degrees F.
3. Pressure Gauge: Bourdon tube insertion with 2 inch to 3 inch diameter dial for pressure ranges from 0 psi to 200 psi.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.

C. Install pressure gauges with pulsation dampers. Provide **<< gauge cock; needle valve; or _____>>** to isolate each gauge. **<< Provide siphon on gauges in steam systems. ; _____ . ; or None - N/A>>** Extend nipples**<< and siphons; _____; or None - N/A>>** to allow clearance from insulation.

D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than **<< 2-1/2 inch>>** for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

E. Install thermometers in air duct systems on flanges.

F. Install thermometers with lagging extensions on insulated piping.

G. Locate duct mounted thermometers minimum **<< 10 feet>>** downstream of mixing dampers, coils, or other devices causing air turbulence. Attach in duct walls with screws.

H. Install gauges and thermometers in locations where they are easily read and maintained from normal operating level. Install vertical to 45 degrees off vertical.

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I. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

J. Locate test plugs **<< adjacent thermometers and thermometer sockets; adjacent to pressure gauges and pressure gauge taps; adjacent to control device sockets; where indicated; or _____>>** and at BACnet IP pressure and temperature sensing devices.

3.02 SCHEDULE

A. Pressure Gauges, Location:
   1. Pumps.
   2. Expansion tanks.
   3. Pressure tanks.

B. Pressure Gauge Tappings, Location:
   1. Control valves - inlets and outlets.
   2. Major coils - inlets and outlets.
   3. Heat exchangers - inlets and outlets.
   4. Chiller - inlets and outlets.
   5. Boiler - inlets and outlets.

C. Thermometers, Location:
   1. Headers to central equipment.
   2. Coil banks - inlets and outlets.
   3. Heat exchangers - inlets and outlets.
   4. Boilers - inlets and outlets.
   5. Chiller - inlets and outlets.
   6. Water zone supply and return.
   7. After major coils.
   8. Domestic hot water supply and recirculation.
   9. Each supply, return, and outside air zone.

END OF SECTION 230519

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SECTION 230523
GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.01 ABBREVIATIONS AND ACRONYMS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. PTFE: Polytetrafluoroethylene.

G. RS: Rising stem.

H. TFE: Tetrafluoroethylene.

I. WOG: Water, oil, and gas.

J. WSP: Working steam pressure.

1.02 REFERENCE STANDARDS

A. API STD 594 - Check Valves: Flanged, Lug, Wafer, and Butt-Welding.

B. ASME B1.20.1 - Pipe Threads, General Purpose, Inch.

C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

D. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard.

E. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves.

F. ASME B16.34 - Valves — Flanged, Threaded, and Welding End.

G. ASME B31.9 - Building Services Piping.

H. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators.

I. ASTM A48/A48M - Standard Specification for Gray Iron Castings.

J. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

K. ASTM A536 - Standard Specification for Ductile Iron Castings.

L. AWWA C606 - Grooved and Shouldered Joints.

M. MSS SP-45 - Drain and Bypass Connections.

N. MSS SP-67 - Butterfly Valves.

O. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends.

P. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends.

Q. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service.

R. MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends.

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S. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves.

T. MSS SP-85 - Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.

U. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

V. MSS SP-125 - Check Valves: Gray Iron and Ductile Iron, In-Line, Spring-Loaded, Center-Guided.

1.03 SUBMITTALS

A. See Section **<< 013000>>** - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in **<<Owner>>**'s name and registered with manufacturer.

D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

E. Maintenance Materials: Furnish **<<Owner>>** with one wrench for every **<< five; ten; or _____>>** plug valves, in each size of square plug valve head.

1. See Section **<< 016000 - Product Requirements>>** for additional provisions.

1.04 QUALITY ASSURANCE

A. Manufacturer:

1. Obtain valves for each valve type from single manufacturer.
2. Company must specialize in manufacturing products specified in this section, with not less than **<< three; or _____>>** years of**<< documented; or None - N/A>>** experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
2. Protect valve parts exposed to piped medium against rust and corrosion.
3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
5. Secure check valves in either the closed position or open position.
6. Adjust butterfly valves to closed or partially closed position.

B. Use the following precautions during storage:

1. Maintain valve end protection and protect flanges and specialties from dirt.
   a. Provide temporary inlet and outlet caps.
   b. Maintain caps in place until installation.

C. Exercise the following precautions for handling:

1. Handle large valves with sling, modified to avoid damage to exposed parts.
2. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. See drawings and Division 23 sections for specific valve locations.

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B. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).

C. Provide the following valves for the applications if not indicated on drawings or in Division 23 sections:
   1. Throttling (Hydronic): **<< Butterfly; Ball; Globe; Angle; and _____>>**.
   2. Isolation (Shutoff): **<< Butterfly; Gate; Ball; Plug; and _____>>**.
   3. Swing Check (Pump Outlet):
      a. Size **<< 2 inch>>** and Smaller: Bronze with **<< bronze; nonmetallic; or _____>>** disc.
      b. Size **<< 2-1/2 inch>>** and Larger: Iron with **<< lever and weight; lever and spring; center-guided metal; center-guided with resilient seat; or _____>>**.

D. Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.

E. Chilled Water Valves:
   1. Size **<< 2 inch>>** and Smaller, **<< Brass; Bronze; and _____>>** Valves:
      a. **<< Threaded; Solder-joint; or _____>>** ends.
      b. Ball: **<< Full; Regular; Reduced; or _____>>** port, **<< one; two; three; or ____>>** piece, **<< brass; bronze; stainless steel; or _____>>** trim.
         1) Class 150 SWP, bronze, two-piece body, full port, TFE seats and seals, stainless-steel ball and stem. Extension handle for use in insulated piping. NIBCO T-585-70-66 or S-585-70-66, threaded or soldered ends.
      c. Swing Check: **<< Bronze; Nonmetallic; or _____>>** disc, Class.
         1) Class 125, bronze, PTFE seat, renewable disks, Y pattern, horizontal swing, NIBCO T-413-Y or S-413-Y, threaded or soldered ends.
   2. Size **<< 2-1/2 inch>>** and Larger, Iron Valves:
      a. **<< 2-1/2 inch>>** to **<< 4 inch>>**: **<< Threaded; Flanged; or _____>>** ends.
      b. Ball: **<< 2-1/2 NPS>>** to **<< 10 inch>>**, Class 150.
         1) Conventional port, NIBCO T-580-70-66 or S-580-70-66,threaded or soldered ends.
      c. Swing Check: **<< Metal; Nonmetallic-to-metal; or _____>>** seats, Class **<< 125; 250; or ___>>**.
         1) Class 125, IBBM, bolted bonnet, renewable seat and disk, horizontal swing NIBCO Fig. F-918-B, flanged ends.
      d. Eccentric Plug: Resilient seating, 175 CWP.

F. Condenser Water Valves:
   1. Size **<< 2 inch>>** and Smaller, **<< Brass; Bronze; and _____>>** Valves:
      a. **<< Threaded; Solder-joint; or _____>>** ends.
      b. Ball: **<< Full; Regular; Reduced; or _____>>** port, **<< one; two; three; or ____>>** piece, **<< brass; bronze; stainless steel; or _____>>** trim.
         1) Class 150 SWP, bronze, two-piece body, full port, TFE seats and seals, stainless-steel ball and stem. Extension handle for use in insulated piping. NIBCO T-585-70-66 or S-585-70-66, threaded or soldered ends.
      c. Swing Check: **<< Bronze; Nonmetallic; or _____>>** disc, Class **<< 125; 150; or ___>>**.
   2. Size **<< 2-1/2 inch>>** and Larger, Iron Valves:
      a. **<< 2-1/2 inch>>** to **<< 4 inch>>**: **<< Threaded; Flanged; or _____>>** ends.
      b. Ball: **<< 2-1/2 inch>>** to **<< 10 inch>>**, Class 150.

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1) Conventional port, NIBCO T-580-70-66 or S-580-70-66,threaded or soldered ends.

c. Swing Check: **<< Metal; Nonmetallic-to-metal; or _____>>** seats, Class **<< 125; 250; or ___>>**.

d. Swing Check with Closure Control, **<< 2-1/2 inch>>** to **<< 12 inch>>**: Lever and **<< spring; weight; or _____>>**, Class 125.

e. Lubricated Plug: **<< Regular gland; Cylindrical; Threaded; Flanged; or _____>>**, Class **<< 125; 250; or ___>>**.

G. Heating Hot Water Valves:

1. Size **<< 2 inch>>** and Smaller, **<< Brass; Bronze; and _____>>** Valves:

a. **<< Threaded; Flanged; or _____>>** ends.

b. Angle: **<< Bronze; Nonmetallic; or _____>>** disc, Class **<< 125; 150; or ___>>**.

c. Ball: **<< Full; Regular; Reduced; or _____>>** port, **<< one; two; three; or ____>>** piece, **<< brass; bronze; stainless steel; or _____>>** trim.

d. Swing Check: **<< Bronze; Nonmetallic; or _____>>** disc, Class **<< 125; 150; or ___>>**.

2. Size **<< 2-1/2 inch>>** and Larger, Iron Valves:

a. **<< 2-1/2 inch>>** to **<< 4 inch>>**: **<< Threaded; Flanged; or _____>>** ends.

b. Ball: **<< 2-1/2 inch>>** to **<< 10 inch>>**, Class 150.

c. Swing Check: **<< Metal; Nonmetallic-to-metal; or _____>>** seats, Class **<< 125; 250; or ___>>**.

d. Swing Check: **<< 2-1/2 inch>>** to **<< 12 inch>>**, lever and **<< spring; weight; or _____>>** closure control, Class 125.

2.02 GENERAL REQUIREMENTS

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

B. Valve Sizes: Match upstream piping unless otherwise indicated.

C. Valve Actuator Types:

1. Handwheel: Valves other than quarter-turn types.
2. Hand Lever: Quarter-turn valves **<< 6 inch>>** and smaller**<< except plug valves; _____; or None - N/A>>**.
3. Wrench: Plug valves with square heads.
4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator, of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

D. Valves in Insulated Piping: Provide **<< 2 inch>>** stem extensions and the following features:

1. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
2. Memory Stops: Fully adjustable after insulation is installed.

E. Valve-End Connections:

1. Threaded End Valves: **<<ASME B1.20.1>>**.
2. Pipe Flanges and Flanged Fittings **<< 1/2 inch>>** through **<< 24 inch>>**: **<<ASME B16.5>>**.

F. General ASME Compliance:

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1. Ferrous Valve Dimensions and Design Criteria: **<<ASME B16.10>>** and **<<ASME B16.34>>**.
2. Power Piping Valves: **<<ASME B31.1>>**.
3. Building Services Piping Valves: **<<ASME B31.9>>**.

G. Bronze Valves:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

H. Valve Bypass and Drain Connections: **<<MSS SP-45>>**.

2.03 BRASS, BALL VALVES

A. Three Piece, Full Port with **<< Brass; Stainless Steel; or _____>>** Trim:
1. Comply with **<<MSS SP-110>>**.
2. WSP Rating: **<< 150 psi>>**.
3. Body: Forged brass.
4. Ends: **<< Threaded; or _____>>**.
5. Seats: **<< PTFE; TFE; or ____>>**.
6. Stem: **<< Brass; Stainless steel; or _____>>**.
7. Ball: **<< Chrome-plated brass; Stainless steel; or _____>><< None - N/A; , vented; or , _____>>**.
8. Manufacturers:
   a. **<< NIBCO >>**.
   b. Watts Regulator Co.
   c. American Valve
   d. Apollo Valves
   e. Milwaukee Valve Co.
   f. Stockham Valve & Fittings
   g. Walworth Co.

2.04 BRONZE, BALL VALVES

A. General:

B. Three Piece, **<< Full Port; Regular Port; or _____>>** with **<< Bronze or Brass; Stainless Steel; or _____>>** Trim:
1. Comply with **<<MSS SP-110>>**.
2. WSP Rating: **<< 150 psi>>**.
3. End Connections: Pipe **<< press; thread; solder; or _____>>**.
4. Seats: PTFE.
5. Stem: **<< Bronze or brass; Stainless steel; or _____>>**.
6. Ball: **<< Stainless steel, vented; Chrome plated brass; or _____>>**.
7. Manufacturers:
   a. Apollo Valves**<< ; ____; or None - N/A>>**:
   b. NIBCO INC**<< ; _____; or None - N/A>>**:
   c. Watts Regulator Co.
   d. American Valve
   e. Apollo Valves

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f. Milwaukee Valve Co.
g. Stockham Valve & Fittings
h. Walworth Co.

2.05 STAINLESS STEEL, BALL VALVES

2.06 BRONZE, SWING CHECK VALVES

A. Class 125:
1. Pressure and Temperature Rating: **<<MSS SP-80>>**, **<< Type 3; Type 4; or _____>>**.
2. Design: Y-pattern, horizontal or vertical flow.
3. WSP Rating: **<< 200 psi; or _____ psi>>**.
4. Body: Bronze, **<<ASTM B62>>**.
5. End Connections: **<< Soldered; Threaded; Threaded or soldered; or _____>>**.
6. Disc: **<< Bronze; PTFE; or _____>>**.
7. Manufacturers:
a. Apollo Valves**<< ; _____; or None - N/A>>**:
b. Kitz Corporation of America**<< ; #22; ; #22T; ; _____; or None - N/A>>**:
c. NIBCO INC**<< ; _____; or None - N/A>>**:

2.07 CHAINWHEELS

A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to **<< ball; butterfly; plug; and _____>>** valve stems.
3. Sprocket Rim with Chain Guides: **<< Ductile iron; Ductile or cast iron; Cast iron; Aluminum; Bronze; or _____>><< include zinc coating; _____; or None - N/A>>**.
4. Chain: **<< Hot-dip galvanized steel; Brass; Stainless steel; or _____>>**. Sized to fit sprocket rim.

B. Manufacturers:
1. **<< Roto Hammer. Model CHAW>>**.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Discard all packing materials and verify that valve interior, including threads and flanges, are completely clean without signs of damage or degradation that could result in leakage.

B. Verify valve parts to be fully operational in all positions from closed to fully open.

C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.

D. Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.

B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welds.

D. Install check valves where necessary to maintain direction of flow as follows:
   1. Swing Check: Install horizontal maintaining hinge pin level.
   2. Orient **<< plate-type; center-guided; and _____>>** into horizontal or vertical position, between flanges.

E. Provide chainwheels on operators for valves **<< 4 NPS>>** and larger where located **<< 96 inches>>** or more above finished floor, terminating **<< 60 inches>>** above finished floor.

END OF SECTION 230523

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SECTION 230529
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components.

1.02 RELATED REQUIREMENTS

A. Section **<< 033000 - Cast-in-Place Concrete>>**: Concrete equipment pads.

B. Section **<< 055000 - Metal Fabrications>>**: Materials and requirements for fabricated metal supports.

C. Section **<< 230548 - Vibration and Seismic Controls for HVAC>>**.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

B. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.

D. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.

E. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

H. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

J. FM (AG) - FM Approval Guide.

K. MFMA-4 - Metal Framing Standards Publication.

L. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

M. UL (DIR) - Online Certifications Directory.

N. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

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1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
2. Coordinate the work with other trades to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
5. Notify **<<Architect>>** of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section **<< 033000; or _____>>**.

1.05 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for **<< channel (strut) framing systems; nonpenetrating rooftop supports; post-installed concrete and masonry anchors; thermal insulated pipe supports; and _____>>**.

C. Shop Drawings: Include details for fabricated hangers and supports**<< where materials or methods other than those indicated are proposed for substitution; upon request; for _____; _____; or None - N/A>>**.
1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.

D. Design Data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer

E. Installer's Qualifications: Include evidence of compliance with specified requirements.

F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Welding Certificates.

1.06 QUALITY ASSURANCE

A. Comply with **<< applicable building code; or _____>>**.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Designer's Qualifications for mechanical supports under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

D. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.

E. Installer Qualifications for Field-Welding: As specified in Section **<< 055000; or _____>>** - Metal Fabrications.

F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

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1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
   2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   3. Where pipe supports are directly connected to metal piping that is subject to vibration, provide anti-vibration clamps.
   4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported**<< with a minimum safety factor of _____; _____; or None - N/A>>**. Include consideration for vibration, equipment operation, and shock loads where applicable.
   5. Do not use **<< wire; chain; perforated pipe strap; wood; or _____>>** for permanent supports unless specifically indicated or permitted.
   6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
      a. Indoor Dry Locations: Use **<< zinc-plated steel; approved equivalent; or _____>>** unless otherwise indicated.
      b. Outdoor and Damp or Wet Indoor Locations: Use **<< galvanized steel; stainless steel; approved equivalent; or _____>>** unless otherwise indicated.
      c. Zinc-Plated Steel: Electroplated in accordance with **<<ASTM B633>>**.
      d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with **<<ASTM A123/A123M>>** or **<<ASTM A153/A153M>>**.

B. Prefabricated Trapeze-Framed Metal Strut Systems:
   1. Manufacturers:
      a. B-Line, a brand of Eaton Corporation**<< ; _____; or None - N/A>>**:
      b. Custom Strut and Roll Forming, LLC**<< ; _____; or None - N/A>>**:
      c. Elgen Manufacturing Company, Inc**<< ; _____; or None - N/A>>**:
      d. Gripple, Inc**<< ; Fast Track - Low Profile; ; Fast Track - Side Loading; ; Fast Track - Standard; ; _____; or None - N/A>>**:
      e. Unistrut, a brand of Atkore International Inc**<< ; _____; or None - N/A>>**:
      f. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
   2. **<<MFMA-4>>** compliant, pre-fabricated, **<<MSS SP-58>>** type 59**<< , low profile; , _____; or None - N/A>>** continuous-slot metal strut channel with associated tracks, fittings, and related accessories.
   3. **<<MFMA-4>>** compliant, prefabricated, side-loading continuous-slot metal strut channel bracket with associated tracks, fittings, and related accessories.
   4. Strut Channel or Bracket Material:
      a. Indoor Dry Locations: Use **<< painted steel; zinc-plated steel; galvanized steel; or _____>>**.

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b. Outdoor and Damp or Wet Indoor Locations: Use **<< galvanized steel; or _____>>**.

5. Minimum Channel Thickness: Steel sheet, **<< 12 gauge, 0.1046 inch; 14 gauge, 0.0747 inch; or ___ gauge, ___ inch>>**.
6. Minimum Channel Dimensions: **<< 1-5/8 inch; 1-1/2 inch; or _____>>** width by **<< 13/16 inch; 1-5/8 inch; or _____>>** height.
7. Accessories: Provide **<< bracket covers; cable basket clips; cable tray clips; clamps; conduit clamps; fire-retarding brackets; j-hooks; protectors; vibration dampeners; and _____>>**.

C. **<< Strut Channels; Low Profile Strut-Channel Brackets; Strut-Channel Brackets; or _____>>**:

1. Manufacturers:
   a. Anvil International.
   b. B-Line, a brand of Eaton Corporation.
   c. Empire Industries, Inc.
   d. ENRICO International Corporation.
   e. Haydon Corporation.
   f. NIBCO INC.
   g. PHD Manufacturing, Inc.
   h. PHS Industries, Inc.
   i. Unistrut, a brand of Atkore International Inc.
   j. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
   k. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. **<<ASTM A653/A653M>>** galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
3. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.

D. Channel Nuts:

1. Provide **<< carbon steel; malleable iron; 304 stainless steel; 316 stainless steel; or _____>>** channel nut with **<< epoxy copper; epoxy plated; galvanized steel; stainless steel; zinc; or _____>>** finish and **<< long; regular; short; or _____>>** spring.

E. Hanger Rods:

1. Threaded zinc-plated steel unless otherwise indicated.
2. Minimum Size, Unless Otherwise Indicated or Required:
   a. Equipment Supports: **<< 1/2 inch; or _____ inch>>** diameter.
   b. Piping**<< up to 1 inch; _____ inch; _____; or None - N/A>>**: **<< 1/4 inch; or _____ inch>>** diameter.
   c. Piping**<< larger than 1 inch; _____ inch; _____; or None - N/A>>**: **<< 3/8 inch; or _____ inch>>** diameter.
   d. Trapeze Support for Multiple Pipes: **<< 3/8 inch; or _____ inch>>** diameter.

F. Pipe Shields for Insulated Piping:

1. Manufacturers:

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a. Anvil International.
b. Buckaroos, Inc.
c. Carpenter and Patterson, Inc.
d. Clement Support Services.
e. Cooper Industries.
f. ERICO International Corporation.
g. National Pipe Hanger Corporation.
h. PHS Industries, Inc.
i. Pipe Shields, Inc.
j. Rilco Manufacturing Co, Inc.
k. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
l. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2. General Construction and Requirements:
   a. Surface Burning Characteristics: Comply with **<< ASTM E84; UL 723; or _____>>**.
   b. Shields Material: **<< UV-resistant polypropylene with glass fill; PVC; or _____>>**.
   c. Maximum Insulated Pipe Outer Diameter: **<< 12-5/8 inch; or ____ inch>>**.
   d. Minimum Service Temperature: **<< Minus 40 degrees F; or ____ degrees F>>**.
   e. Maximum Service Temperature: **<< 178 degrees F; or ____ degrees F>>**.
   f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.

G. Pipe Supports:
   1. Material: **<<ASTM A395/A395M>>** ductile iron, **<<ASTM A36/A36M>>** carbon steel, **<<ASTM A47/A47M>>** malleable iron, **<<ASTM A181/A181M>>** forged steel, or **<<ASTM A283/A283M>>** steel.
   2. Liquid Temperatures Up To **<< 122 degrees F; or ____ degrees F>>**:
      a. Overhead Support: **<<MSS SP-58>><< Types 1, 3 through 12; Types 24 and 26; or ____>>**.
      b. Support From Below: **<<MSS SP-58>>** Types 35 through 38.

H. Nonpenetrating Pipe Supports:

I. Pipe Stanchions:
   1. Material: Malleable iron, **<<ASTM A47/A47M>>**; or carbon steel, **<<ASTM A36/A36M>>**.
   2. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
   3. For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.

J. Beam Clamps:
   1. **<<MSS SP-58>>** types **<< 19 through 23, 25 or 27 through 30; or ____>>** based on required load.
   2. Beam C-Clamp: **<<MSS SP-58>>** type 23, **<< malleable iron; steel; and _____>>** with **<< plain; stainless steel; zinc; and _____>>** finish.
   3. Small or Junior Beam Clamp: **<<MSS SP-58>>** type 19, malleable iron with **<< plain; zinc; or _____>>** finish. For inverted usage provide manufacturer listed size(s).

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4. Wide Mouth Beam Clamp: **<<MSS SP-58>>** type 19, malleable iron with plain finish.
5. Centerload Beam Clamp with Extension Piece: **<<MSS SP-58>>** type 30, malleable iron with plain finish.
6. **<<FM (AG)>>** and **<<UL (DIR)>>** Approved Beam Clamp: **<<MSS SP-58>>** type 19, **<< plain finish; plated finish; or _____>>**,
7. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
8. Material: **<<ASTM A395/A395M>>** ductile iron, **<<ASTM A36/A36M>>** carbon steel, **<<ASTM A47/A47M>>** malleable iron, **<<ASTM A181/A181M>>** forged steel, or **<<ASTM A283/A283M>>** steel.

K. Riser Clamps:
1. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
2. **<<MSS SP-58>>** type 1 or 8, **<< carbon steel; steel; or _____>>** with **<< epoxy plated; plain; stainless steel; zinc plated; or _____>>** finish.
3. Medium Split Horizontal Pipe Clamp: **<<MSS SP-58>>** type 4, **<< carbon steel; stainless steel; or _____>>** with **<< epoxy plated; plain; stainless steel; zinc plated; or _____>>** finish.
4. Copper Tube Pipe Clamp: **<<MSS SP-58>>** type 8, epoxy plated copper.
5. **<<UL (DIR)>>** listed: Pipe sizes **<< 1/2 to 8 inch; 3/4 to 8 inch; 1/2 to 12 inch; or _____ inch>>**.

L. U-Bolts:
1. **<<MSS SP-58>>** Type 24, **<< carbon steel; zinc-coated carbon steel; 304 stainless steel; or _____>>** u-bolt for pipe support or anchoring.

M. Pipe Hangers:
1. Split Ring Hangers:
   a. Provide **<< hinged split ring; yoke roller; and _____>>** hanger with **<< epoxy copper; plain; zinc; or _____>>** finish.
   b. Material: **<<ASTM A47/A47M>>** malleable iron or **<<ASTM A36/A36M>>** carbon steel.
   c. Provide hanger rod and nuts of the same type and material for a given pipe run.
   d. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
2. Swivel Ring Hangers, Adjustable:
   a. **<<MSS SP-58>>** Type 10, epoxy-painted, zinc-colored.
   b. Material: **<<ASTM A395/A395M>>** ductile iron, **<<ASTM A36/A36M>>** carbon steel, **<<ASTM A47/A47M>>** malleable iron, **<<ASTM A181/A181M>>** forged steel, or **<<ASTM A283/A283M>>** steel.
   c. **<<FM (AG)>>** and **<<UL (DIR)>>** listed for specific pipe size runs and loads.
   d. Felt-Lining: Provide for uninsulated pipe to reduce noise and prevent static issues.
3. Clevis Hangers, Adjustable:
   a. Copper Tube: **<<MSS SP-58>>** Type 1, epoxy-plated copper.
   b. Felt-Lined: **<<MSS SP-58>>** Type 1, **<< epoxy-plated, zinc; zinc-plated, silicone-free carbon steel; or _____>>**.
   c. Light-Duty: **<<MSS SP-58>>** Type 1, **<< plain finish; zinc-plated; zinc-colored, epoxy plated; or _____>>**.

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d. Standard-Duty: **<<MSS SP-58>>** Type 1, **<< plain finish; stainless steel; zinc-plated; zinc-colored, epoxy plated; or _____>>**.

e. **<<UL (DIR)>>** listed: Pipe sizes **<< 1/2 to 4 inch; 3/4 to 4 inch; 2-1/2 to 8 inch; or _____ inch>>**.

N. Pipe Alignment Guides:

1. Pipe Sizes **<< 8 inch; or ____ inch>>** and Smaller: Spider or sleeve type.
2. Pipe Sizes **<< 10 inch; or ____ inch>>** and Larger: Roller type.

O. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

P. Rooftop Supports for Low-Slope Roofs:

1. Products:
   a. Curb Plus, Inc; CPES-X
   b. Kees; Equipment Support Model SF.
   c. Pate Company; Equipment Support ES2.
   d. Portals Plus; ER-2A.
   e. Roof Products and Systems; Equipment Rails ER-2B.
   f. Thybar Corporation; TEMS 3.
   g. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
2. Provide carbon steel pedestals with integral base that mount to roof deck, with support fixtures as specified. Factory fabricated 18 gauge counterflashing fastened with tek-screws and neoprene washers.
3. Structure: Internal C-channel reinforcement on 12 inch centers with 6 inch spreader channels on alternating 12 inch centers.
4. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
5. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
6. Mounting Height: Provide minimum clearance of 12 inches under supported component to top of roofing.

Q. Anchors and Fasteners:

1. Manufacturers - Mechanical Anchors:
   a. FNW**<< ; 7502; ; _____; or None - N/A>>**:
   b. Hilti, Inc**<< ; _____; or None - N/A>>**:
   c. ITW Red Head, a division of Illinois Tool Works, Inc**<< ; _____; or None - N/A>>**:
   d. MKT Fastening**<< ; _____; or None - N/A>>**:
   e. Powers Fasteners, Inc**<< ; _____; or None - N/A>>**:
   f. Simpson Strong-Tie Company Inc**<< ; _____; or None - N/A>>**:
2. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
3. Concrete: Use **<< preset concrete inserts; expansion anchors; screw anchors; or _____>>**.
4. Solid or Grout-Filled Masonry: Use **<< expansion anchors; screw anchors; or _____>>**.

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5. Hollow Masonry: Use **<< toggle bolts; or _____>>**.
6. Hollow Stud Walls: Use **<< toggle bolts; or _____>>**.
7. Beam Ceiling Flanges: **<<ASTM A47/A47M>>** Grade 32510, **<< malleable iron; stainless steel; or _____>>** with **<< copper; plain; stainless steel; zinc; or _____>>** finish.
8. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
   a. Comply with **<<MFMA-4>>**.
   b. Channel Material: Use **<< galvanized steel; or _____>>**.
   c. Minimum Channel Thickness: Steel sheet, **<< 12 gauge, 0.1046 inch; or ___ gauge, ___ inch>>** minimum base metal thickness.
   d. Manufacturer: Same as manufacturer of metal channel (strut) framing system.

R. Pipe Installation Accessories:
1. Copper Pipe Supports:
   a. Manufacturers:
      1) HoldRite, a brand of Reliance Worldwide Corporation**<< ; _____; or None - N/A>>**:
      2) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
      3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Thermal Insulated, Surface-Mounted Pipe Supports:
   a. Manufacturers:
      1) FNW**<< ; 7701; ; 7706; ; _____; or None - N/A>>**:
      2) HoldRite, a brand of Reliance Worldwide Corporation**<< ; _____; or None - N/A>>**:
      3) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
   b. Material: **<< Carbon steel; Malleable iron; 304 Stainless steel; 316 Stainless steel; or _____>>** with **<< epoxy copper; epoxy plated; galvanized steel; stainless steel; zinc; or _____>>** finish.
   c. Weather and UV light resistant foam, plastic, or rubber material with built-in strut. Maximum Load: **<< 50 lb; or _____ lb>>** for single pipe or multiple landed on top strut.
3. Overhead Pipe Supports:
   a. Manufacturers:
      1) HoldRite, a brand of Reliance Worldwide Corporation**<< ; _____; or None - N/A>>**:
      2) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
4. Plenum Pipe Supports:
   a. Manufacturers:
      1) HoldRite, a brand of Reliance Worldwide Corporation**<< ; _____; or None - N/A>>**:
      2) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
5. Inserts and Clamps:

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a. Manufacturers:
   1) HoldRite, a brand of Reliance Worldwide Corporation**<< ; _____; or None - N/A>>**:
   2) Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2.02 ACCESSORIES

A. Structural Steel: ASTM A36/A36M, carbon steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C1107, factory mixed, pre-packaged, dry, hydraulic cement, non-shrink, nonmetallic, non-staining, noncorrosive, and nongaseous grout with a 5000 psi rating for interior and exterior applications.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. For support from floor deck under 4" piping
   1. Mechanical expansion anchors: Self-drilling type expansion shields or machine bolt drop-in anchors for drilled holes, equal to ITT Phillips Anchors “Red Head.” Fasteners to floor slabs shall be vibration and shock resistant. Load applied to fasteners shall not exceed 25 percent of manufacturer’s stated load capacity in 3500 psi (24,000 kPa) concrete. Provide zinc-coated anchors for indoor applications and stainless-steel anchors for outdoor applications

D. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

E. Unless specifically indicated or approved by **<<Architect>>**, do not provide support from suspended ceiling support system or ceiling grid.

F. Unless specifically indicated or approved by **<<Architect>>**, do not provide support from roof deck.

G. Do not penetrate or otherwise notch or cut structural members without approval of **<< Structural Engineer; Architect; or _____>>**.

H. Field-Welding (where approved by **<<Architect>>**): Comply with Section **<< 055000; or _____>>** - Metal Fabrications.

I. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

J. Equipment Support and Attachment:
   1. Use **<< metal fabricated supports; supports assembled from metal channel (strut); or _____>>** to support equipment as required.

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2. Use **<< metal channel (strut) secured to studs; or _____>>** to support equipment surface-mounted on hollow stud walls**<< when wall strength is not sufficient to resist pull-out; _____; or None - N/A>>**.
3. Use **<< metal channel (strut); or _____>>** to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Unless otherwise indicated, mount floor-mounted equipment on properly sized **<< 3 inch; 4 inch; or _____>>** high concrete pad constructed in accordance with Section **<< 033000; or _____>>** - Cast in Place Concrete.
5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

K. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.

L. Secure fasteners according to manufacturer's recommended torque settings.

M. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 230529

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SECTION 230533
HEAT TRACING FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Self-regulating parallel resistance electric heating cable.

B. Controls.

1.02 RELATED REQUIREMENTS

A. Section **<< 230553 - Identification for HVAC Piping and Equipment>>**.

B. Section **<< 230719 - HVAC Piping Insulation>>**.

C. Section **<< 230913 - Instrumentation and Control Devices for HVAC>>**.

D. Section **<< 230923 - Direct-Digital Control System for HVAC>>**.

E. Section **<< 230993 - Sequence of Operations for HVAC Controls>>**.

F. Section **<< 232113 - Hydronic Piping>>**.

G. Section **<< 232114 - Hydronic Specialties>>**.

H. Section **<< 260526 - Grounding and Bonding for Electrical Systems>>**.

I. Section **<< 260533 - Conduit for Electrical Systems>>**.

J. Section **<< 260534 - Boxes for Electrical Systems>>**.

K. Section **<< 260583 - Wiring Connections>>**.

1.03 REFERENCE STANDARDS

A. IEEE 515.1 - IEEE Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Trace Heating for Commercial Applications.

B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. NFPA 70 - National Electrical Code.

D. UL (DIR) - Online Certifications Directory.

E. UL 1053 - Ground-Fault Sensing and Relaying Equipment.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting **<< one week; at least one week; _____; or None - N/A>>** prior to the start of the work of this section; require attendance by all affected installers.

B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

C. Coordinate the work with other trades to provide ground fault protection for electric heat tracing circuits as required by **<<NFPA 70>>**.

D. Coordinate the work with other trades to provide circuit breaker ratings suitable for installed circuit lengths.

1.05 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>**, for submittal procedures.

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B. Product Data: Provide data for **<< electric heat tracing; and _____>>**.

C. Shop Drawings: Indicate **<< electric heat tracing; and _____>>** layout, **<< electrical terminations; thermostats; controls; branch circuit connections; and _____>>**.

D. Manufacturer's Installation Instructions: Indicate installation instructions and recommendations.

E. Field Quality Control Submittals: Indicate **<< test reports; inspection reports; and _____>>**.

F. Manufacturer's Qualification Statement.

G. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions of equipment and controls, maintenance and repair data, and parts listings.

H. Warranty: Submit manufacturer warranty and ensure that forms have been completed in **<<Owner>>**'s name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with at least **<< three; or _____>>** years of**<< documented; _____; or None - N/A>>** experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least **<< three; or _____>>** years of**<< documented; _____; or None - N/A>>** experience**<< and approved by manufacturer; _____; or None - N/A>>**.

C. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.07 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Provide **<< two; one; or _____>>** year manufacturer warranty for **<< cables; connection kits; accessories; controls; and _____>>**.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Chromalox, Inc**<< ; _____; or None - N/A>>**:

B. Emerson Electric Co**<< ; _____; or None - N/A>>**:

C. nVent RAYCHEM**<< ; _____; or None - N/A>>**:

D. Thermon Manufacturing Company**<< ; _____; or None - N/A>>**:

2.02 SELF-REGULATING PARALLEL RESISTANCE ELECTRIC HEATING CABLE

A. Provide products listed, classified, and labeled by **<< UL (DIR); ITS (DIR); or testing firm acceptable to authorities having jurisdiction (AHJ)>>**.

B. Factory Rating and Testing: Comply with **<<IEEE 515.1>>**.

C. Heating Element:

1. Provide pair of parallel No. 16 **<< tinned; nickel coated; or _____>>** stranded copper bus wires embedded in cross linked conductive polymer core with varying heat output in response to temperature along its length.
2. Terminations: Waterproof, factory assembled, non-heating leads with connector at one end and water-tight seal at opposite end.

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3. Capable of crossing over itself without overheating.

D. Insulated Jacket: Flame retardant polyolefin.

E. Cable Cover: Provide **<< tinned copper; stainless steel; braid; or _____>>** and **<< polyolefin; or _____>>** outer jacket**<< with UV inhibitor; _____; or None - N/A>>**.

F. Maximum Power-On Operating Temperature: **<< 150 degrees F; or ___ degrees F>>**.

G. Maximum Power-Off Exposure Temperature: **<< 185 degrees F; or __ degrees F>>**.

H. Electrical Characteristics:

1. **<< 2 W/lineal ft>>**for pipe sizes up to NPS 3
2. 4 W/lineal ft for pipe sizesNPS 4 to NPS 8
3. 6 W/lineal ft for pipe sizesNPS 10 to NPS 14
4. 8 W/lineal ft for pipe sizesNPS 16 to NPS 20

2.03 OUTER JACKET MARKINGS

A. Name of manufacturer, trademark, or other recognized symbol of identification.

B. Catalog number, reference number, or model.

C. Month and year of manufacture, date coding, applicable serial number, or equivalent.

D. Agency listing or approval.

E. Applicable environmental or area use requirements, such as NEMA 4, Type 4, IP ratings, and hazardous (classified) location markings including temperature rating.

F. Any applicable warning/caution statements such as "WARNING: De-energize circuit before removing cover.

2.04 CONNECTION KITS

A. Provide **<< power connection; splice/tee; end seal; and _____>>** kits compatible with the heating cable and without requiring cutting of the cable core to expose bus wires.

B. Furnish with NEMA 4X rating for prevention of corrosion and water ingress.

C. Provide UV stabilized components.

2.05 ACCESSORIES

A. Provide Accessories As Indicated or As Required for Complete Installation, Including but Not Limited To:

1. High temperature, glass filament tape for attachment of heating cable to metal piping.
2. Aluminum self-adhesive tape for attachment of heating cable to plastic piping.
3. Heat-conductive putty.
4. Cable ties.
5. Silicone end seals and splice kits.
6. Installation clips.
7. Warning labels for attachment to exterior of piping insulation. Refer to Section **<< 230553>>**.

2.06 CONTROLS

A. Manufacturers:

1. Chromalox, Inc**<< ; _____; or None - N/A>>**:
2. Frio**<< ; _____; or None - N/A>>**:

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3. nVent RAYCHEM**<< ; _____; or None - N/A>>**:
4. Thermon Manufacturing Company**<< ; _____; or None - N/A>>**:

B. Pipe Mounted Thermostats:
1. Remote bulb unit with adjustable temperature range from **<< 30 to 50 degrees F; or _____ degrees F>>**.
2. Snap-action, open-on-rise, single pole switch with minimum current rating adequate for the connected cable.
3. Remote bulb on capillary, **<< resistance temperature device (RTD); thermistor; or _____>>** for direct sensing of pipe wall temperature.
4. Control Enclosure: Corrosion resistant and waterproof.

C. System Controller:
1. **<<NEMA EN 10250>><< Type 4; Type 4X; or ____>>** enclosure.
2. Microprocessor based.
3. User interface with status indicator lights.
4. RS-485 communications port.
5. BACnet connectivity via gateway.
6. Diagnostic self-testing with field-adjustable testing interval.
7. Ground fault equipment protection (GFEP) complying with **<<UL 1053>>**.
8. Available Control Modes:
   a. ON/OFF.
   b. Proportional.
   c. Ambient proportional.
9. Manual ON/OFF override control.
10. Dry contact for alarm reporting.
11. Alarms:
    a. Ground fault.
    b. Sensor failure.
    c. Low temperature.
    d. High temperature.
    e. Low current.
    f. High current.
    g. Communications loss.
    h. Power loss.

PART 3 EXECUTION

3.01 INSTALLERS

A. Installer List:

3.02 EXAMINATION

A. Verify that **<< piping; equipment; and _____>><< is; are; or ____>>** ready to receive work.

B. Verify field measurements are as indicated on **<< shop drawings; drawings; or _____>>**.

C. Verify required power is available, in proper location, and ready for use.

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3.03 PREPARATION

A. Clean all surfaces prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer.

3.04 INSTALLATION

A. Install in accordance with manufacturer's recommendations.

B. Comply with installation requirements of **<<IEEE 515.1>>** and **<<NFPA 70>>**, Article 427.

C. Apply heating cable linearly on pipe with fiberglass tape only after piping has successfully completed any required pressure testing.

D. Comply with all national and local code requirements.

E. Identification:

1. After thermal insulation installation, apply external pipeline decals to indicate presence of the thermal insulation cladding at intervals not to exceed **<< 20 ft; or __ ft>>** including cladding over each valve or other equipment that may require maintenance.

3.05 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Perform start-up by **<< factory technician; factory representative; or _____>>** as per **<< Owner's requirements; or _____>>**.

C. Field Testing and Inspections:

1. Commission system in accordance with **<< installation and operation manual; or _____>>**.
2. Inspect for sources of water entry and proper sealing.
3. Inspect weather barrier to confirm that no sharp edges are contacting the trace heating.
4. Minimum Acceptable Insulation Resistance: **<< 20; or _____>>** megohms or greater at a test voltage of 2500 VDC for polymer insulated trace heaters.
5. Test heating cable integrity with megohmmeter at the following intervals:
   a. Prior to initial start-up (commissioning).
6. Measure voltage and current at each unit.
7. Controls:

3.06 CLOSEOUT ACTIVITIES

A. See Section **<< 017800 - Closeout Submittals>>**.

B. Demonstrate operation of controls.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 230533

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SECTION 230548
VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vibration isolation requirements.

B. Vibration-isolated equipment support bases.

C. Vibration isolators.

D. Vibration-isolated and/or seismically engineered roof curbs.

1.02 RELATED REQUIREMENTS

A. Section **<< 033000 - Cast-in-Place Concrete>>**.

B. Section **<< 055000 - Metal Fabrications>>**: Materials and requirements for fabricated metal supports.

C. Section **<< 230529 - Hangers and Supports for HVAC Piping and Equipment>>**.

1.03 DEFINITIONS

A. HVAC Component: Where referenced in this section in regards to seismic controls, applies to any portion of the HVAC system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., ductwork, piping).

B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.04 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

B. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications.

C. ICC (IBC) - International Building Code.

D. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
2. Coordinate the work with other trades to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Notify **<<Architect>>** of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section **<< 033000; or _____>>**.

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1.06 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.

1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.

D. Shop Drawings - Vibration Isolation Systems:

1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.

E. Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.

F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Evidence of qualifications for manufacturer.

H. Manufacturer's detailed field testing and inspection procedures.

I. Field quality control test reports.

1.07 QUALITY ASSURANCE

A. Comply with **<< applicable building code; ICC (IBC); or _____>>**.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum **<< three; or _____>>** years**<< documented; _____; or None - N/A>>** experience.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

A. **<< Provide; Design and provide; or _____>>** vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.

B. Comply with applicable general recommendations of **<<ASHRAE (HVACA)>>**, where not in conflict with other specified requirements:

C. General Requirements:

1. Select vibration isolators to provide required static deflection.

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2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
3. Select vibration isolators for outdoor equipment to comply with wind design requirements.
4. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum **<< 2-inch; or ____-inch>>** operating clearance beneath base unless otherwise indicated.

D. Piping Isolation:
1. Provide vibration isolators for piping supports:
   a. Located in equipment rooms.
   b. Located within **<< 50 feet; _____ feet; or _____>>** of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
   c. For piping over **<< 2 inch; or _____ inch>>** located below or within **<< 50 feet; _____ feet; or _____>>** of **<< noise-sensitive areas indicated; or _____>>**.
2. Minimum Static Deflection:
   a. First **<< Three; or _____>>** Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of **<< 2 inch; 3 inch; _____ inch; or _____>>** deflection required.
   b. Remainder of Supports: **<< 0.75 inch; _____ inch; or _____>>** deflection unless otherwise indicated.
3. Suspended Piping, Nonseismic Applications: Use **<< resilient material isolator hangers; spring isolator hangers; combination resilient material/spring isolator hangers; or _____>>**.
4. Suspended Piping, Seismic Applications: Use **<< seismic type resilient material isolator hangers; seismic type spring isolator hangers; seismic type combination resilient material/spring isolator hangers; or _____>>**.
5. Floor-Mounted Piping, Nonseismic Applications: Use **<< open (unhoused) spring isolators; or _____>>**.
6. Floor-Mounted Piping, Seismic Applications: Use **<< seismic type restrained spring isolators; or _____>>**.
7. Use **<< modular seal; approved resilient material; or _____>>** where vibration-isolated piping penetrates building elements (e.g., walls, floors) arranged to prevent vibration transmission to structure.

E. Thrust Restraint Applications:
1. Use thrust restraints to resist horizontal motion due to thrust for fan heads, suspended fans, and base-mounted and suspended air handling equipment operating at **<< 2.0 inches wg; or ____ inches wg>>** or greater total static pressure.
2. Minimum Static Deflection: Same as static deflection of equipment.
3. Limit lateral movement to **<< 0.25 inch; or _____ inch>>** or less unless otherwise indicated.

2.02 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

A. Manufacturers:
1. Vibration-Isolated Equipment Support Bases:
   a. Kinetics Noise Control, Inc**<< ; _____; or None - N/A>>**: www.kineticsnoise.com/#sle.
   b. Mason Industries**<< ; _____; or None - N/A>>**: www.mason-ind.com/#sle.

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c. Vibration Eliminator Company, Inc**<< ; _____; or None - N/A>>**: www.veco-nyc.com/#sle.

d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2. Source Limitations: Furnish vibration-isolated equipment support bases and associated components and accessories produced by **<< a single manufacturer; the same manufacturer as the vibration isolators; or _____>>** and obtained from a single supplier.

B. Vibration-Isolated Structural Steel Bases:

1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
2. Centrifugal Fan Applications: Provide adjustable motor slide rails as required.

C. Vibration-Isolated Concrete Inertia Bases:

1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
2. Minimum Base Depth: **<< 6 inches; or ____ inches>>**.
3. Minimum Base Mass (Including Concrete): **<< 1.5 times; or _____>>** weight of supported equipment.
4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
5. Concrete: Filled on site with minimum **<< 3000 psi>>** concrete in accordance with Section **<< 033000; or _____>>**.
6. Centrifugal Fan Applications: Provide adjustable motor slide rails as required.
7. Pump Applications: Size and configure bases for piping elbow supports as required.

2.03 VIBRATION ISOLATORS

A. Manufacturers:

1. Vibration Isolators:
   a. Kinetics Noise Control, Inc**<< ; _____; or None - N/A>>**: www.kineticsnoise.com/#sle.
   b. Mason Industries**<< ; _____; or None - N/A>>**: www.mason-ind.com/#sle.
   c. Vibration Eliminator Company, Inc**<< ; _____; or None - N/A>>**: www.veco-nyc.com/#sle.
   d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
2. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.

B. General Requirements:

1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
2. Spring Elements for Spring Isolators:
   a. Color code or otherwise identify springs to indicate load capacity.
   b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
   c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
   d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.

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e. Selected to provide designed deflection of not less than 75 percent of specified deflection.

f. Selected to function without undue stress or overloading.

C. Vibration Isolators for Nonseismic Applications:

1. **<< Type _____ - ; _____ ; or None - N/A>>**Resilient Material Isolator Pads:
   a. Description: Single or multiple layer pads utilizing **<< elastomeric (e.g., neoprene, rubber); fiberglass; or _____>>** isolator material.
   b. Pad Thickness: As required for specified minimum static deflection; minimum **<< 0.25 inch>>** thickness.
   c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.
2. **<< Type _____ - ; _____ ; or None - N/A>>**Resilient Material Isolator Mounts, Nonseismic:
   a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing **<< elastomeric (e.g., neoprene, rubber); fiberglass; or _____>>** isolator material**<< ; fail-safe type; ; _____; or None - N/A>>**.
3. **<< Type _____ - ; _____ ; or None - N/A>>**Open (Unhoused) Spring Isolators:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
   b. Bottom Load Plate: Nonskid, molded, elastomeric isolator material or steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
   c. Furnished with integral leveling device for positioning and securing supported equipment.
4. **<< Type _____ - ; _____ ; or None - N/A>>**Housed Spring Isolators:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing.
   b. Furnished with integral elastomeric snubbing elements, **<< nonadjustable type; adjustable type; nonadjustable or adjustable type as indicated; or _____>>**, for limiting equipment movement and preventing metal-to-metal contact between housing elements.
   c. Bottom Load Plate: Steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.
   d. Furnished with integral leveling device for positioning and securing supported equipment.
5. **<< Type _____ - ; _____ ; or None - N/A>>**Restrained Spring Isolators, Nonseismic:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
   b. Bottom Load Plate: Steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
   c. Furnished with integral leveling device for positioning and securing supported equipment.
   d. Provides constant free and operating height.
6. **<< Type _____ - ; _____ ; or None - N/A>>**Resilient Material Isolator Hangers, Nonseismic:

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a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing **<< elastomeric (e.g., neoprene, rubber); fiberglass; or _____>>** isolator material for the lower hanger rod connection.

7. **<< Type _____ - ; _____ ; or None - N/A>>**Spring Isolator Hangers, Nonseismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
8. **<< Type _____ - ; _____ ; or None - N/A>>**Combination Resilient Material/Spring Isolator Hangers, Nonseismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and **<< elastomeric (e.g., neoprene, rubber); fiberglass; or _____>>** isolator material for the upper hanger rod connection.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
9. **<< Type _____ - ; _____ ; or None - N/A>>**Thrust Restraints:
   a. Description: Assembly utilizing free-standing, laterally stable steel spring designed for resisting horizontal motion due to thrust (e.g., air pressure from a fan), and intended for installation in pairs.

2.04 ACOUSTICAL AND VIBRATION ISOLATORS

A. Manufacturers:
   1. Acoustical and Vibration Isolators:
      a. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
   2. Source Limitations: Furnish isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.

B. General Requirements:
   1. Acoustical Isolation System: Through-stud isolators, pipe clamps, riser clamp pads, neoprene and felt lining material and associated support brackets.

2.05 VIBRATION-ISOLATED AND/OR SEISMICALLY ENGINEERED ROOF CURBS

A. Manufacturers:
   1. Vibration-Isolated and/or Seismically Engineered Roof Curbs:
      a. Kinetics Noise Control, Inc**<< ; _____; or None - N/A>>**: www.kineticsnoise.com/#sle.
      b. Mason Industries**<< ; _____; or None - N/A>>**: www.mason-ind.com/#sle.
      c. Vibration Eliminator Company, Inc**<< ; _____; or None - N/A>>**: www.veco-nyc.com/#sle.
      d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
   2. Source Limitations: Furnish vibration-isolated roof curbs and associated accessories produced by **<< a single manufacturer; the same manufacturer as the vibration isolators; or _____>>** and obtained from a single supplier.

B. Vibration Isolation Curbs:

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1. Nonseismic Curb Rail:
   a. Location: Between existing roof curb and rooftop equipment.
   b. Construction: **<< Aluminum; Steel; or _____>>**.
   c. Integral vibration isolation to comply with requirements of this section.
   d. Weather exposed components consist of corrosion resistant materials.
2. Nonseismic Curb:
   a. Location: Between structure and rooftop equipment.
   b. Construction: **<< Aluminum; Steel; or _____>>**.
   c. Integral vibration isolation to comply with requirements of this section.
   d. Weather exposed components consist of corrosion resistant materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 CODE-REQUIRED SPECIAL INSPECTIONS

A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by **<<Owner>>** or **<<Architect>>** in accordance with Section **<< 014533>>** and statement of special inspections as required by applicable building code.

B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
   1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
   2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

C. Prior to starting work, **<<Contractor>>** to submit written statement of responsibility to authorities having jurisdiction and to **<<Owner>>** acknowledging awareness of special requirements contained in the statement of special inspections.

D. Special Inspection Agency services do not relieve **<<Contractor>>** from performing inspections and testing specified elsewhere.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Secure fasteners according to manufacturer's recommended torque settings.

D. Field-Welding (where approved by **<<Architect>>**): Comply with Section **<< 055000; or _____>>**.

E. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.

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F. Vibration Isolation Systems:
   1. Vibration-Isolated Equipment Support Bases:
      a. Provide specified minimum clearance beneath base.
   2. Spring Isolators:
      a. Position equipment at operating height; provide temporary blocking as required.
      b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
      c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
   3. Isolator Hangers:
      a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
      b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
   4. Thrust Restraints:
      a. Adjust restraint movement under normal operating static pressure.
   5. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
   6. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
   7. Adjust isolators to be free of isolation short circuits during normal operation.
   8. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

3.04 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Inspect vibration isolation and/or seismic control components for damage and defects.

C. Provide manufacturer representative or authorized technician services to **<< assist with inspection and testing; execute inspection and testing; or _____>>** of **<< vibration isolation systems; seismic controls; and _____>>**. Submit a detailed copy of manufacturer recommended **<< inspection; testing; field report; and _____>>** procedures.

D. Vibration Isolation Systems:
   1. Verify isolator static deflections.
   2. Verify required clearance beneath vibration-isolated equipment support bases.
   3. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.

E. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.05 ATTACHMENTS

A. Statement of special inspections.

END OF SECTION 230548

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SECTION 230553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems.

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials.

1.02 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Samples: Submit **<< two; or _____>> << labels; tags; or _____>> << ____by ____ inch>>** in size.

F. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

G. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Air Handling Units: **<< Nameplates; Stencilled painting; or _____>>**.

B. Air Terminal Units: Tags.

C. Automatic Controls: Tags. Key to control schematic.

D. Control Panels: Nameplates.

E. Dampers: Ceiling tacks, where located above lay-in ceiling.

F. Ductwork: **<< Nameplates; Stencilled painting; or _____>>**.

G. Heat Transfer Equipment: **<< Nameplates; Stencilled painting; or _____>>**.

H. Instrumentation: Tags.

I. Major Control Components: Nameplates.

J. Piping: **<< Pipe markers; Stencilled painting; Tags; or _____>>**.

K. Pumps: **<< Nameplates; Stencilled painting; or _____>>**.

L. Relays: Tags.

M. Small-sized Equipment: Tags.

N. Tanks: **<< Nameplates; Stencilled painting; or _____>>**.

O. Thermostats: Nameplates.

P. Valves:**<< Tags; or _____>><< and ceiling tacks where located above lay-in ceiling; _____; or None - N/A>>**.

Q. Water Treatment Devices: **<< Nameplates; Stencilled painting; or _____>>**.

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R. VFD: Nameplates.

2.02 NAMEPLATES

A. Manufacturers:
1. Advanced Graphic Engraving, LLC**<< ; ____; or None - N/A>>**:
2. Brimar Industries, Inc**<< ; ____; or None - N/A>>**:
3. Craftmark Pipe Markers**<< ; ____; or None - N/A>>**:
4. Kolbi Pipe Marker Co**<< ; ____; or None - N/A>>**:
5. Seton Identification Products, a Tricor Direct Company**<< ; ____; or None - N/A>>**:

B. Letter Color: **<< White; Black; or _____>>**.

C. Letter Height: **<< 1/4 inch; 1/2 inch; or ____ inch>>**.

D. Background Color: **<< Black; Red; Green; Yellow; or _____>>**.

E. Plastic: Comply with **<<ASTM D709>>**.

2.03 TAGS

A. Manufacturers:
1. Advanced Graphic Engraving**<< ; ____; or None - N/A>>**:
2. Brady Corporation**<< ; ____; or None - N/A>>**:
3. Brimar Industries, Inc**<< ; ____; or None - N/A>>**:
4. Craftmark Pipe Markers**<< ; ____; or None - N/A>>**:
5. Kolbi Pipe Marker Co**<< ; ____; or None - N/A>>**:
6. Seton Identification Products, a Tricor Company**<< ; ____; or None - N/A>>**:
7. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Plastic Tags: Laminated three-layer plastic with engraved **<< black; or _____>>** letters on light contrasting background color. Tag size minimum **<< 1-1/2 inch>> << diameter; square; or _____>>**.

C. Metal Tags: **<< Brass; Aluminum; Stainless Steel; or _____>>** with stamped letters; tag size minimum **<< 1-1/2 inch>> << diameter; square; or _____>>** with smooth edges.

D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 STENCILS

A. Manufacturers:
1. Brady Corporation**<< ; ____; or None - N/A>>**:
2. Craftmark Pipe Markers**<< ; ____; or None - N/A>>**:
3. Insite Solutions, LLC**<< ; ____; or None - N/A>>**:
4. Kolbi Pipe Marker Co**<< ; ____; or None - N/A>>**:
5. Seton Identification Products, a Tricor Company**<< ; ____; or None - N/A>>**:

B. Stencils: With clean cut symbols and letters of following size:
1. **<< 3/4 to 1-1/4 inch>>** Outside Diameter of Insulation or Pipe: **<< 8 inch>>** long color field, **<< 1/2 inch>>** high letters.
2. **<< 1-1/2 to 2 inch>>** Outside Diameter of Insulation or Pipe: **<< 8 inch>>** long color field, **<< 3/4 inch>>** high letters.
3. **<< 2-1/2 to 6 inch>>** Outside Diameter of Insulation or Pipe: **<< 12 inch>>** long color field, **<< 1-1/4 inch>>** high letters.

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4. **<< 8 to 10 inch>>** Outside Diameter of Insulation or Pipe: **<< 24 inch>>** long color field, **<< 2-1/2 inch>>** high letters.
5. Over **<< 10 inch>>** Outside Diameter of Insulation or Pipe: **<< 32 inch>>** long color field, **<< 3-1/2 inch>>** high letters.
6. Ductwork and Equipment: **<< 2 inch (minimum)>>** high letters.

2.05 PIPE MARKERS

A. Manufacturers:
1. Brady Corporation**<< ; ____; or None - N/A>>**:
2. Brimar Industries, Inc**<< ; ____; or None - N/A>>**:
3. Craftmark Pipe Markers**<< ; ____; or None - N/A>>**:
4. Kolbi Pipe Marker Co**<< ; ____; or None - N/A>>**:
5. Seton Identification Products, a Tricor Company**<< ; ____; or None - N/A>>**:
6. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

D. Underground Plastic Pipe Markers: Bright-colored continuously printed plastic ribbon tape, minimum **<< 6 inches>>** wide by **<< 4 mil, 0.004 inch>>** thick, manufactured for direct burial service.

E. Ammonia Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

F. Color code as follows:

2.06 CEILING TACKS

A. Manufacturers:
1. Craftmark Pipe Markers**<< ; ____; or None - N/A>>**:

B. Description: Steel with **<< 3/4 inch>>** diameter color coded head.

C. Color code as follows:
1. HVAC Equipment: Yellow.
2. Fire Dampers and Smoke Dampers: Red.
3. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section **<< 099123>>** for stencil painting.

3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

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C. Apply stencil painting in accordance with Section **<< 099123>>**.

D. Install plastic pipe markers in accordance with manufacturer's instructions.

E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

F. Install underground plastic pipe markers **<< 6 to 8 inches>>** below finished grade, directly above buried pipe.

G. Use tags on piping **<< 3/4 inch>>** diameter and smaller.
   1. Identify service, flow direction, and pressure.
   2. Install in clear view and align with axis of piping.
   3. Locate identification not to exceed **<< 20 feet>>** on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

H. Install ductwork with **<< plastic nameplates; stencilled painting; or _____>>**. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

I. Locate ceiling tacks to locate valves, equipment or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

J.

3.03 SCHEDULE

A. Service - Color - Stencil
   1. Heat pump loop supply and return - Purple - HPWS, HPWR
   2. Condenser water supply and return (from/to cooling tower) - Gray - CTS/CTR
   3. Heating water return (from condenser loop to boilers) - Orange - HWR
   4. Heating water supply (from boilers to condenser loop) Orange HWS
   5. Cold water potable - Green - POTABLE WATER
   6. Hot water potable - Red - HW
   7. Hot water return potable - Red - HWR
   8. Refrigerant piping - Black - REF
   9. Gas - Yellow - GAS
   10. Ductwork - Black - DOAS Supply, RTU Return, EF Exhaust

END OF SECTION 230553

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SECTION 230593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of **<< hydronic; steam; refrigerating; and _____>>** systems.

C. Field quality-control testing of Laboratory fume hoods.

D. Measurement of final operating condition of HVAC systems.

E. Sound measurement of equipment operating conditions.

F. Vibration measurement of equipment operating conditions.

G. Commissioning activities.

1.02 RELATED REQUIREMENTS

A. Section **<< 012100 - Allowances>>**: Inspection and testing allowances.

B. Section **<< 019113 - General Commissioning Requirements>>**: Commissioning requirements that apply to all types of work.

C. Section **<< 230800 - Commissioning of HVAC>>**.

D. Section **<< 250500 - Common Work Results for Integrated Automation>>**.

1.03 REFERENCE STANDARDS

A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition.

B. ASHRAE Std 110 - Methods of Testing Performance of Laboratory Fume Hoods.

C. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems.

D. NEBB (TAB) - Procedural Standard for Testing, Adjusting and Balancing of Environmental Systems.

E. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing.

1.04 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>**, for submittal procedures.

B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within **<< 30; or ____>>** days after award of Contract.

C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.

1. Submit to **<<Architect>>**.
2. Submit **<< six weeks; or _____>>** prior to starting the testing, adjusting, and balancing work.
3. Include certification that the plan developer has reviewed Contract Documents, the equipment and systems, and the control system with the **<<Architect>>** and other installers to sufficiently understand the design intent for each system.
4. Include at least the following in the plan:

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a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
c. Identification and types of measurement instruments to be used and their most recent calibration date.
d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
e. Final test report forms to be used.
f. Criteria for using air flow straighteners or relocating flow stations and sensors**<< ; analogous explanations for the water side; ; _____; or None - N/A>>**.
g. Details of how TOTAL flow will be determined; for example:
   1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
   2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
h. Methods for making coil or other system plant capacity measurements, if specified.
i. Procedures for formal deficiency reports, including scope, frequency and distribution.

D. Field Quality-control Testing of Laboratory Fume Hoods:
   1. Product Data sheets for all equipment proposed for use in on-site as-installed testing.
   2. List of laboratory fume hoods to be tested. Submit a minimum of **<< one week; two weeks; or _____ weels>>** prior to commencement of testing.

E. Field Logs: Submit **<< at least twice a week; at least once a week; or _____>>** to the **<< Commissioning Provider; Construction Manager; and _____>>**.

F. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.

G. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
   1. Revise TAB plan to reflect actual procedures and submit as part of final report.
   2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for **<<Architect>>** and for inclusion in operating and maintenance manuals.
   3. Provide reports in **<< soft cover, letter size, 3-ring; or _____>>** binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
   4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
   5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow **<<ASHRAE Std 111>>**.
   6. Units of Measure: Report data in **<< both I-P (inch-pound) and SI (metric) units; I-P (inch-pound) units only; SI (metric) units only; or _____>>**.
   7. Include the following on the title page of each report:
      a. Name of Testing, Adjusting, and Balancing Agency.
      b. Address of Testing, Adjusting, and Balancing Agency.
      c. Telephone number of Testing, Adjusting, and Balancing Agency.

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d. Project name.
e. Project location.
f. Project **<<Architect>>**.
g. Project Engineer.
h. Project **<<Contractor>>**.
i. Report date.

H. Project Record Documents: Record actual locations of **<< flow measuring stations; balancing valves and rough setting; and _____>>**.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Instruments: Approved and properly calibrated.

B. temperatures where thermometer wells are not provided in the piping.

C. Pyrometer surface temperature measurements may be used for piping system water

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:
1. **<<AABC (NSTSB)>>**, AABC National Standards for Total System Balance.
2. **<<SMACNA (TAB)>>**.

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

D. TAB Agency Qualifications:
1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
2. Having minimum of **<< three; or _____>>** years**<< documented; _____; or None - N/A>>** experience.
3. Certified by one of the following:
a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.

E. TAB Supervisor**<< and Technician; _____; or None - N/A>>** Qualifications: Certified by same organization as TAB agency.

3.02 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
1. Systems are started and operating in a safe and normal condition.

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2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.
12. Hydronic systems are flushed, filled, and vented.
13. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place.
15. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

A. Hold a pre-balancing meeting **<< at least one week; or _____>>** prior to starting TAB work.

B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to **<<Architect>>** to facilitate spot checks during testing.

C. Provide additional balancing devices as required.

3.04 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus **<< 5; or ___>>** percent of design for supply systems and plus or minus **<< 10; or ___>>** percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus **<< 10; or ___>>** percent and minus **<< 5; or ___>>** percent of design to space. Adjust outlets and inlets in space to within plus or minus **<< 10; or ___>>** percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:
1. Running log of events and issues.
2. Discrepancies, deficient or uncompleted work by others.
3. Contract interpretation requests.
4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

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E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the **<<Owner>>**.

H. Check and adjust systems approximately six months after final acceptance and submit report.

3.06 FUME HOOD TESTING (ON SITE)

A. General: Test fume hoods as installed to assess **<< airflow velocity; airflow visualization; and level of containment>>**. Perform tests with **<< static mode (set sash position); and dynamic mode (sash movement effect)>>** conditions. Conduct testing as outlined below for **<< 25% of the ; 50% of the ; 100% of the ; or _____>>**hoods provided in the Project.

B. Testing to be performed by firm certified by National Environmental Balancing Bureau - NEBB (FHT).

C. Preparation: Visit the project site to confirm that construction activities related to the fume hood system(s) and equipment are complete. Review design documents and **<<Contractor>>**'s submittals. Verify that mechanical ventilation systems serving the space are functioning and operating in the normal mode. Notify **<<Owner>>** in writing, if conditions exist which preclude proper fume hood testing. Starting of testing constitutes acceptance of site conditions.

D. Testing Requirements:
   1. Perform the following tests, in order:
      a. Airflow Velocity Test.
      b. Airflow Visualization Test.
      c. Tracer Gas Containment Test.
   2. If more than one test procedure is selected, proceed to the next test only if any unsafe condition discovered during current test has been successfully rectified.
   3. Airflow Velocity Test: Comply with **<< Section 9 of NEBB (FHT) Fume Hood Testing Standard - current edition; or _____>>**.
   4. Airflow Visualization Test: Comply with **<< Section 10 of NEBB (FHT) Fume Hood Testing Standard - current edition; or _____>>**.
   5. Tracer Gas Containment Test:
      a. Comply with **<< Section 11 of NEBB Fume Hood Testing Standard - current edition; or _____>>**.
   6. Reporting Requirements:**<< Comply with Section 5 of NEBB (FHT) Fume Hood Testing Standard - current edition.; or None - N/A>>** Organize and include, at a minimum, the following information:
      a. Report Title.
      b. Report Certification.
      c. Table of Contents.
      d. Report Summary/ Remarks.
      e. Appropriate Forms.
      f. Instrument Calibration.
      g. List of Abbreviations Used.
      h. A room layout drawing for each tested item. Identify: walls; doors; fume hood(s); other present environmental enclosures (e.g. biological safety cabinet(s), laminar flow

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hood(s), canopy hood(s), etc.); location and airflow pattern of all air supply, return, and exhaust grilles, registers and diffusers.

3.07 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities**<< at site altitude; _____; or None - N/A>>**.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions.**<< Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.; _____ .; or None - N/A>>**

L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately **<< 0.05 inches>>** positive static pressure **<< near the building entries; in clean rooms; and _____>>**.

M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.

N. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

O. On fan powered VAV boxes, adjust air flow switches for proper operation.

3.08 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated**<< Venturi tubes, orifices, or other metered; _____; or None - N/A>>** fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

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D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.09 COMMISSIONING

A. See Sections **<< 019113 - General Commissioning Requirements>>** and **<< 230800>>** for additional requirements.

B. Perform prerequisites prior to starting commissioning activities.

C. Fill out Prefunctional Checklists for:
   1. Air side systems.
   2. Water side systems.

D. Furnish to the Commissioning Provider, upon request, any data gathered but not shown in the final TAB report.

E. Re-check**<< minimum outdoor air intake flows and maximum and intermediate total airflow rates for _____ percent of the air handlers plus; _____; or None - N/A>>** a random sample equivalent to **<< ____>>** percent of the final TAB report data as directed by Commissioning Provider.
   1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Provider.
   2. Use the same test instruments as used in the original TAB work.
   3. Failure of more than **<< 10 percent; or ____>>** of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
   4. For purposes of re-check, failure is defined as follows:
      a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
      b. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading; for inlet vane or VFD OSA compensation system using linear proportional control, deviation of more than 30 percent at intermediate supply flow.
      c. Temperatures: Deviation of more than **<< one degree F; or ___ degree F>>**.
      d. Air and Water Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
      e. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.
   5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system.

F. In the presence of the Commissioning Provider, verify that:
   1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
   2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off

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downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.

3. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.

3.10 SCOPE

A. Test, adjust, and balance the following:
   1. Fire Pumps.
   2. Sprinkler Air Compressor.
   3. Plumbing Pumps.
   4. Steam Condensate Pumps.
   5. Boiler Feedwater Pumps.
   6. HVAC Pumps.
   7. Water Tube Boilers.
   8. Packaged Steel Water Tube Boilers.
   9. Packaged Steel Fire Tube Boilers.
   10. Forced Air Furnaces.
   11. Direct Fired Furnaces.
   12. Reciprocating Water Chillers.
   13. Air Cooled Water Chillers.
   14. Centrifugal Water Chillers.
   15. Absorption Water Chillers.
   16. Induced Draft Cooling Tower.
   17. Blow Through Cooling Tower.
   18. Packaged Roof Top Heating/Cooling Units.
   19. Packaged Terminal Air Conditioning Units.
   20. Unit Air Conditioners.
   21. Computer Room Air Conditioning Units.
   22. Air Coils.
   23. Evaporative Humidifier.
   24. Sprayed Coil Dehumidifier.
   25. Terminal Heat Transfer Units.
   26. Induction Units.
   27. Air Handling Units.
   28. Fans.
   29. Air Filters.
   30. Air Terminal Units.
   31. Air Inlets and Outlets.

3.11 MINIMUM DATA TO BE REPORTED

A. Electric Motors:
   1. Manufacturer.

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2. Model/Frame.
3. HP/BHP.
4. Phase, voltage, amperage; nameplate, actual, no load.
5. RPM.
6. Service factor.
7. Starter size, rating, heater elements.
8. Sheave Make/Size/Bore.

B. Pumps:
1. Identification/number.
2. Manufacturer.
3. Size/model.
4. Impeller.
5. Service.
6. Design flow rate, pressure drop, BHP.
7. Actual flow rate, pressure drop, BHP.
8. Discharge pressure.
9. Suction pressure.
10. Total operating head pressure.
11. Shut off, discharge and suction pressures.
12. Shut off, total head pressure.

C. Combustion Equipment:
1. Boiler manufacturer.
2. Model number.
3. Serial number.
4. Heat input.
5. Heat output.

D. Air Cooled Condensers:
1. Identification/number.
2. Location.
3. Manufacturer.
4. Model number.
5. Serial number.
6. Number of compressors.

E. Chillers:
1. Identification/number.
2. Manufacturer.
3. Capacity.
4. Model number.
5. Serial number.
6. Evaporator entering water temperature, design and actual.
7. Evaporator leaving water temperature, design and actual.
8. Evaporator pressure drop, design and actual.
9. Evaporator water flow rate, design and actual.

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10. Condenser entering water temperature, design and actual.
11. Condenser pressure drop, design and actual.
12. Condenser water flow rate, design and actual.

F. Cooling Tower:
1. Tower identification/number.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Rated capacity.
6. Entering air WB temperature, specified and actual.
7. Leaving air WB temperature, specified and actual.
8. Ambient air DB temperature.
9. Condenser water entering temperature.
10. Condenser water leaving temperature.
11. Condenser water flow rate.
12. Fan RPM.

G. Heat Exchangers:
1. Identification/number.
2. Location.
3. Service.
4. Manufacturer.
5. Model number.
6. Serial number.
7. Primary water entering temperature, design and actual.
8. Primary water leaving temperature, design and actual.
9. Primary water flow, design and actual.
10. Primary water pressure drop, design and actual.
11. Secondary water leaving temperature, design and actual.
12. Secondary water flow, design and actual.
13. Secondary water pressure drop, design and actual.

H. Cooling Coils:
1. Identification/number.
2. Location.
3. Service.
4. Manufacturer.
5. Air flow, design and actual.
6. Entering air DB temperature, design and actual.
7. Entering air WB temperature, design and actual.
8. Leaving air DB temperature, design and actual.
9. Leaving air WB temperature, design and actual.
10. Water flow, design and actual.
11. Water pressure drop, design and actual.
12. Entering water temperature, design and actual.

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13. Leaving water temperature, design and actual.
14. Air pressure drop, design and actual.

I. Heating Coils:
1. Identification/number.
2. Location.
3. Service.
4. Manufacturer.
5. Air flow, design and actual.
6. Water flow, design and actual.
7. Water pressure drop, design and actual.
8. Entering water temperature, design and actual.
9. Leaving water temperature, design and actual.
10. Entering air temperature, design and actual.
11. Leaving air temperature, design and actual.
12. Air pressure drop, design and actual.

J. Electric Duct Heaters:
1. Manufacturer.
2. Identification/number.
3. Location.
4. Model number.
5. Design kW.
6. Number of stages.
7. Phase, voltage, amperage.
8. Test voltage (each phase).
9. Test amperage (each phase).
10. Air flow, specified and actual.
11. Temperature rise, specified and actual.

K. Induction Units:
1. Manufacturer.
2. Identification/number.
3. Location.
4. Model number.
5. Size.
6. Design air flow.
7. Design nozzle pressure drop.
8. Final nozzle pressure drop.
9. Final air flow.

L. Air Moving Equipment:
1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Arrangement/Class/Discharge.

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6. Air flow, specified and actual.
7. Return air flow, specified and actual.
8. Outside air flow, specified and actual.
9. Total static pressure (total external), specified and actual.
10. Inlet pressure.
11. Discharge pressure.
12. Sheave Make/Size/Bore.
13. Number of Belts/Make/Size.
14. Fan RPM.

M. Return Air/Outside Air:
1. Identification/location.
2. Design air flow.
3. Actual air flow.
4. Design return air flow.
5. Actual return air flow.
6. Design outside air flow.
7. Actual outside air flow.
8. Return air temperature.
9. Outside air temperature.
10. Required mixed air temperature.
11. Actual mixed air temperature.
12. Design outside/return air ratio.
13. Actual outside/return air ratio.

N. Exhaust Fans:
1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Air flow, specified and actual.
6. Total static pressure (total external), specified and actual.
7. Inlet pressure.
8. Discharge pressure.
9. Sheave Make/Size/Bore.
10. Number of Belts/Make/Size.
11. Fan RPM.

O. Duct Traverses:
1. System zone/branch.
2. Duct size.
3. Area.
4. Design velocity.
5. Design air flow.
6. Test velocity.
7. Test air flow.

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8. Duct static pressure.
9. Air temperature.
10. Air correction factor.

P. Duct Leak Tests:
1. Description of ductwork under test.
2. Duct design operating pressure.
3. Duct design test static pressure.
4. Duct capacity, air flow.
5. Maximum allowable leakage duct capacity times leak factor.
6. Test apparatus:
    a. Blower.
    b. Orifice, tube size.
    c. Orifice size.
    d. Calibrated.
7. Test static pressure.
8. Test orifice differential pressure.
9. Leakage.

Q. Air Monitoring Stations:
1. Identification/location.
2. System.
3. Size.
4. Area.
5. Design velocity.
6. Design air flow.
7. Test velocity.
8. Test air flow.

R. Flow Measuring Stations:
1. Identification/number.
2. Location.
3. Size.
4. Manufacturer.
5. Model number.
6. Serial number.
7. Design Flow rate.
8. Design pressure drop.
9. Actual/final pressure drop.
10. Actual/final flow rate.
11. Station calibrated setting.

S. Terminal Unit Data:
1. Manufacturer.
2. Type, constant, variable, single, dual duct.
3. Identification/number.
4. Location.

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5. Model number.
6. Size.
7. Minimum static pressure.
8. Minimum design air flow.
9. Maximum design air flow.
10. Maximum actual air flow.
11. Inlet static pressure.

T. Air Distribution Tests:
1. Air terminal number.
2. Room number/location.
3. Terminal type.
4. Terminal size.
5. Area factor.
6. Design velocity.
7. Design air flow.
8. Test (final) velocity.
9. Test (final) air flow.
10. Percent of design air flow.

END OF SECTION 230593

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SECTION 230713
DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Duct insulation.

B. Flexible removable and reusable blanket insulation.

C. Duct liner.

D. Weather barrier coatings.

E. Jacketing and accessories.

1.02 RELATED REQUIREMENTS

A. Section **<< 099113 - Exterior Painting>>**: Painting insulation jackets.

B. Section **<< 099123 - Interior Painting>>**: Painting insulation jackets.

C. Section **<< 230553 - Identification for HVAC Piping and Equipment>>**.

1.03 REFERENCE STANDARDS

A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

C. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

D. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

F. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation.

G. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

H. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.

I. ASTM C1371 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.

J. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation.

K. ASTM C1775 - Standard Specification for Laminate Protective Jacket and Tape for Use Over Thermal Insulation for Outdoor Applications.

L. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay.

M. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

N. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

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O. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

P. FM 4924 - Examination Standard for Pipe and Duct Insulation.

Q. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth.

R. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.

S. UL 181A - Closure Systems for Use with Rigid Air Ducts.

T. UL 181B - Closure Systems for Use with Flexible Air Ducts and Air Connectors.

U. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.04 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than **<< three; or _____>>** years of**<< documented; _____; or None - N/A>>** experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of **<< 24; or ____>>** hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with **<< ASTM E84; UL 723; or _____>>**.

2.02 GLASS FIBER, FLEXIBLE

A. Manufacturer:

1. CertainTeed Corporatio: www.certainteed.com/#sle.
2. Johns Manville: www.jm.com/#sle.

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3. Knauf Insulation**<< ; Performance+ Duct Wrap; ; Performance+ KwikFlex (High-Temperature Application and Diameters Exceeding 10"); ; _____; or None - N/A>>**: www.knaufinsulation.com/#sle.
4. Manson Insulation, a company of Knauf Insulation**<< ; AK FLEX with ECOSE (High-Temperature Application and Diameters Exceeding 10"); ; Alley Wrap B; ; _____; or None - N/A>>**: www.imanson.com/#sle.
5. Owens Corning Corporation**<< ; SOFTR Duct Wrap FRK; ; _____; or None - N/A>>**: www.owenscorning.com/en-us/#sle.
6. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Insulation: **<<ASTM C553>>**and ASTM C1290; flexible, noncombustible blanket.
1. **<< K>>** value: **<< 0.36 at 75 degrees F; 0.31 at 75 degrees F; 0.26 at 75 degrees F; 0.25 at 75 degrees F; or _____ at 75 degrees F>>**, when tested in accordance with **<<ASTM C518>>**.
2. Maximum Service Temperature: **<< 250 degrees F; 450 degrees F; 850 degrees F; 1,000 degrees F; 1,200 degrees F; or ____ degrees F>>**.
3. Maximum Water Vapor Absorption: 5.0 percent by weight.
4. Multi-purpose foil-scrim kraft (FSK) jacket shall meet requirements of ASTM C 1136, Type II.
5. Products:
   a. Knauf Insulation; Performance+ Duct Wrap: www.knaufinsulation.com/#sle.
   b. Manson Insulation, a company of Knauf Insulation; Alley Wrap B: www.imanson.com/#sle.
   c. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

C. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.

D. Indoor Vapor Barrier Mastic:
1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

E. Outdoor Vapor Barrier Mastic:
1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

F. Tie Wire: Annealed steel, **<< 16 gauge, 0.0508 inch diameter>>**.

2.03 GLASS FIBER, RIGID

A. Manufacturer:
1. CertainTeed Corporation**<< ; _____; or None - N/A>>**: www.certainteed.com/#sle.
2. Johns Manville**<< ; _____; or None - N/A>>**: www.jm.com/#sle.
3. Knauf Insulation**<< ; Earthwool Insulation Board; ; _____; or None - N/A>>**: www.knaufinsulation.com/#sle.
4. Manson Insulation, a company of Knauf Insulation**<< ; AK Board; ; _____; or None - N/A>>**: www.imanson.com/#sle.
5. Owens Corning Corporation**<< ; 700 Series FIBERGLAS Insulation; ; _____; or None - N/A>>**: www.owenscorning.com/en-us/#sle.
6. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Insulation: **<<ASTM C612>>**; rigid, noncombustible.

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1. **<< K>>** Value: **<< 0.24 at 75 degrees F; or ____ at 75 degrees F>>**, when tested in accordance with **<<ASTM C518>>**.
2. Maximum Service Temperature: **<< 450 degrees F; 850 degrees F; or ____ degrees F>>**.
3. Maximum Water Vapor Absorption: 5.0 percent.
4. Maximum Density: **<< 8.0 pcf; 12.0 pcf; or ____ pcf>>**.

C. Vapor Barrier Jacket:
1. **<< Kraft paper with glass fiber yarn and bonded to aluminized film; 0.0032 inch vinyl; or _____>>**.
2. Moisture Vapor Permeability: **<< 0.02 perm inch; 0.04 perm inch; 1.3 perm inch; or ____ perm inch>>**, when tested in accordance with **<<ASTM E96/E96M>>**.
3. Secure with **<< pressure-sensitive tape; two coats of vapor barrier mastic and glass tape; or _____>>**.

D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.

E. Protective Coating:
1. Manufacturers:
a. Design Polymerics**<< ; DP 2510 Water Based, Low VOC, Duct Liner Protective Coating; ; DP 2540 Water Based, Low VOC, EPA Registered Anti-Microbial Protective Coating; ; _____; or None - N/A>>**: www.designpoly.com/#sle.

F. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; **<< 9 oz/sq yd>>** weight, glass fabric.
2. Vinyl emulsion type acrylic, compatible with insulation, **<< black; white; or _____>>** color.

2.04 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturers:
1. Aeroflex USA**<< ; AEROFLEX Breathe-EZ; ; _____; or None - N/A>>**: www.aeroflexusa.com/#sle.
2. Armacell LLC**<< ; AP ArmaFlex; ; AP ArmaFlex FS; ; ArmaFlex Ultima; ; _____; or None - N/A>>**: www.armacell.us/#sle.
3. K-Flex USA LLC**<< ; Insul-Sheet; ; Duct Liner Gray; ; _____; or None - N/A>>**: www.kflexusa.com/#sle.
4. Substitutions: **<< See Section 016000 - Product Requirements; See Section _____ .; or Not permitted.>>**

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with **<<ASTM C534/C534M>><< Grade 1; Grade 2; Grade 3; or _____>>**, in sheet form.
1. Minimum Service Temperature: **<< Minus 40 degrees F; or ____ degrees F>>**.
2. Maximum Service Temperature: **<< 180 degrees F; 220 degrees F; or ____ degrees F>>**.
3. Connection: Waterproof vapor barrier adhesive.
4. Flammability Rating: **<<FM 4924>>** approval for reduced combustibility testing.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

D. Weather Barrier Coating: Air dried, contact adhesive, compatible with insulation and **<<ASTM E84>>** compliant.

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1. Manufacturers:
   a. Design Polymerics**<< ; DP 5050 Water Based, High Strength, Weather Barrier Coating; ; _____; or None - N/A>>**: www.designpoly.com/#sle.
   b. Substitutions: **<< See Section 016000 - Product Requirements; See Section _____ .; or Not permitted.>>**

2.05 FLEXIBLE REMOVABLE AND REUSABLE BLANKET INSULATION

A. Manufacturers:
   1. Firwin**<< ; _____; or None - N/A>>**: www.firwin.com/#sle.
   2. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Description: Custom cut and fabricated, removable and reusable blanket insulation system, consisting of inner liner, insulation layer, outer protective jacket, and fastening system.

C. Provide insulation system based on surface temperature of piping, installed location of piping, and maximum safe-to-touch temperature of jacketing.

D. Performance Criteria:
   1. Maximum Service Temperature: Constructed for temperatures up to **<< 500 degrees F; 1200 degrees F; or _____ degrees F>>**.
   2. Safe-to-Touch Temperature of Jacketing: **<< 140 degrees F; 185 degrees F; 203 degrees F; or _____ degrees F>>**.
   3. Space Ambient Temperature, High: **<< 85 degrees F; or _____ degrees F>>**.
   4. Space Ambient Temperature, Low: **<< 40 degrees F; or _____ degrees F>>**.

E. Components:
   1. Inner Liner: Use **<< stainless steel mesh; silicone-impregnated fiberglass; or _____>>**.
   2. Insulation:
      a. Material: **<< Needled fiberglass felt mat; CMS (calcium, magnesium, silica) fiber wool; or _____>>**.
      b. Thickness: **<< 1 inch; 2 inches; or _____ inches>>**.
      c. Density: **<< 8 pcf; 10 pcf; 11 pcf; or _____ pcf>>**.
      d. Thermal Conductivity k-factor in **<< Btu inch/hr sq ft degrees F>>**: **<< 0.50 at 500 degrees F; 0.54 at 752 degrees F; or _____ at _____ degrees F>>**.
      e. Outer Jacket: **<< Silicone-impregnated fiberglass; or _____>>**.
      f. Fastening System: **<< Lacing wire; Snaps; Springs; Straps; Velcro; or _____>>**.

2.06 WEATHER BARRIER COATINGS

A. Weather-Resistive Barrier Coating: Fire-resistive, UV resistant, water-based mastic for use over closed cell polyethylene and polyurethane foam insulation; applied with glass fiber or synthetic reinforcing mesh.
   1. Manufacturers:
      a. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
   2. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A, when tested in accordance with **<<ASTM E84>>**.
   3. Water Vapor Permeance: Greater than **<< 1.0 perm; or ____ perm>>** in accordance with **<<ASTM E96/E96M>>**.

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4. Resistance to Fungal Growth: No growth when tested in accordance with **<<ASTM D5590>>**.
5. Color: **<< As selected by Architect; White; Metallic gray; Black; or _____>>**.

2.07 JACKETING AND ACCESSORIES

A. Canvas Jacket: UL listed **<< 6 oz/sq yd>>** plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
   1. Lagging Adhesive:
      a. Manufacturers:
         1) Design Polymerics**<< ; DP 3050 Water Based, Premium Quality, Lagging Adhesive, and Vapor Retarder; ; _____; or None - N/A>>**: www.designpoly.com/#sle.
         2) Substitutions: **<< See Section 016000 - Product Requirements; See Section _____ .; or Not permitted.>>**
      b. Compatible with insulation.

B. Mineral Fiber (Outdoor) Jacket: Asphalt impregnated and coated sheet, **<< 50 lb/square; 36 lb/square; or _____>>**.

C. Aluminum Jacket:
   1. Comply with **<<ASTM B209/B209M>>**, Temper H14, minimum thickness of **<< 0.016 inch>>** with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
   2. Thickness: **<< 0.016 inch; 0.020 inch; 0.025 inch; 0.032 inch; 0.040 inch; or ____ inch>>** sheet.
   3. Finish: **<< Smooth; Embossed; or _____>>**.
   4. Joining: Longitudinal slip joints and **<< 2 inch>>** laps.
   5. Fittings: **<< 0.016 inch; or ____ inch>>** thick die-shaped fitting covers with factory-attached protective liner.
   6. Metal Jacket Bands: **<< 3/8 inch>>** wide; **<< 0.015 inch; or ____ inch>>** thick aluminum.

D. Aluminum-Foil Laminate Jacket:
   1. Manufacturers:
      a. Ideal Tape Co., Inc**<< ; _____; or None - N/A>>**: www.idealtape.com/#sle.
      b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
   2. Factory-applied, pressure sensitive adhesive jacketing on paper release liner.
   3. Finish: **<< Aluminum smooth; Aluminum embossed; Gloss white; Embossed white; or _____>>**.
   4. Comply with **<<ASTM C1775>>**.

E. Aluminum-Foil Laminate Jacket:
   1. Manufacturers:
      a. H.B. Fuller Construction Products, Inc**<< ; Foster - Vapor-Fas; ; _____; or None - N/A>>**: www.fosterproducts.com/#sle.
      b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
   2. Factory-applied, pressure sensitive adhesive jacketing to comply with **<<ASTM C1775>>**.

F. Flexible Weather-Proofing Outdoor Jacket: Self-healing, field-applied outdoor cladding.

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1. Material: **<< Aluminum foil/polymer laminate with rubberized asphalt layer and acrylic adhesive; or _____>>**.
2. Thickness: **<< 34 mil, 0.034 inch; 37 mil, 0.037 inch; or ___ mil, ___ inch>>**.
3. Finish: **<< Smooth; Embossed; or _____>>**.
4. Color: **<< Silver; White; or _____>>**.
5. Water Vapor Transmission: **<< 0.002 perm inch; or ____ perm inch>>**, maximum, when tested in accordance with **<<ASTM E96/E96M>>**.
6. Mold Resistance: Pass when tested in accordance with **<<ASTM C1338>>**.
7. Emissivity: **<< 0.30; or ___>>** when tested in accordance with **<<ASTM C1371>>**.
8. Manufacturers:
   a. Polyguard Products**<< ; Alumaguard; ; Alumaguard All-Weather; : Alumaguard Lite; ; _____; or None - N/A>>**: www.polyguardproducts.com.com/#sle.
   b. Substitutions: **<< See Section 016000 - Product Requirements; See Section _____ .; or Not permitted.>>**

G. Reinforced Tape:
1. **<< FSK; All Service Jacket; PSK; or _____>>** tape suitable for sealing seams between insulation, insulated elbows, and fittings resulting in a tight, smooth surface without wrinkles.
2. Comply with **<<UL 723>>** or **<<ASTM E84>>**.
3. Moisture Vapor Permeability: **<< 0.00 perm inch; or ____ perm inch>>**, when tested in accordance with **<<ASTM E96/E96M>>**.
4. Finish: Match insulation.

H. Plain Foil Tape:
1. Manufacturers:
   a. Ideal Tape Co., Inc**<< ; _____; or None - N/A>>**: www.idealtape.com/#sle.
   b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
2. Aluminum foil with pressure-sensitive adhesive on paper release liner.
3. Finish: Plain foil.

I. UL181 Tape for **<< Rigid; and Flexible>>** Ductwork:
1. Manufacturers:
   a. Ideal Tape Co., Inc**<< ; _____; or None - N/A>>**: www.idealtape.com/#sle.
   b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
2. Comply with **<<UL 181A>>** for rigid ductwork.
3. Comply with **<<UL 181B>>** for flexible ductwork.
4. Aluminum foil coated with pressure-sensitive adhesive on paper release liner.
5. **<< Foil; Polypropylene; or _____>>** tape suitable for sealing seams between insulation, insulated elbows, and fittings resulting in a tight, smooth surface without wrinkles.
6. Finish: **<< Printed with UL Listing for identification; Silver or black, printed with UL Listing for identification; or _____>>**.

2.08 DUCT LINER

A. Manufacturers:

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1. Aeroflex USA**<< ; AEROFLEX Breathe-EZ; ; AEROFLEX-EP; ; _____; or None - N/A>>**: www.aeroflexusa.com/#sle.
2. Armacell LLC**<< ; ArmaFlex Ultima; ; AP ArmaFlex; ; AP ArmaFlex FS; ; _____; or None - N/A>>**: www.armacell.us/#sle.
3. CertainTeed Corporation**<< ; _____; or None - N/A>>**: www.certainteed.com/#sle.
4. Ductmate Industries, Inc, a DMI Company**<< ; _____; or None - N/A>>**: www.ductmate.com/#sle.
5. Johns Manville**<< ; _____; or None - N/A>>**: www.jm.com/#sle.
6. Knauf Insulation**<< ; Performance+ Duct Liner; ; Performance+ Rigid Plenum Liner; ; _____; or None - N/A>>**: www.knaufinsulation.com/#sle.
7. Manson Insulation, a company of Knauf Insulation**<< ; Akousti-Liner; ; Akousti-Liner R; ; _____; or None - N/A>>**: www.imanson.com/#sle.
8. Owens Corning Corporation**<< ; QuietR Rotary Duct Insulation; ; _____; or None - N/A>>**: www.owenscorning.com/en-us/#sle.
9. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Elastomeric Foam Insulation: Preformed flexible elastomeric cellular rubber insulation complying with **<<ASTM C534/C534M>><< Grade 1; Grade 2; Grade 3; or _____>>**, in sheet form.
1. Minimum Service Temperature: **<< Minus 40 degrees F; or ____ degrees F>>**.
2. Maximum Service Temperature: **<< 180 degrees F; 220 degrees F; or ____ degrees F>>**.
3. Fungal Resistance: No growth when tested according to **<<ASTM G21>>**.
4. Apparent Thermal Conductivity: Maximum of **<< 0.28 at 75 degrees F; or ____ at 75 degrees F>>**.
5. Minimum Noise Reduction Coefficients:
   a. **<< 1/2 inch>>** Thickness: **<< 0.30; or ___>>**.
   b. **<< 1 inch>>** Thickness: **<< 0.40; or ___>>**.
   c. **<< 1-1/2 inches>>** Thickness: **<< 0.50; or ___>>**.
   d. **<< 2 inch>>** Thickness: **<< 0.60; or ___>>**.
6. Erosion Resistance: Does not show evidence of breaking away, flaking off, or delamination at velocities of **<< 10,000 fpm; or ____ fpm>>** when tested in accordance with **<<ASTM C1071>>**.
7. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation. Comply with **<<ASTM C916>>**.

PART 3 EXECUTION

3.01 EXAMINATION

A. Test ductwork for design pressure prior to applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Insulated Ducts Conveying Air Below Ambient Temperature:

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1. Provide insulation with vapor barrier jackets.
2. Finish with tape and vapor barrier jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

D. Insulated Ducts Conveying Air Above Ambient Temperature:
1. Provide with or without standard vapor barrier jacket.
2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

E. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces**<< (below 10 feet above finished floor); _____; or None - N/A>>**: Finish with **<< canvas jacket sized for finish painting; aluminum jacket; or _____>>**.

F. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with **<< outdoor jacket finished; see Section _____; caulked aluminum jacket with seams located on bottom side of horizontal duct section; or _____>>**.

G. Slope exterior ductwork to shed water.

H. External Duct Insulation Application:
1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
2. Secure insulation without vapor barrier with staples, tape, or wires.
3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

I. Duct**<< and Plenum; _____; or None - N/A>>** Liner Application:
1. Adhere insulation with adhesive for **<< 90; 100; or _____>>** percent coverage.
2. Secure insulation with mechanical liner fasteners. Refer to **<<SMACNA (DCS)>>** for spacing.
3. Seal and smooth joints. Seal and coat transverse joints.
4. Seal liner surface penetrations with adhesive.
5. Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.

3.03 INDOOR APPLICATION SCHEDULE

A. Service: Unless otherwise indicated provide the following:
1. Concealed Ducts and Plenums:
a. Material: Mineral-Fiber Blanket.
b. Thickness: 2 inches.
c. Vapor Retarder Required: Yes.
2. Ducts and Plenums in Exposed, Finished Spaces:
a. Material: Mineral-Fiber Board.
b. Thickness: 1-1/2 inches.
c. Field-Applied Jacket: Glass cloth.
d. Vapor Retarder Required: Yes.

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e. Paint: Color as selected by Architect. Refer to Section “Painting.”

B. Service: Round and flat oval, supply-air ducts, concealed and within the building insulation envelope.
   1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
   2. Thickness: 1-1/2 inches.
   3. Vapor Retarder Required: Yes.

C. Service: Round and flat oval, outside-air ducts, concealed and within the building insulation envelope.
   1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
   2. Thickness: 1-1/2 inches.
   3. Vapor Retarder Required: Yes.

D. Service: Rectangular, supply-air ducts, concealed and within the building insulation envelope.
   1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
   2. Thickness: 1-1/2 inches.
   3. Vapor Retarder Required: Yes.

E. Service: Rectangular, outside-air ducts, concealed and within the building insulation envelope.
   1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
   2. Thickness: 1-1/2 inches.
   3. Vapor Retarder Required: Yes.

F. Service: Round and flat oval, supply-air ducts, concealed in vented attics and in unvented attics with insulated ceilings.
   1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
   2. Thickness: 2 inches.
   3. Vapor Retarder Required: Yes.

G. Service: Round and flat oval, return-air ducts, concealed in vented attics and unvented attics with insulated ceilings.
   1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
   2. Thickness: 1-1/2 inches.
   3. Vapor Retarder Required: Yes.

H. Service: Rectangular, supply-air ducts, concealed in vented attics and unvented attics with insulated ceilings.
   1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
   2. Thickness: 2 inches.
   3. Vapor Retarder Required: Yes.

I. Service: Rectangular, return-air ducts, concealed in vented attics and unvented attics with insulated ceilings.
   1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
   2. Thickness: 1-1/2 inches.
   3. Vapor Retarder Required: Yes.

J. Service: Round and flat oval, supply-air ducts, exposed.
   1. Refer to Section “Metal Ducts.”

K. Service: Round and flat oval, outside-air ducts, exposed.
   1. Refer to Section “Metal Ducts.”

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L. Service: Rectangular, supply-air ducts, in Exposed, Finished Spaces.
   1. Material: Mineral-Fiber Board Thermal Insulation, Unfaced
   2. Thickness: 1-1/2 inches.
   3. Field-Applied Jacket: Glass cloth.
   4. Vapor Retarder Required: Yes.
   5. Paint: Color as selected by Architect. Refer to Section “Painting.”

M. Service: Rectangular, outside-air ducts, in Exposed Finished Spaces.
   1. Material: Mineral-Fiber Board Thermal Insulation, Unfaced
   2. Thickness: 2 inches
   3. Field-Applied Jacket: Glass cloth.
   4. Vapor Retarder Required: Yes.
   5. Paint: Color as selected by Architect. Refer to Section “Painting.”

N. Service: Duct Liner
   1. Provide where indicated on drawings.
   2. Supply Air Ducts: 1-1/2" thickness.
   3. Transfer Air Ducts: 1" thickness.
   4. Return Air Ducts: 1" thickness.

O. Service: Supply Diffusers Back Pan:
   1. Where they are not factory insulated, field insulate.
   2. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
   3. Thickness: 1-1/2 inches.
   4. Vapor Retarder Required: Yes.

3.04 OUTDOOR APPLICATION SCHEDULE

A. Service: Round, supply-air ducts.
   1. Material: Round supply air ducts shall be factory fabricated double wall ducts as specified in Section “Metal Ducts.”

B. Service: Round, return-air ducts.
   1. Material: Round supply air ducts shall be factory fabricated double wall ducts as specified in Section “Metal Ducts.”

C. Service: Rectangular, supply-air ducts.
   1. Material: Mineral-fiber board.
   2. Total Thickness: 2 Inches (two 1” layers).
   3. Number of Layers: Two
   4. Field-Applied Jacket: Glass cloth.
   5. Vapor Retarder Required: Yes
   6. Outer Jacket: Smooth or stucco embossed aluminum.
      a. Thickness: Minimum 0.024 inches.

D. Service: Rectangular, return-air ducts.
   1. Material: Mineral-fiber board.
   2. Total Thickness: 2 Inches (two 1” layers).
   3. Number of Layers: Two
   4. Field-Applied Jacket: Glass cloth.

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5. Vapor Retarder Required: Yes
6. Outer Jacket: Smooth or stucco embossed aluminum.
   a. Thickness: Minimum 0.024 inches.

END OF SECTION 230713

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SECTION 230716
HVAC EQUIPMENT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Equipment insulation.

B. Flexible removable and reusable blanket insulation.

C. Weather barrier coatings.

D. Jacketing and accessories.

1.02 REFERENCE STANDARDS

A. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

D. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.

E. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

F. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

G. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.

H. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

I. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).

J. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

K. ASTM C1393 - Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks.

L. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation.

M. ASTM C1775 - Standard Specification for Laminate Protective Jacket and Tape for Use Over Thermal Insulation for Outdoor Applications.

N. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay.

O. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

P. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

Q. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth.

R. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

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1.03 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>**, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than **<< three; or _____>>** years of**<< documented; _____; or None - N/A>>** experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.06 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of **<< 24; or ____>>** hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with **<< ASTM E84; UL 723; or _____>>**.

2.02 GLASS FIBER, FLEXIBLE

A. Manufacturers:

1. CertainTeed Corporation**<< ; _____; or None - N/A>>**: www.certainteed.com/#sle.
2. Johns Manville Corporation**<< ; _____; or None - N/A>>**: www.jm.com/#sle.
3. Knauf Insulation**<< ; _____; or None - N/A>>**: www.knaufinsulation.com/#sle.
4. Manson Insulation, a company of Knauf Insulation**<< ; _____; or None - N/A>>**: www.imanson.com/#sle.
5. Owens Corning Corporation**<< ; SOFTR Duct Wrap FRK; ; _____; or None - N/A>>**: www.owenscorning.com/en-us/#sle.
6. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Insulation: **<<ASTM C553>>**; flexible, noncombustible.

1. **<< K>>** Value: **<< 0.36 at 75 degrees F; or ____ at 75 degrees F>>**, when tested in accordance with **<<ASTM C177>>** or **<<ASTM C518>>**.
2. Maximum Service Temperature: **<< 450 degrees F; 850 degrees F; 1,000 degrees F; 1,200 degrees F; or _____ degrees F>>**.
3. Maximum Water Vapor Absorption: 5.0 percent by weight.

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C. Insulation: **<<ASTM C1393>>**; pipe and tank, end grain adhered to jacket.
   1. **<< K>>** Value: **<<ASTM C177>>**, **<< 0.27 at 75 degrees F; or _____ at 75 degrees F>>**.
   2. Maximum Service Temperature: **<< 850 degrees F; or _____ degrees F>>**.
   3. Maximum Moisture Absorption: 0.2 percent by volume.
   4. Products:
      a. Knauf Insulation; Performance+ Earthwool Pipe and Tank Insulation: www.knaufinsulation.com/#sle.
      b. Knauf Insulation; Performance+ KwikFlex Pipe and Tank Insulation: www.knaufinsulation.com/#sle.
      c. Manson Insulation, a company of Knauf Insulation; AK FLEX with ECOSE: www.imanson.com/#sle.
      d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

D. Vapor Barrier Jacket: **<< Kraft paper reinforced with glass fiber yarn and bonded to aluminized film; Vinyl; or _____>>**.
   1. Moisture Vapor Permeability: **<< 0.02 perm inch; 0.04 perm inch; 1.3 perm inch; or ____ perm inch>>**, when tested in accordance with **<<ASTM E96/E96M>>**.
   2. Secure with self-sealing longitudinal laps and butt strips.

E. Tie Wire: **<< 0.048 inch>>** stainless steel with twisted ends on maximum **<< 12 inch>>** centers.

F. Vapor Barrier Lap Adhesive: Compatible with insulation.

G. Insulating Cement/Mastic: **<<ASTM C195>>**, hydraulic setting on mineral wool.

2.03 FLEXIBLE REMOVABLE AND REUSABLE BLANKET INSULATION

A. Manufacturers:
   1. Firwin**<< ; _____; or None - N/A>>**: www.firwin.com/#sle.
   2. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Description: Custom cut and fabricated, removable and reusable blanket insulation system, consisting of inner liner, insulation layer, outer protective jacket, and fastening system.

C. Provide insulation system based on surface temperature of piping, installed location of piping, and maximum safe-to-touch temperature of jacketing.

D. Performance Criteria:
   1. Maximum Service Temperature: Constructed for temperatures up to **<< 500 degrees F; 1200 degrees F; or _____ degrees F>>**.
   2. Safe-to-Touch Temperature of Jacketing: **<< 140 degrees F; 185 degrees F; 203 degrees F; or _____ degrees F>>**.
   3. Space Ambient Temperature, High: **<< 85 degrees F; or _____ degrees F>>**.
   4. Space Ambient Temperature, Low: **<< 40 degrees F; or _____ degrees F>>**.

E. Components:
   1. Inner Liner: Use **<< stainless steel mesh; silicone-impregnated fiberglass; or _____>>**.
   2. Insulation:
      a. Material: **<< Needled fiberglass felt mat; CMS (calcium, magnesium, silica) fiber wool; or _____>>**.

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b. Thickness: **<< 1 inch; 2 inches; or _____ inches>>**.
c. Density: **<< 8 pcf; 10 pcf; 11 pcf; or _____ pcf>>**.
d. Thermal Conductivity k-factor in **<< Btu inch/hr sq ft degrees F>>**: **<< 0.50 at 500 degrees F; 0.54 at 752 degrees F; or _____ at _____ degrees F>>**.
e. Outer Jacket: **<< Silicone-impregnated fiberglass; or _____>>**.
f. Fastening System: **<< Lacing wire; Snaps; Springs; Straps; Velcro; or _____>>**.

2.04 GLASS FIBER, RIGID

A. Manufacturer:
1. CertainTeed Corporation**<< ; _____; or None - N/A>>**: www.certainteed.com/#sle.
2. Johns Manville Corporation**<< ; _____; or None - N/A>>**: www.jm.com/#sle.
3. Knauf Insulation**<< ; Earthwool Insulation Board; ; _____; or None - N/A>>**: www.knaufinsulation.com/#sle.
4. Manson Insulation, a company of Knauf Insulation**<< ; AK Board; ; _____; or None - N/A>>**: www.imanson.com/#sle.
5. Owens Corning Corporation**<< ; _____; or None - N/A>>**: www.owenscorning.com/en-us/#sle.
6. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Insulation: **<<ASTM C612>><< or ASTM C592; _____; or None - N/A>>**; rigid, noncombustible.
1. **<< K>>** Value: **<< 0.25 at 75 degrees F; or ____ at 75 degrees F>>**, when tested in accordance with **<<ASTM C177>>** or **<<ASTM C518>>**.
2. Maximum Service Temperature: **<< 850 degrees F; 1,200 degrees F; or ____ degrees F>>**.
3. Maximum Water Vapor Absorption: 5.0 percent by weight.
4. Maximum Density: **<< 8.0 pcf; 12.0 pcf; or ____ pcf>>**.

C. Aluminum-Foil Laminate Jacket:
1. Manufacturers:
a. H.B. Fuller Construction Products, Inc**<< ; Foster - Vapor-Fas; ; _____; or None - N/A>>**: www.fosterproducts.com/#sle.
b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
2. Factory-applied, pressure sensitive adhesive jacketing to comply with **<<ASTM C1775>>**.

D. Vapor Barrier Jacket:
1. **<< Kraft paper reinforced with glass fiber yarn and bonded to aluminized film; Vinyl; or _____>>**.
2. Moisture Vapor Permeability: **<< 0.02 perm inch; 0.04 perm inch; 1.3 perm inch; or ____ perm inch>>**, when tested in accordance with **<<ASTM E96/E96M>>**.
3. Secure with self-sealing longitudinal laps and butt strips.
4. Secure with outward clinch expanding staples and vapor barrier mastic.

E. Facing: **<< 1 inch>><< galvanized; stainless; _____; or None - N/A>>** steel hexagonal wire mesh stitched **<< on one face of insulation; onto both faces of insulation; on one face of insulation with expanded metal lath on other; or _____>>**.

F. Vapor Barrier Lap Adhesive: Compatible with insulation.

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G. Insulating Cement/Mastic: **<<ASTM C195>>**; hydraulic setting on mineral wool.

2.05 REMOVABLE PUMP INSULATION COV

A. General:

1. Provide suitcase style removable insulation cover with aluminum enclosure, latches, and lined with 2" of flexible elastomeric cellular insulation. Formed edges with gasketing to create air-tight enclosure around chilled water pumps.

2.06 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturer:

1. Aeroflex USA**<< ; AEROFLEX EPDM Sheet/Roll; ; _____; or None - N/A>>**: www.aeroflexusa.com/#sle.
2. Armacell LLC**<< ; AP ArmaFlex; ; AP ArmaFlex FS; ; ArmaFlex Ultima; ; ArmaTuff; ; _____; or None - N/A>>**: www.armacell.us/#sle.
3. K-Flex USA LLC**<< ; Insul-Sheet; ; K-FONIK GK; ; _____; or None - N/A>>**: www.kflexusa.com/#sle.
4. Substitutions: **<< See Section 016000 - Product Requirements; See Section _____ .; or Not permitted.>>**

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with **<<ASTM C534/C534M>><< Grade 1; Grade 2; Grade 3; or _____>>**, in sheet form.

1. Minimum Service Temperature: **<< Minus 40 degrees F; or ____ degrees F>>**.
2. Maximum Service Temperature: **<< 220 degrees F; or ____ degrees F>>**.
3. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.07 WEATHER BARRIER COATINGS

A. Weather-Resistive Barrier Coating: Fire-resistive, UV resistant, water-based mastic for use over closed cell polyethylene and polyurethane foam insulation; applied with glass fiber or synthetic reinforcing mesh.

1. Manufacturers:
   a. H.B. Fuller Construction Products, Inc**<< ; Childers - CP Series Weather Barrier Coating; ; _____; or None - N/A>>**: www.fosterproducts.com/#sle.
   b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
2. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A, when tested in accordance with **<<ASTM E84>>**.
3. Water Vapor Permeance: Greater than **<< 1.0 perm; or ____ perm>>** in accordance with **<<ASTM E96/E96M>>**.
4. Resistance to Fungal Growth: No growth when tested in accordance with **<<ASTM D5590>>**.
5. Color: **<< As selected by Architect; White; Metallic gray; Black; or _____>>**.

2.08 JACKETING AND ACCESSORIES

A. PVC Plastic:

1. Manufacturers:
   a. Johns Manville Corporation**<< ; _____; or None - N/A>>**: www.jm.com/#sle.

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b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2. Jacket: Sheet material, off-white color.
   a. Minimum Service Temperature: **<< Minus 40 degrees F; or ____ degrees F>>**.
   b. Maximum Service Temperature: **<< 150 degrees F; or ____ degrees F>>**.
   c. Moisture Vapor Permeability: **<< 0.02 perm inch; 0.04 perm inch; 1.3 perm inch; or ____ perm inch>>**, when tested in accordance with **<<ASTM E96/E96M>>**.
   d. Thickness: **<< 10 mil, 0.010 inch; 15 mil, 0.015 inch; 20 mil, 0.020 inch; 30 mil, 0.030 inch; or _____ mil, _____ inch>>**.
   e. Connections: **<< Brush on welding adhesive; Tacks; Pressure sensitive color matching vinyl tape; or _____>>**.
3. Covering Adhesive Mastic: Compatible with insulation.

B. Canvas Jacket: UL listed **<< 6 oz/sq yd>>** plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
   1. Lagging Adhesive: Compatible with insulation.

C. Aluminum Jacket:
   1. Comply with **<<ASTM B209/B209M>>**, Temper H14, minimum thickness of **<< 0.016 inch>>** with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
   2. Thickness: **<< 0.016 inch; 0.020 inch; 0.025 inch; 0.032 inch; 0.040 inch; or ____ inch>>** sheet.
   3. Finish: **<< Smooth; Embossed; or _____>>**.
   4. Joining: Longitudinal slip joints and **<< 2 inch>>** laps.
   5. Fittings: **<< 0.016 inch; or ____ inch>>** thick die-shaped fitting covers with factory-attached protective liner.
   6. Metal Jacket Bands: **<< 3/8 inch>>** wide; **<< 0.015 inch; or ____ inch>>** thick aluminum.

D. Aluminum-Foil Laminate Jacket:
   1. Manufacturers:
      a. Ideal Tape Co., Inc**<< ; _____; or None - N/A>>**: www.idealtape.com/#sle.
      b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
   2. Factory-applied, pressure sensitive adhesive jacketing on paper release liner.
   3. Finish: **<< Aluminum smooth; Aluminum embossed; Gloss white; Embossed white; or _____>>**.
   4. Comply with **<<ASTM C1775>>**.

E. Aluminum-Foil Laminate Jacket:
   1. Manufacturers:
      a. H.B. Fuller Construction Products, Inc**<< ; Foster - Vapor-Fas; ; _____; or None - N/A>>**: www.fosterproducts.com/#sle.
   2. Factory-applied, pressure sensitive adhesive jacketing to comply with **<<ASTM C1775>>**.

F. Stainless Steel Jacket: **<<ASTM A666/A666M>>**, Type **<< 302; 304; 316; or _____>>** stainless steel.
   1. Thickness: **<< 0.010 inch; 0.016 inch; 0.018 inch; or ____ inch>>**.
   2. Finish: **<< Smooth.; Corrugated.; or _____>>**

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3. Metal Jacket Bands: **<< 3/8 inch>>** wide; **<< 0.010 inch; or ____ inch>>** thick stainless steel.

G. Reinforced Tape:
1. Manufacturers:
a. Ideal Tape Co., Inc**<< ; _____; or None - N/A>>**: www.idealtape.com/#sle.
b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
2. **<< FSK; All Service Jacket; PSK; or _____>>** tape suitable for sealing seams in insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
3. Comply with **<<UL 723>>** or **<<ASTM E84>>**.
4. Moisture Vapor Permeability: **<< 0.00 perm inch; or ____ perm inch>>**, when tested in accordance with **<<ASTM E96/E96M>>**.
5. Finish: Match insulation.

H. Plain Foil Tape:
1. Manufacturers:
a. Ideal Tape Co., Inc**<< ; _____; or None - N/A>>**: www.idealtape.com/#sle.
b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
2. Aluminum foil with pressure-sensitive adhesive on paper release liner.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that equipment has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Factory Insulated Equipment: Do not insulate.

C. Exposed Equipment: Locate insulation and cover seams in least visible locations.

D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.

F. Insulated equipment containing fluids below ambient temperature; insulate entire system.

G. Fiber glass insulated equipment containing fluids below ambient temperature; provide vapor barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapor barrier adhesive.

H. For hot equipment containing fluids **<< 140 degrees F; or ____ degrees F>>** or less, do not insulate flanges and unions, but bevel and seal ends of insulation.

I. For hot equipment containing fluids over **<< 140 degrees F; or ____ degrees F>>**, insulate flanges and unions with removable sections and jackets.

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J. Fiber glass insulated equipment containing fluids above ambient temperature; provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.

K. Inserts and Shields:
   1. Application: Equipment **<< 1-1/2 inches; 2 inches; or ____ inches>>** diameter or larger.
   2. Shields: **<< Galvanized steel; Steel; or _____>>** between hangers and inserts.
   3. Insert Location: Between support shield and equipment and under the finish jacket.
   4. Insert Configuration: Minimum **<< 6 inches>>** long, of same thickness and contour as adjoining insulation; may be factory fabricated.
   5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

L. Finish insulation at supports, protrusions, and interruptions.

M. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with **<< canvas jacket sized for finish painting; PVC jacket and fitting covers; aluminum jacket; stainless steel jacket; or _____>>**.

N. Exterior Applications:
   1. Provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement.
   2. Cover with **<< aluminum; stainless steel; or _____>>**.

O. Cover **<< glass fiber; cellular glass; hydrous calcium silicate; cellular foam; or _____>>** insulation with metal mesh and finish with heavy coat of insulating cement.

P. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.

Q. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

3.03 SCHEDULE

A. Equipment: Chilled-water air separators and expansion/compression tanks.
   1. Operating Temperature: 35 to 75 deg F.
   2. Insulation Material: Semi-Rigid Mineral-Fiber Board
      a. Insulation Thickness: 2”
      b. Field-Applied Jacket: Glass cloth.
      c. Vapor Retarder Required: Yes.
      d. Finish: Painted.
   3. Insulation Material: Flexible Elastomeric
      a. Insulation Thickness: 1”
      b. Field-Applied Jacket: Glass cloth.
      c. Vapor Retarder Required: Yes.
      d. Finish: Painted.

B. Equipment: Chilled-water pumps
   1. Operating Temperature: 35 to 75 deg F.
   2. Insulation Material: Removable pump insulation cover
   3. Vapor Retarder Required: Yes.

END OF SECTION 230716

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SECTION 230719
HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Flexible removable and reusable blanket insulation.

C. Weather barrier coatings.

D. Jacketing and accessories.

E. Engineered wall outlet seals and refrigerant piping insulation protection.

1.02 RELATED REQUIREMENTS

A. Section **<< 078400 - Firestopping>>**.

1.03 REFERENCE STANDARDS

A. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

B. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

D. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

E. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.

F. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

G. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

H. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

I. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.

J. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

K. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

L. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

M. ASTM C1393 - Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks.

N. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation.

O. ASTM C1775 - Standard Specification for Laminate Protective Jacket and Tape for Use Over Thermal Insulation for Outdoor Applications.

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P. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension.

Q. ASTM D570 - Standard Test Method for Water Absorption of Plastics.

R. ASTM D610 - Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces.

S. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay.

T. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

U. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

V. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

W. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

X. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials.

Y. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

Z. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials.

AA. FM 4924 - Examination Standard for Pipe and Duct Insulation.

BB. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth.

CC. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

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1.04 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than **<< three; or _____>>** years of**<< documented; _____; or None - N/A>>** experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of **<< 24; or ____>>** hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with **<< ASTM E84; UL 723; or _____>>**.

2.02 GLASS FIBER, FLEXIBLE

A. Manufacturers:
   1. JP Lamborn Co**<< ; _____; or None - N/A>>**: www.jpflex.com/#sle.
   2. Knauf Insulation**<< ; _____; or None - N/A>>**: www.knaufinsulation.com/#sle.
   3. Manson Insulation, a company of Knauf Insulation**<< ; _____; or None - N/A>>**: www.imanson.com/#sle.
   4. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Insulation: **<<ASTM C553>>**; flexible, noncombustible blanket.
   1. **<< K>>** Value: **<< 0.36 at 75 degrees F; 0.31 at 75 degrees F; 0.26 at 75 degrees F; 0.25 at 75 degrees F; or _____ at 75 degrees F>>**, when tested in accordance with **<<ASTM C518>>**.
   2. Maximum Service Temperature: **<< 250 degrees F; 450 degrees F; 850 degrees F; 1,000 degrees F; 1,200 degrees F; or ___ degrees F>>**.
   3. Maximum Water Vapor Absorption: 5.0 percent by weight.

C. Insulation: **<<ASTM C1393>>**; pipe and tank, end grain adhered to jacket.
   1. **<< K>>** Value: **<<ASTM C177>>**, **<< 0.27 at 75 degrees F; or _____ at 75 degrees F>>**.
   2. Maximum Service Temperature: **<< 850 degrees F; or ____ degrees F>>**.
   3. Maximum Moisture Absorption: 0.2 percent by volume.
   4. Products:
      a. Knauf Insulation; Performance+ Earthwool Pipe and Tank Insulation: www.knaufinsulation.com/#sle.
      b. Knauf Insulation; Performance+ KwikFlex Pipe and Tank Insulation: www.knaufinsulation.com/#sle.
      c. Manson Insulation, a company of Knauf Insulation; AK FLEX with ECOSE: www.imanson.com/#sle.
      d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

D. Aluminum-Foil Laminate Jacket:
   1. Manufacturers:
      a. H.B. Fuller Construction Products, Inc**<< ; Foster - Vapor-Fas; ; _____; or None - N/A>>**: www.fosterproducts.com/#sle.
      b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
   2. Factory-applied, pressure sensitive adhesive jacketing to comply with **<<ASTM C1775>>**.

E. Vapor Barrier Jacket:
   1. **<< Kraft paper with glass fiber yarn and bonded to aluminized film; 0.0032 inch vinyl; or _____>>**.
   2. Moisture Vapor Permeability: **<< 0.02 perm inch; 0.04 perm inch; 1.3 perm inch; or ____ perm inch>>**, when tested in accordance with **<<ASTM E96/E96M>>**.

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3. Secure with pressure-sensitive tape.

F. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film with pressure-sensitive rubber-based adhesive.

G. Outdoor Vapor Barrier Mastic:
1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

H. Tie Wire: Annealed steel, **<< 16 gauge, 0.0508 inch diameter>>**.

2.03 GLASS FIBER, RIGID

A. Manufacturers:
1. CertainTeed Corporation**<< ; _____; or None - N/A>>**: www.certainteed.com/#sle.
2. Johns Manville Corporation**<< ; _____; or None - N/A>>**: www.jm.com/#sle.
3. Knauf Insulation**<< ; Performance+ Earthwool 1000 Pipe Insulation; ; _____; or None - N/A>>**: www.knaufinsulation.com/#sle.
4. Manson Insulation, a company of Knauf Insulation**<< ; Alley-K Pipe Insulation; ; _____; or None - N/A>>**: www.imanson.com/#sle.
5. Owens Corning Corporation**<< ; Fiberglas Pipe Insulation ASJ; ; _____; or None - N/A>>**: www.owenscorning.com/en-us/#sle.
6. Owens Corning Corporation**<< ; VaporWick Pipe Insulation; ; _____; or None - N/A>>**: www.owenscorning.com/en-us/#sle.
7. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Insulation: **<<ASTM C547>><< and ASTM C795; _____; or None - N/A>>**; rigid molded, noncombustible.
1. **<< K>>** Value: **<<ASTM C177>>**, **<< 0.24 at 75 degrees F; or ____ at 75 degrees F>>**.
2. Maximum Service Temperature: **<< 850 degrees F; 1200 degrees F; 1600 degrees F; or ____ degrees F>>**.
3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Insulation: **<<ASTM C547>><< and ASTM C795; _____; or None - N/A>>**; semi-rigid, noncombustible, end grain adhered to jacket.
1. **<< K>>** Value: **<<ASTM C177>>**, **<< 0.24 at 75 degrees F; or _____ at 75 degrees F>>**.
2. Maximum Service Temperature: **<< 650 degrees F; or ____ degrees F>>**.
3. Maximum Moisture Absorption: 0.2 percent by volume.

D. Aluminum-Foil Laminate Jacket:
1. Manufacturers:
a. H.B. Fuller Construction Products, Inc**<< ; Foster - Vapor-Fas; ; _____; or None - N/A>>**: www.fosterproducts.com/#sle.
2. Factory-applied, pressure sensitive adhesive jacketing to comply with **<<ASTM C1775>>**.

E. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with **<<ASTM E96/E96M>>** of **<< 0.02 perm-inches>>**.

F. Tie Wire: **<< 0.048 inch>>** stainless steel with twisted ends on maximum **<< 12 inch>>** centers.

G. Vapor Barrier Lap Adhesive: Compatible with insulation.

H. Insulating Cement/Mastic: **<<ASTM C195>>**; hydraulic setting on mineral wool.

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I. Fibrous Glass Fabric:
   1. Cloth: Untreated; **<< 9 oz/sq yd>>** weight.
   2. Blanket: **<< 1.0 pcf>>** density.
   3. Weave: **<< 5 by 5; 10 by 10; 10 by 20; or _____>>**.

J. Indoor Vapor Barrier Finish:
   1. Cloth: Untreated; **<< 9 oz/sq yd>>** weight.
   2. Vinyl emulsion type acrylic, compatible with insulation, **<< black; white; or _____>>** color.

K. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

L. Insulating Cement: **<<ASTM C449>>**.

2.04 FLEXIBLE REMOVABLE AND REUSABLE BLANKET INSULATION

A. Manufacturers:
   1. Firwin**<< ; _____; or None - N/A>>**: www.firwin.com/#sle.
   2. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Description: Custom cut and fabricated, removable and reusable blanket insulation system, consisting of inner liner, insulation layer, outer protective jacket, and fastening system.

C. Provide insulation system based on surface temperature of piping, installed location of piping, and maximum safe-to-touch temperature of jacketing.

D. Performance Criteria:
   1. Maximum Service Temperature: Constructed for temperatures up to **<< 500 degrees F; 1200 degrees F; or _____ degrees F>>**.
   2. Safe-to-Touch Temperature of Jacketing: **<< 140 degrees F; 185 degrees F; 203 degrees F; or _____ degrees F>>**.
   3. Space Ambient Temperature, High: **<< 85 degrees F; or _____ degrees F>>**.
   4. Space Ambient Temperature, Low: **<< 40 degrees F; or _____ degrees F>>**.

E. Components:
   1. Inner Liner: Use **<< stainless steel mesh; silicone-impregnated fiberglass; or _____>>**.
   2. Insulation:
      a. Material: **<< Needled fiberglass felt mat; CMS (calcium, magnesium, silica) fiber wool; or _____>>**.
      b. Thickness: **<< 1 inch; 2 inches; or _____ inches>>**.
      c. Density: **<< 8 pcf; 10 pcf; 11 pcf; or _____ pcf>>**.
      d. Thermal Conductivity k-factor in **<< Btu inch/hr sq ft degrees F>>**: **<< 0.50 at 500 degrees F; 0.54 at 752 degrees F; or _____ at _____ degrees F>>**.
   3. Outer Jacket: **<< Silicone-impregnated fiberglass; or _____>>**.
   4. Fastening System: **<< Lacing wire; Snaps; Springs; Straps; Velcro; or _____>>**.

2.05 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturers:
   1. Aeroflex USA**<< ; AEROFLEX Self-Seal; ; AEROFLEX-EP; ; _____; or None - N/A>>**: www.aeroflexusa.com/#sle.

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2. Armacell LLC**<< ; AP ArmaFlex; ; ArmaFlex Ultima; ; _____; or None - N/A>>**: www.armacell.us/#sle.
3. K-Flex USA LLC**<< ; Insul-Lock DS; ; Insul-Tube; ; Insul-Sheet; ; K-Flex Titan; ; _____; or None - N/A>>**: www.kflexusa.com/#sle.
4. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with **<<ASTM C534/C534M>><< Grade 1; Grade 2; Grade 3; or _____>>**; use molded tubular material wherever possible.
1. Minimum Service Temperature: **<< Minus 40 degrees F; or ____ degrees F>>**.
2. Maximum Service Temperature: **<< 180 degrees F; 220 degrees F; or ____ degrees F>>**.
3. Connection: Waterproof vapor barrier adhesive.
4. Flammability Rating: **<<FM 4924>>** approval for reduced combustibility testing.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

D. Weather Barrier Coating: Air dried, contact adhesive, compatible with insulation and **<<ASTM E84>>** compliant.

E. For exterior refrigerant piping application, use K-Flex Titan or equal, with flexible coextruded jacketed composition material apply to K-Flex.

2.06 WEATHER BARRIER COATINGS

A. Weather-Resistive Barrier Coating: Fire-resistive, UV resistant, water-based mastic for use over closed cell polyethylene and polyurethane foam insulation; applied with glass fiber or synthetic reinforcing mesh.
1. Manufacturers:
a. H.B. Fuller Construction Products, Inc**<< ; Childers - CP Series Weather Barrier Coating; ; _____; or None - N/A>>**: www.fosterproducts.com/#sle.
b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
2. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A, when tested in accordance with **<<ASTM E84>>**.
3. Water Vapor Permeance: Greater than **<< 1.0 perm; or ____ perm>>** in accordance with **<<ASTM E96/E96M>>**.
4. Resistance to Fungal Growth: No growth when tested in accordance with **<<ASTM D5590>>**.
5. Color: **<< As selected by Architect; White; Metallic gray; Black; or _____>>**.

2.07 JACKETING AND ACCESSORIES

A. PVC Plastic.
1. Manufacturers:
a. Johns Manville Corporation**<< ; _____; or None - N/A>>**: www.jm.com/#sle.
b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
a. Minimum Service Temperature: **<< 0 degrees F; or ____ degrees F>>**.
b. Maximum Service Temperature: **<< 150 degrees F; or ____ degrees F>>**.

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c. Moisture Vapor Permeability: **<< 0.002 perm inch; or ____ perm inch>>**, maximum, when tested in accordance with **<<ASTM E96/E96M>>**.

d. Thickness: **<< 10 mil, 0.010 inch; 15 mil, 0.015 inch; 20 mil, 0.020 inch; 30 mil, 0.030 inch; or _____ mil, _____ inch>>**.

e. Connections: **<< Brush on welding adhesive; Tacks; Pressure sensitive color matching vinyl tape; or _____>>**.

3. Covering Adhesive Mastic: Compatible with insulation.

B. ABS Plastic:

1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
   a. Minimum Service Temperature: **<< Minus 40 degrees F; or ____ degrees F>>**.
   b. Maximum Service Temperature: **<< 180 degrees F; or ____ degrees F>>**.
   c. Moisture Vapor Permeability: **<< 0.012 perm inch; or ____ perm inch>>**, when tested in accordance with **<<ASTM E96/E96M>>**.
   d. Thickness: **<< 30 mil, 0.030 inch; or ____ mil, ____ inch>>**.
   e. Connections: Brush on welding adhesive.

C. Canvas Jacket: UL listed **<< 6 oz/sq yd>>** plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.

1. Lagging Adhesive: Compatible with insulation.

D. Aluminum Jacket:

1. Comply with **<<ASTM B209/B209M>>**, Temper H14, minimum thickness of **<< 0.016 inch>>** with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
2. Thickness: **<< 0.016 inch; 0.020 inch; 0.025 inch; 0.032 inch; 0.040 inch; or ____ inch>>** sheet.
3. Type: **<< Factory-applied, self-adhesive jacketing; or _____>>**.
4. Finish: **<< Smooth; Embossed; or _____>>**.
5. Joining: Longitudinal slip joints and **<< 2 inch>>** laps.
6. Fittings: **<< 0.016 inch; or ____ inch>>** thick die-shaped fitting covers with factory-attached protective liner.
7. Metal Jacket Bands: **<< 3/8 inch>>** wide; **<< 0.015 inch; or ____ inch>>** thick aluminum.

E. Aluminum-Foil Laminate Jacket:

1. Manufacturers:
   a. Ideal Tape Co., Inc**<< ; _____; or None - N/A>>**: www.idealtape.com/#sle.
   b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
2. Factory-applied, pressure sensitive adhesive jacketing on paper release liner.
3. Finish: **<< Aluminum smooth; Aluminum embossed; Gloss white; Embossed white; or _____>>**.
4. Comply with **<<ASTM C1775>>**.

F. Aluminum-Foil Laminate Jacket:

1. Manufacturers:
   a. H.B. Fuller Construction Products, Inc**<< ; Foster - Vapor-Fas; ; _____; or None - N/A>>**: www.fosterproducts.com/#sle.

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b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2. Factory-applied, pressure sensitive adhesive jacketing to comply with **<<ASTM C1775>>**.

G. Stainless Steel Jacket: **<<ASTM A666/A666M>>**, Type **<< 302; 304; 316; or _____>>** stainless steel.

1. Thickness: **<< 0.010 inch; 0.016 inch; 0.018 inch; or ____ inch>>**.
2. Finish: **<< Smooth.; Corrugated.; or _____>>**
3. Metal Jacket Bands: **<< 3/8 inch>>** wide; **<< 0.010 inch; or ____ inch>>** thick stainless steel.

H. Reinforced Tape:

1. Manufacturers:
   a. Ideal Tape Co., Inc**<< ; _____; or None - N/A>>**: www.idealtape.com/#sle.
   b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
2. **<< FSK; All Service Jacket; PSK; or _____>>** tape suitable for sealing seams between insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
3. Comply with **<<UL 723>>**, **<<ASTM E84>>**.
4. Moisture Vapor Permeability: **<< 0.00 perm inch; or ____ perm inch>>**, when tested in accordance with **<<ASTM E96/E96M>>**.
5. Finish: Match insulation.

I. Plain Foil Tape:

1. Manufacturers:
   a. Ideal Tape Co., Inc**<< ; _____; or None - N/A>>**: www.idealtape.com/#sle.
   b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
2. Aluminum foil with pressure-sensitive adhesive on paper release liner.
3. Finish: Plain foil.

J. Vapor Barrier Membranes: **<<ASTM C1136>>**, Type IX.

1. Multilayer Laminate Vapor Barrier:
   a. Provide multilayer laminate with **<< 1.0 mil, 0.001 inch; or _____ mil, _____ inch>>** foil, reversible.
   b. Thickness: **<< 2.4 mil, 0.002 inch; or _____ mil, _____ inch>>**.
   c. Moisture Vapor Permeability: **<< 0.00 perm inch; or ____ perm inch>>**, when tested in accordance with **<<ASTM E96/E96M>>**.
   d. Manufacturers:
      1) Polyguard Products**<< ; ZERO-PERM; ; ____; or None - N/A>>**: www.polyguardproducts.com/#sle.
      2) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
2. Rubberized Asphalt Vapor Barrier:
   a. Thickness: **<< 30 mil, 0.030 inch; 50 mil, 0.050 inch; or _____ mil, _____ inch>>**.
   b. Moisture Vapor Permeability: **<< 0.00 perm inch; or ____ perm inch>>**, when tested in accordance with **<<ASTM E96/E96M>>**.
   c. Manufacturers:

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1) Polyguard Products**<< ; Insulrap 30 NG; ; Insulrap 50 NG; ; Insulrap JB; ; ____; or None - N/A>>**: www.polyguardproducts.com/#sle.
2) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.08 ENGINEERED WALL OUTLET SEALS AND REFRIGERANT PIPING INSULATION PROTECTION

A. Manufacturers:
1. Airex Manufacturing, Inc**<< ; ____; or None - N/A>>**: www.airexmfg.com/#sle.
2. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Basis of Design: Airex Manufacturing, Inc; www.airexmfg.com/#sle.
1. Pipe Penetration Wall Seal**<< : Airex Titan Outlet; : ____; or None - N/A>>**.
2. Refrigeration Pipe Insulation Protection System**<< : Airex E-Flex Guard; : ____; or None - N/A>>**.
3. Pipe Penetration Wall Seal and Insulation Protection System**<< : Airex Pro-System Kit; : ____; or None - N/A>>**.

C. Pipe Penetration Wall Seal: Seals HVAC piping wall penetrations with compression gasket wall mounted rigid plastic outlet cover.
1. Wall Outlet Size, Stucco and Masonry Applications: **<< 7-1/2 inch wide by 10 inch high>>**.
a. Elastomeric Sleeve Diameter: **<< 1-11/16 inch; 2-3/8 inch; 3-3/16 inch; or ___ inch>>**.
2. Outlet Cover Color: **<< Gray; White; or _____>>**.
3. Water Penetration: Comply with **<<ASTM E331>>**.
4. Air Leakage: Comply with **<<ASTM E283/E283M>>**.
5. Air Permeance: Comply with **<<ASTM E2178>>**.

D. Insulation Protection System: Refrigerant piping insulation PVC protective cover.
1. PVC Insulation Cover Color: **<< Black; White; or _____>>** with full-length velcro fastener.
2. Weatherization and Ultraviolet Exposure Protection: Comply with **<<ASTM G153>>**.
3. Water/Vapor Permeability: Comply with **<<ASTM E96/E96M>>**.
4. Anti-Fungal and Anti-Microbial Resistance: Comply with **<<ASTM G21>>**.
5. Flame Spread and Smoke Development Rating of 24/450: Comply with **<< ASTM E84; UL 723; or _____>>**.
6. Carbon Arc Light Exposure: Comply with **<<ASTM G153>>**.
7. Tensile Strength After UV Exposure and Water Immersion: Comply with **<<ASTM D412>>**.
8. Water Absorption of Plastics: Comply with **<<ASTM D570>>**.
9. Adhesive free.

2.09 ACCESSORIES

A. General Requirements:
1. Provide required accessories in accordance with and subject to the recommendations of the insulation manufacturer.
2. Furnish compatible materials which do not contribute to corrosion, soften, or otherwise attack surfaces to which applied, in either the wet or dry state.

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3. Comply with **<<ASTM C795>>** requirements for materials to be used on stainless steel surfaces.
4. Supply materials that are asbestos free.
5. Provide calcium silicate, high-density, 100 psi minimum compressive strength for all piping support inserts at hangers and support locations.

B. Corrosion Inhibitors:
1. Corrosion Control Gel:
a. Manufacturers:
1) Polyguard Products**<< ; RG2400LT; ; RG2400CHW; ; ____; or None - N/A>>**: www.polyguardproducts.com/#sle.
2) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
b. Corrosion Protection: Comply with **<<ASTM B117>>** and **<<ASTM D610>>**.

PART 3 EXECUTION

3.01 EXAMINATION

A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with **<< manufacturer's instructions; or _____>>**.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated Pipes Conveying Fluids Below Ambient Temperature:
1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections,**<< pump bodies,; _____ ,; or None - N/A>>** and expansion joints.

E. Glass Fiber Insulated Pipes Conveying Fluids Below Ambient Temperature:
1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

F. For hot piping conveying fluids **<< 140 degrees F; or ____ degrees F>>** or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

G. For hot piping conveying fluids over **<< 140 degrees F; or ____ degrees F>>**, insulate flanges and unions at equipment.

H. Glass Fiber Insulated Pipes Conveying Fluids Above Ambient Temperature:
1. Provide standard jackets, with or without vapor barrier, factory-applied, or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

I. Inserts and Shields:

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1. Application: Piping **<< 1-1/2 inches; 2 inches; or ____ inches>>** diameter or larger.
2. Shields: **<< Galvanized steel; Steel; or _____>>** between pipe hangers or pipe hanger rolls and inserts.
3. Insert location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum **<< 6 inches>>** long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section **<< 078400>>**.

K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than **<< 10 feet>>** above finished floor): Finish with **<< canvas jacket sized for finish painting; PVC jacket and fitting covers; ABS jacket and fitting covers; aluminum jacket; stainless steel jacket; or _____>>**.

L. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with **<< aluminum; stainless steel; or _____>>** jacket with seams located on bottom side of horizontal piping. Provide two coats of UV-resistant finish for flexible elastomeric cellular insulation without jacketing.

M. Buried Piping: Provide factory-fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with **<< 1 mil, 0.001 inch>>** thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.

N. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with **<< aluminum; stainless steel; or _____>>** jacket with seams located on bottom side of horizontal piping.

3.03 INDOOR APPLICATAION SCHEDULE

A. Service: Condensate drain piping except plastic.
1. Insulation Material: Mineral fiber preformed pipe insulation.
2. Insulation Thickness: 1”
3. Vapor Retarder Required: Yes.
4. Finish:
   a. Exposed, Finished Spaces: Painted.
   b. Concealed: None.

B. Service: Chilled water supply and return.
1. Insulation Material: Mineral fiber preformed pipe insulation.
2. Insulation Thickness: Apply the following insulation thickness:
   a. 40°F to 60°F Systems:
      1) Pipe sizes less than 1-1/2” diameter: 1/2 inch.
      2) Pipe sizes 1-1/2” diameter and larger: 1 inch.
   b. In mechanical rooms and unconditioned spaces, increase thickness by 1 inch.
3. Vapor Retarder Required: Yes
4. Finish:
   a. Exposed Finished Spaces: Painted.

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b. Concealed: None.

C. Service: Heating hot-water supply and return.
1. Insulation Material: Mineral fiber preformed pipe insulation.
2. Insulation Thickness: Apply the following insulation thicknesses:
a. 105°F to 140°F Systems:
1) Pipe sizes less than 1-1/2” diameter: 1 inch.
2) Pipe sizes 1-1/2” diameter and larger: 1-1/2 inches.
b. 141°F to 200°F Systems:
1) Pipe sizes less than 1-1/2” diameter: 1-1/2 inches.
2) Pipe sizes 1-1/2” diameter and larger: 2 inches.
c. In mechanical rooms and unconditioned spaces, increase thickness by 1 inch.
3. Vapor Retarder Required: No.
4. Finish:
a. Exposed, Finished Spaces: Painted.
b. Concealed: None.

D. Refrigerant Suction and Hot-Gas Piping/Tubing:
1. Insulation Material and Thickness:
a. Flexible Elastomeric: 1 inch.

3.04 OUTDOOR APPLICATAION SCHEDULE

A. Insulation shall be applied after heat tracing and temperature sensors are in place and have been tested.

B. Service: Chilled water supply and return.
1. Insulation Material: Flexible elastomeric.
2. Insulation Thickness: 1 1/2”.
3. Field-Applied Jacket: Aluminum.
4. Vapor Retarder Required: Yes.
5. Finish: Two coats UV protectant applied to flexible elastomeric insulation prior to installation of aluminum jacket.

C. Refrigerant Suction and Hot-Gas Piping:
1. Insulation Material: Flexible elastomeric.
2. Insulation Thickness: 1”.
3. Intergral Jacketing System: K-Flex Tital or equal with flexible coextruded jacketed composite material.

END OF SECTION 230719

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SECTION 230800
COMMISSIONING OF HVAC

PART 1 GENERAL

1.01 SUMMARY

A. See Section **<< 019113 - General Commissioning Requirements>>** for overall objectives; comply with the requirements of Section **<< 019113>>**.

B. This section covers the **<<Contractor>>**'s responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.

C. The Commissioning Authority (CA) directs and coordinates all commissioning activities and provides Prefunctional Checklists and Functional Test Procedures for **<<Contractor>>**'s use.

D. The **<< entire HVAC system is; following HVAC equipment is; or _____>>** to be commissioned, including commissioning activities for the following specific items:

1. Control system.
2. Major and minor equipment items.
3. Piping systems and equipment.
4. Ductwork and accessories.
5. Terminal units.
6. Sound control devices.
7. Vibration control devices.
8. Variable frequency drives.
9. Special Ventilation:
    a. Fume hoods.
    b. Laboratory pressurization.
    c. Specialty fans.
    d. Egress pressurization.
10. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.
11. Indoor Air Quality Procedures: The Commissioning Authority will coordinate; Contractor will execute; see Section **<< 015719>>**.

E. The Prefunctional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

1.02 RELATED REQUIREMENTS

A. Section **<< 015719 - Temporary Environmental Controls>>**: Precautions and procedures; smoking room testing; building flush-out.

B. Section **<< 017800 - Closeout Submittals>>**: Scope and procedures for operation and maintenance manuals and project record documents.

C. Section **<< 017900 - Demonstration and Training>>**: Scope and procedures for **<<Owner>>** personnel training.

D. Section **<< 019113 - General Commissioning Requirements>>**: Commissioning requirements that apply to all types of work.

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E. Section **<< 230593 - Testing, Adjusting, and Balancing for HVAC>>**.

1.03 REFERENCE STANDARDS

A. ASHRAE Guideline 1.1 - HVAC&R Technical Requirements for the Commissioning Process.

1.04 SUBMITTALS

A. Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.

B. Draft Prefunctional Checklists and Functional Test Procedures for Control System: Detailed written plan indicating the procedures to be followed to test, checkout and adjust the control system prior to full system Functional Testing; include at least the following for each type of equipment controlled:
   1. System name.
   2. List of devices.
   3. Step-by-step procedures for testing each controller after installation, including:
      a. Process of verifying proper hardware and wiring installation.
      b. Process of downloading programs to local controllers and verifying that they are addressed correctly.
      c. Process of performing operational checks of each controlled component.
      d. Plan and process for calibrating valve and damper actuators and all sensors.
      e. Description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
   4. Copy of proposed log and field checkout sheets to be used to document the process; include space for initial and final read values during calibration of each point and space to specifically indicate when a sensor or controller has “passed” and is operating within the contract parameters.
   5. Description of the instrumentation required for testing.
   6. Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the Commissioning Authority and TAB contractor for this determination.

C. Startup Reports, Prefunctional Checklists, and Trend Logs: Submit for approval of Commissioning Authority.

D. HVAC Control System O&M Manual Requirements. In addition to documentation specified elsewhere, compile and organize at minimum the following data on the control system:
   1. Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. Provide an index and clear table of contents. Include the detailed technical manual for programming and customizing control loops and algorithms.
   2. Full as-built set of control drawings.
   3. Full as-built sequence of operations for each piece of equipment.
   4. Full points list; in addition to the information on the original points list submittal, include a listing of all rooms with the following information for each room:
      a. Floor.
      b. Room number.
      c. Room name.
      d. Air handler unit ID.

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e. Reference drawing number.
f. Air terminal unit tag ID.
g. Heating and/or cooling valve tag ID.
h. Minimum air flow rate.
i. Maximum air flow rate.

5. Full print out of all schedules and set points after testing and acceptance of the system.
6. Full as-built print out of software program.
7. Electronic copy on disk of the entire program for this facility.
8. Marking of all system sensors and thermostats on the as-built floor plan and HVAC drawings with their control system designations.
9. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
10. Control equipment component submittals, parts lists, etc.
11. Warranty requirements.
12. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
13. Organize and subdivide the manual with permanently labeled tabs for each of the following data in the given order:
    a. Sequences of operation.
    b. Control drawings.
    c. Points lists.
    d. Controller and/or module data.
    e. Thermostats and timers.
    f. Sensors and DP switches.
    g. Valves and valve actuators.
    h. Dampers and damper actuators.
    i. Program setups (software program printouts).

E. Project Record Documents: See Section **<< 017800>>** for additional requirements.
1. Submit updated version of control system documentation, for inclusion with operation and maintenance data.
2. Show actual locations of all static and differential pressure sensors (air, water and building pressure) and air-flow stations on project record drawings.

F. Draft Training Plan: In addition to requirements specified in Section **<< 017900>>**, include:
1. Follow the recommendations of ASHRAE Guideline 1.1.
2. Control system manufacturer's recommended training.
3. Demonstration and instruction on function and overrides of any local packaged controls not controlled by the HVAC control system.

G. Training Manuals: See Section **<< 017900>>** for additional requirements.
1. Provide **<< three extra copies; or ____>>** of the controls training manuals in a separate manual from the O&M manuals.

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PART 2 PRODUCTS

2.01 TEST EQUIPMENT

A. Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will NOT become the property of **<<Owner>>**.

B. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to **<<Owner>>**; such equipment, tools, and instruments are to become the property of **<<Owner>>**.

PART 3 EXECUTION

3.01 PREPARATION

A. Cooperate with the Commissioning Authority in development of the Prefunctional Checklists and Functional Test Procedures.

B. Furnish additional information requested by the Commissioning Authority.

C. Prepare a preliminary schedule for HVAC pipe and duct system testing, flushing and cleaning, equipment start-up and testing, adjusting, and balancing start and completion for use by the Commissioning Authority; update the schedule as appropriate.

D. Notify the Commissioning Authority when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and testing, adjusting, and balancing will occur; when commissioning activities not yet performed or not yet scheduled will delay construction notify ahead of time and be proactive in seeing that the Commissioning Authority has the scheduling information needed to efficiently execute the commissioning process.

E. Put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.

1. Include cost of sheaves and belts that may be required for testing, adjusting, and balancing.

F. Provide test holes in ducts and plenums where directed to allow air measurements and air balancing; close with an approved plug.

G. Provide temperature and pressure taps in accordance with Contract Documents.

1. Provide a pressure/temperature plug at each water sensor that is an input point to the control system.

3.02 INSPECTING AND TESTING - GENERAL

A. Submit startup plans, startup reports, and Prefunctional Checklists for each item of equipment or other assembly to be commissioned.

B. Perform the Functional Tests directed by the Commissioning Authority for each item of equipment or other assembly to be commissioned.

C. Provide two-way radios for use during the testing.

D. Valve/Damper Stroke Setup and Check:

1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
2. Set pump/fan to normal operating mode.

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3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
4. Command valve/damper open; verify position is full open and adjust output signal as required.
5. Command valve/damper to a few intermediate positions.
6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).
7. Closure for Heating Coil Valves - Normally Open:
   a. Set heating setpoint **<< 20 degrees F; or ___ degrees F>>** above room temperature.
   b. Observe valve open.
   c. Remove control air or power from the valve and verify that the valve stem and actuator position do not change.
   d. Restore to normal.
   e. Set heating setpoint to **<< 20 degrees F; or ___ degrees F>>** below room temperature.
   f. Observe the valve close.
8. Closure for Cooling Coil Valves - Normally Closed:
   a. Observe the valve close.
   b. Remove control air or power from the valve and verify that the valve stem and actuator position do not change.
   c. Restore to normal.
   d. Set cooling setpoint to **<< 20 degrees F; or ___ degrees F>>** below room temperature.
   e. Observe valve open.

E. Coil Valve Leak Check:
1. Method 1 - Water Temperature With 2-Way Valve:
   a. Calibrate water temperature sensors on each side of coil to be within **<< 0.2 degree F ; or ____ >>** of each other.
   b. Turn off air handler fans, close outside air dampers. Keep pump running. Make sure appropriate coil dampers are open.
   c. Normally closed valves will close.
   d. Override normally open valves to the closed position.
   e. After 10 minutes observe water delta T across coil. If it is greater than **<< 2 degrees F (; or _____ (>>**, leakage is probably occurring.
   f. Reset valve stroke to close tighter.
   g. Repeat test until compliance is achieved.
2. Method 2 - Air Temperature With 2 or 3-Way Valve: Water leak-by less than 10 percent will likely not be detected with this method.
   a. Calibrate air temperature sensors on each side of coil to be within **<< 0.2 degree F ; or ____ >>** of each other.
   b. Air handler fans should be on.
   c. Change mixed or discharge air setpoint, override values or bleed or squeeze bulb pneumatic controller to cause the valve to close.
   d. After 5 minutes observe air delta T across coil. If it is greater than **<< one degree F (; or _____ (>>**, leakage is probably occurring.

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e. Reset valve stroke to close tighter.
f. Repeat test until compliance is achieved.

3. Method 3 - Coil Drain Down: Not for 3-way valves.
   a. Put systems in normal mode.
   b. If cooling coil valve, remove all call for cooling; if heating coil valve, put system in full cooling.
   c. Close isolation valve on supply side of coil, open air bleed cap, open drain-down cock and drain water from coil.
   d. If water does not stop draining, there may be a leak through the control valve.
   e. Return all to normal when done.

F. Isolation Valve or System Valve Leak Check: For valves not by coils.
   1. With full pressure in the system, command valve closed.
   2. Use an ultra-sonic flow meter to detect flow or leakage.

G. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to **<<Owner>>**.

3.03 TAB COORDINATION

A. TAB: Testing, adjusting, and balancing of HVAC.

B. Coordinate commissioning schedule with TAB schedule.

C. Review the TAB plan to determine the capabilities of the control system toward completing TAB.

D. Provide all necessary unique instruments and instruct the TAB technicians in their use; such as handheld control system interface for setting terminal unit boxes, etc.

E. Have all required Prefunctional Checklists, calibrations, startup and component Functional Tests of the system completed and approved by the Commissioning Authority prior to starting TAB.

F. Provide a qualified control system technician to operate the controls to assist the TAB technicians or provide sufficient training for the TAB technicians to operate the system without assistance.

3.04 CONTROL SYSTEM FUNCTIONAL TESTING

A. Prefunctional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of Contract Documents and the detailed Sequences of Operation documentation submittal.

B. Do not start Functional Testing until all controlled components have themselves been successfully Functionally Tested in accordance with Contract Documents.

C. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system as required by the Commissioning Authority.

D. Functional Testing of the control system constitutes demonstration **<< and trend logging of control points monitored by the control system; or None - N/A>>**.
   1. The scope of trend logging is partially specified; trend log up to **<< 50 percent; 20 percent; or _____>>** more points than specified at no extra cost to **<<Owner>>**.
   2. Perform all trend logging specified in Prefunctional Checklists and Functional Test procedures.

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E. Functionally Test integral or stand-alone controls in conjunction with the Functional Tests of the equipment they are attached to, including any interlocks with other equipment or systems; further testing during control system Functional Test is not required unless specifically indicated below.

F. Demonstrate the following to the Commissioning Authority during testing of controlled equipment; coordinate with commissioning of equipment.
   1. Setpoint changing features and functions.
   2. Sensor calibrations.

G. Demonstrate to the Commissioning Authority:
   1. That all specified functions and features are set up, debugged and fully operable.
   2. That scheduling features are fully functional and setup, including holidays.
   3. That all graphic screens and value readouts are completed.
   4. Correct date and time setting in central computer.
   5. That field panels read the same time as the central computer; sample 10 percent of field panels; if any of those fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to **<<Owner>>**.
   6. Functionality of field panels using local operator keypads and local ports (plug-ins) using portable computer/keypad; demonstrate 100 percent of panels and 10 percent of ports; if any ports fail, sample another 10 percent; if any of those fail, test all remaining units at no extra cost to **<<Owner>>**.
   7. Power failure and battery backup and power-up restart functions.
   8. Global commands features.
   9. Security and access codes.
   10. Occupant over-rides (manual, telephone, key, keypad, etc.).
   11. O&M schedules and alarms.
   12. Occupancy sensors and controls.
   13. “After hours” use tracking and billing.
   14. Communications to remote sites.
   15. Fire alarm interlocks and response.
   16. Fire protection and suppression systems interfaces.
   17. Security system interlocks.
   18. That points that are monitored only, having no control function, are reporting properly to the control system.
   19. All control strategies and sequences not tested during controlled equipment testing.
   20. Trend logging and graphing features that are specified.
   21. Other integrated tests specified in Contract Documents
   22. That control system features that are included but not specified to be setup are actually installed.

H. Perform and submit trend logging on the following using the control system, for minimum period of **<< 5 days including one weekend; or _____>>**, if the control points are monitored by the control system:
   1. Duty cycling, if specified.
   2. Demand limiting, including over-ride of limiting.
   3. Sequential staging ON of equipment; optionally demonstrate manually.
   4. Optimum start-stop functions.

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5. Miscellaneous equipment current or status for duty cycling and demand limiting.
6. Equipment or building kW or current for demand limiting.
7. Equipment optimum start/stop functions.

I. If the control system, integral control components, or related equipment do not respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice, under any of the conditions, sequences, or modes tested, correct all systems, equipment, components, and software required at no additional cost to **<<Owner>>**.

3.05 OPERATION AND MAINTENANCE MANUALS

A. See Section **<< 017800>>** for additional requirements.

B. Add design intent documentation furnished by **<<Architect>>** to manuals prior to submission to **<<Owner>>**.

C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.

D. Commissioning Authority will add commissioning records to manuals after submission to **<<Owner>>**.

3.06 DEMONSTRATION AND TRAINING

A. See Section **<< 017900>>** for additional requirements.

B. Demonstrate operation and maintenance of HVAC system to **<<Owner>>'** personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.

C. These demonstrations are in addition to, and not a substitute for, Prefunctional Checklists and demonstrations to the Commissioning Authority during Functional Testing.

D. Provide classroom and hands-on training of **<<Owner>>**'s designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned.

E. TAB Review: Instruct **<<Owner>>**'s personnel for minimum **<< 8>>** hours, after completion of TAB, on the following:
   1. Review final TAB report, explaining the layout and meanings of each data type.
   2. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
   3. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
   4. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
   5. Other salient information that may be useful for facility operations, relative to TAB.

F. HVAC Control System Training: Perform training in at least three phases:
   1. Phase 1 - Basic Control System: Provide minimum of **<< 8>>** hours of actual training on the control system itself. Upon completion of training, each attendee, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.
      a. This training may be held on-site or at the manufacturer's facility.

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b. If held off-site, the training may occur prior to final completion of the system installation.

c. For off-site training, **<<Contractor>>** shall pay expenses of up to **<< two; or ___>>** attendees.

2. Phase 2 - Integrating with HVAC Systems: Provide minimum of **<< 8>>** hours of on-site, hands-on training after completion of Functional Testing. Include instruction on:

a. The specific hardware configuration of installed systems in this facility and specific instruction for operating the installed system, including interfaces with other systems, if any.

b. Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.

c. Trend logging and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends; provide practice in setting up trend logging and monitoring during training session.

d. Every display screen, allowing time for questions.

e. Use of keypad or plug-in laptop computer at the zone level.

f. Use of remote access to the system via phone lines or networks.

g. Setting up and changing an air terminal unit controller.

h. Graphics generation.

i. Point database entry and modifications.

j. Understanding DDC field panel operating programming, when applicable.

3. Phase 3 - Post-Occupancy: **<< Six months; or _____>>** after occupancy conduct minimum of **<< 4>>** hours of training. Tailor training session to questions and topics solicited beforehand from **<<Owner>>**. Also be prepared to address topics brought up and answer questions concerning operation of the system.

G. Provide the services of manufacturer representatives to assist instructors where necessary.

H. Provide the services of the HVAC controls instructor at other training sessions, when requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

END OF SECTION 230800

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SECTION 230900
BUILDING AUTOMATION SYSTEM

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Where materials, methods, and/or procedures specified in this section differ from similarly specified materials, methods, and/or procedures in other sections of the specifications, this section shall take precedence in governing the work by the energy management contractor.

B. Refer to Common Work Results for HVAC for additional requirements.

1.02 SCOPE

A. The intent of this Specification Section is to provide Montgomery County Public Schools (MCPS), the Owner, a complete temperature control system consisting of, but not limited to electric, and electronic controls and an automated energy management and digital control system. The general configuration of the automation system consists of microprocessor controllers communicating via a BACnet local area network within the school; remote access via MCPS Ethernet; and central server at MCPS Energy Management Office. The EMS is to meet all of the performance requirements outlined in this Section. The head end and all controllers are to be BACnet compliant and shall be able to integrate into the MCPS Dashboard. Dashboard shall be able to READ/WRITE thru BACnet device discovery protocol. Dashboard programming is performed separate from this project, but this contractor is required to coordinate the interface with and subcontract the dashboard programmer under this project. Comminications to main controller goes from controller to mini-switch to MCPS network switch. Ring protocal is not allowed. Only one mini-switch connected to MCPS network port.

B. All control work shall be installed by a single Automatic Temperature Controls (ATC) and Energy Management system (EMS) Contractor, unless specified otherwise. Certain mechanical systems such as packaged air conditioning units are equipped with manufacturer furnished controls and shall be interfaced with the automation system via hardwire and/or BACnet as herein after specified. All labor, materials, equipment, software, and services necessary for the installation of a complete integrated system of EMS, ATC, and manufacturers' controls shall be furnished as specified herein, on drawings, and in related Sections of the Specifications.

C. All labor, materials, equipment, software, and services necessary for the installation of a complete integrated system of EMS, ATC, and manufacturers' controls shall be furnished as specified herein, on drawings, and in related Sections of the Specifications. Equipment and labor not specifically referred to herein or on the plans that are required to meet the functional intent shall be provided without additional cost to the Owner.

D. The main building automation system panel shall be located in central plant mechanical room or main mechancial room.

1.03 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

B. Related Sections include the following:

1. Division 23 Section "Meters and Gages for HVAC Piping" for measuring equipment that relates to this Section.
2. Division 26 Sections for additional conduit requirements for all electronic safety and security systems specified under Division 26.

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C. Work Under Other Sections:
   1. All wells, valves, taps, dampers, flow stations, etc. furnished by the BAS manufacturer shall be installed under Section “Hydronic Piping.”
   2. The following shall be provided under Division 23 specifications sections:
      a. 120V power to BAS panels and devices with circuits indicated on the drawings. Refer to “Coordination” paragraph below.
      b. Wiring of power feeds to disconnect switches and starters.
      c. Wiring from disconnect switches and starters to electric motors.
      d. Wiring of any remote start/stop switches and manual or automatic motor speed control devices not furnished under this section of the specifications.

1.04 DEFINITIONS

A. ATC: Automatic Temperature Controls.
B. BAS: Building Automation System.
C. DDC: Direct digital control.
D. EMS: Energy Management System.
E. I/O: Input/output.
F. IT: Information Technology.
G. IS: Information Systems.
H. LAN: Local Area Network.
I. MS/TP: Master-slave/token-passing
J. NAC: Network area controllers.
K. PC: Personal computer.
L. PID: Proportional plus integral plus derivative.
M. PPM: Parts per million.
N. RTD: Resistance temperature detector.
O. WAN: Wide-Area Network
P. EMS, BAS, ATC: The terms Energy Management System (EMS), Building Automation System (BAS), and Automatic Temperature Controls (ATC) are interchangeable throughout this specification and shall be the responsibility of the controls contractor.

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1.05 REFERENCE STANDARDS

A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating.
B. IEEE 802.3 - IEEE Standard for Ethernet.
C. NFPA 70 - National Electrical Code.
D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
E. UL 916 - Energy Management Equipment.

1.06 SYSTEM DESCRIPTION

A. Control system consists of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.
B. Control system includes interface to the following:

1. Security Systems. Provide interface outputs for selective annunciation and monitoring (i.e. alarm status).

1.07 WARRANTY

A. Upon achieving initial acceptance, submit warranty covering project hardware for two (2) years. Warranty shall become valid and operative upon issuance of certification of initial acceptance by the Owner. Warranty shall not apply to work where damage is the result of abuse, neglect by Owner or his successor(s) in interest.

B. The Contractor guarantees all work Specified, with any approved modifications, as follows:
   1. Against faulty or defective material or workmanship.
   2. That all mechanical and electrical devices and equipment shall operate satisfactorily with ordinary care and shall perform the specified or intended functions.
   3. That all software and control strategies shall perform their specified or intended functions.
   4. Against damage or undue deterioration resulting from normal use of the building(s).

C. In event of such required correction, Contractor shall make good all damage to other work caused by faulty work or corrective measures.

D. Neither the final payment, final certificate nor any provisions of the Contract Documents, relieves the Contractor from his responsibilities under this guarantee.

E. If, at any time, deficiencies in the Work are discovered which result from a deliberate attempt to defraud the Owner, the Contractor will be held liable for replacement or correction, regardless of the time limit on the guarantee.

F. If the Contractor, after notice, fails to proceed promptly to comply with the terms of the guarantee, the Owner may have the defects corrected and the Contractor and his Surety shall be liable for all expense incurred.

G. Should the Contractor be required to do off-time work after final payment, the Contractor shall pay "overtime" for the required presence of the custodian.

H. Over the 2-year warranty period, Contractor shall provide and install all software upgrades released by the manufacturer as applicable to the systems installed at the facility, at the head-end, on the POT, workstation and on the server. At the end of the warranty period, the latest version of the software and databases shall be installed for each of the active licenses, not just an update of the older version.

I. For the end-of warranty, the Controls Contractor submit a complete set of trends for review and shall arrange to meet with the Mechanical Engineer and the Owner within thirty (30) days prior to the specified end of the 2-year guarantee period for the purpose of compiling a list of items that require correction under specified guarantees. Should the Contractor fail to schedule the final meeting, then the 2-year controls system Guarantee shall be automatically extended until such time as the meeting takes place; and the Contractor shall be fully responsible for correcting such deficiencies as if they occurred under the original guarantee period.

J. Controls Contractor shall have qualified service personnel on staff to respond in person at the project site within twenty-four (24) hours of receiving of service call from the Owner to the Contractors' office throughout the guarantee period. A no-heat or emergency condition shall require an immediate response.

K. Provide monitoring analytics during life of warranty.

1.08 SUBMITTALS

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A. Submit copies of appropriate shop drawings and control drawings for the HVAC equipment installation. The quantities of shop drawings submitted shall be in response to the requirements of the General Contractor; at a minimum, a copy shall be provided for each of the following:
   1. Provide to Architect, Mechanical Consulting Engineer, MCPS Construction Division, MCPS Energy Management Division, Commissioning Authority, Mechanical Subcontractor, and Electrical Subcontractor.
   2. Required shop drawings shall include but not be limited to the following items:
      a. Cover Sheet and Table of Contents
      b. Hardware to be furnished, with specific models/options clearly identified. Include shop drawings as applicable to the project for:
         1) Controllers.
         2) Transmitters.
         3) Power Monitors.
         4) Current Transducers.
         5) Switches.
         6) Software Manuals.
         7) WEB Interface Devices.
         8) Local Interface Equipment.
         9) Thermostats.
         10) Relays.
         11) Sensors.
         12) Microprocessors.
         13) Current Switches.
         14) Freezestats.
         15) Enclosures.
         16) Modems.
         17) Valves.
         18) Dampers.
         19) Actuators.
         20) Guards.
   3. General Control Drawing Requirement:
      a. Contractor shall maintain a set of all specs, drawings and documents on site during construction and make them available on request. This includes as-built notations to be recorded immediately as they occur and maintained.
      b. Control Drawings shall be 11” x 17”.
      c. The control drawing format shall be prepared such that all information regarding any control point or sub system shall be grouped in a single location on the drawings.
      d. Spreading control point information unnecessarily over several pages is not allowed.
      e. Copies shall be provided in searchable PDF format and AutoCAD DWG format. Scanned drawings are not allowed.
      f. There shall be a detailed index immediately after the cover page showing every item of equipment in alphabetical order.
      g. The index will show the page(s) that equipment is on, controller address number, building area served, mechanical drawing numbers where equipment is found.
      h. Provide equipment schedules for all terminal equipment showing at a minimum: room numbers, unit type, size, address, master controller connected, controller part

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numbers and any other properties that apply to describing the unit. Each unit shall be on a separate line of the schedule.

i. Wherever it is unavoidable and a reference requires the reader to go to another page to follow the logic, that page number shall be shown.
j. Provide detailed overview of all installation requirements for the products to be used – cable types, cable colors to be used, standard installation practices, etc.
k. All text shall be in landscape orientation. Sideways or vertical text is not allowed.
l. Text shall be clear and be measured at least 1/16' height when printed.
m. Allowed fonts are Arial, Calibri or Tahoma.
n. Drawing formats that use only standard “boiler plate” details that do not precisely illustrate the systems to be installed are not allowed.
o. Drawing formats that put controller information solely in a spreadsheet in lieu of showing actual wiring details are not allowed.
p. Prior to engineering, provide a sample drawing set from a previous job for approval of the drawing style.
q. Show building zone plan, detailed equipment floor plan, installation plans (including all wire runs, circuit numbers, panel locations, equipment locations, etc). Provide these in searchable PDF format available from a link on the main school screen.
r. Sequences shall always appear on same sheet with flow diagrams and wiring details.
s. In all tables and wherever room numbers are displayed, show the original mechanical drawing room number and the final actual room number when it becomes available.

4. Controller details drawing shall include:
   a. A clear English language name for each point.
   b. All devices indicate manufacturer and part number.
   c. Controller termination numbers.
   d. Controller Input or Output number.
   e. Wire and tubing termination identification numbers.
   f. Cable numbering.
   g. The sensor range (i.e. 4-20mA = 0-100% RH)
   h. Actuator range (i.e. 2 VDC= Valve is 0% open, 10 VDC=valve 100% open)
   i. Position actuator fails to upon a loss of power (i.e. Open, Closed or Fails in Place)
   j. Device power supply source is clear and easily traced.
   k. Jumper settings or similar set up information.
   l. Cable specification requirements.
   m. Cable shielding and its termination requirements.
   n. Location of device in the building (i.e. 2/3 static sensor is above the ceiling in room 101)
   o. All VFD and starter wiring and safety interlocks shall be shown entirely in one location with all wires connected and detailed labeling.
   p. Give reference page number to find the equipment flow diagram and control sequence.
   q. Show a single power wiring detail for each control panel with all power supplies, transformers, etc. with all connected.
   r. Building area served by the controller.
   s. Provide an Excel Spreadsheet electronically and on control drawings listing all controllers in the project with all relevant data. Include at a minimum a column for:

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unit served, building area served, controller part number, controller number, serial number, controller IP address, LAN connected to, controller location, BACnet device object name. Sort the data alphabetically by unit served. Example:

Controller details	
Unit Served	Ahu-5
Area served	Administration
Controller part number	TC-1043-X
Controller number	15
Serial number	abc123
Controller IP Address	10.10.1.115
LAN connected to	Ethernet Switch 3
Controller location	Mech Room 201
BACnet Device Object Name	433Ahu5Admin
Current communication status	Online

t. For each controller, provide an Excel spreadsheet electronically and on control drawings listing the details of all point data in columns shown in example spreadsheet. Include at a minimum a column for: point name, current value, terminal, point type, Engr units, device part number, I/O type/range, BACnet object name. Sort by AI, BI, AO, DO numerically. Include lines for all spare points. Example:

Point details for Ahu-5 Controller #15

Point Name	Current Value	Terminal	Type	Engr Units	Device Part number	I/O type/Range	BACnet Object Name
Ahu-5 Room Temperature	73.1 deg	IN-1	AI	deg F	TS-5711-850	10K thermister	Ahu5RoomTemp
Ahu-5 Fan Status	ON	IN-2	BI	On/Off	H800	Current Switch	Ahu5FanStatus
Ahu-5 Return Air RH	53%	IN-3	AI	% RH	HU-224A-1-1	4-20mA=0-100% RH	Ahu5RoomRH
Spare		IN-4					
Ahu-5 Supply Fan Command	ON	OUT-1	BO	On/Off	RIB-121C	Relay	Ahu5FanCommand
Ahu-5 Supply Fan Speed Control	65%	OUT-2	AO	%	VFD	2-10 vdc=0-100%	Ahu5FanSpeedControl
Ahu-5 HW Valve Control	0%	OUT-3	AO	%	B229+LF24-SR-NO	10-2 vdc=0-100% (N.O.)	Ahu5HwValve Control
Ahu-5 CHWS Valve Control	33%	OUT-4	AO	%	B229+LF24-SR-NC	2-10 vdc=0-100% (N.C.)	Ahu5ChwsValveControl

5. Equipment flow diagrams shall:
   a. Reflect all information shown on the design mechanical controls drawings. Flow diagrams in as-builts shall reflect the actual equipment as installed.
   b. The same numbering and identification shown on mechanical design drawings shall be used on the contractors control drawings.
   c. A clear English language description of each point which matches the one shown on the controller detail drawing (i.e. Supply Air Temperature).
   d. For each point display the controller number and point number (i.e. Controller #8, IN-3).
   e. The ductwork or piping shall be single line for clarity. 3-D diagrams are not allowed.
   f. The controller graphic symbols for valves, actuators, sensors, etc. shall be industry standard as approved in advance.
   g. The sequence of operation shall be included with the equipment flow diagrams.
   h. Notations indicating Normally Open or Closed shall be included.
   i. Give reference page number to find the controller details (i.e. “Next Sheet” or “Previous Sheet” is allowed where applicable).
   j. Display the building area served in the title block with the unit number.
6. Network diagrams shall include:
   a. All controllers on the project shall be represented.
   b. List the mechanical equipment each serves.
   c. Controller part number for all devices.

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d. Installation routing of all LAN wiring.
e. BACnet device numbers and MAC addresses.
f. For all devices, give the location, floor and room number where the device is located.
g. Show the diagram in a riser diagram format.
h. Clearly label cable type (i.e. Cat5e, MSTP, Lonworks Bus, etc.).
i. Show All Ethernet switches and routers, servers, laptops, etc.
j. Show Port connection numbers.
k. Show End of Line terminators.
l. All connections are to be complete and show all devices on one sheet.
m. Each device type shall have a unique distinguished graphical appearance.

7. Damper schedules shall include:
   a. HVAC Equipment served (i.e. F-1).
   b. Exact description (i.e. Return Air Damper).
   c. Damper Dimensions - width and height.
   d. Damper manufacturer and part number.
   e. Type – Opposed or Parallel.
   f. Actuator manufacturer and model number.
   g. Actuator torque (inch/pounds).
   h. Quantity.
   i. Spring Return position (N.O., N.C. or Non-Spring).
8. Valve Schedule shall include:
   a. Equipment served.
   b. Building area served.
   c. Exact description (i.e. Ahu-1 Chilled Water).
   d. Valve size.
   e. Quantity.
   f. Design GPM.
   g. CV of valve.
   h. Actual pressure drop calculated.
   i. Valve manufacturer and part number including actuator.
   j. Valve tagging to be done at valve factory.
   k. Indicate 2-way or 3-way.
   l. Control Signal (i.e. 2VDC=Closed, 10 VDC=100% Open).
   m. Power source (i.e. 24 VAC).
   n. Indicate spring return position upon loss of power (N.O., N.C. or Non-Spring).
   o. Rated valve close-off pressure in PSI.
   p. Indicate if actuator is provided with a manual override capability.
9. Submit points list showing each control input and output, the device being controlled, the location of the device, and the symbol or label of the control point in the software. Indicate the point of connection and function where connections are made to equipment with manufacturers' controls.
10. Contactor’s quality assurance procedure shall be a narrative description of point-to-point installation verification procedures and sample of verification forms. Completed point-to-device / device-to-point verification forms are to be furnished by the contractor upon installation completion, prior to any graphics reviews, trending reviews, or on-site

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performance verification performed by the Owner's energy management engineer or commissioning authority.

11. BACnet integrated points shall be coordinated with equipment manufacturers and identified on controls drawings; only those points indicated on contract control drawings and/or cited in Specifications shall communicate to the EMS via BACnet.

B. Coordination with Equipment Manufacturers:

1. Equipment/system manufacturers (DOAS, RTU, Variable Refrigerant Flow Systems, etc.) are required to coordinate control requirements with ATC/EMS prior to submission of equipment shop drawings and letters confirming coordination are to be included with the manufacturers' submittals. EMS contractor shall provide all necessary efforts to assure that equipment for the project are furnished with all controls required for the sequences specified via combination of manufacturers controls, ATC/EMS furnished controls, hardwire interfaces, and BACnet communications.
   a. OEM unit shall have an Occupied/Unoccupied input point and a separate Emergency Shutdown input point. OEM control systems must be able to provide 2 input separate inputs for EMS contractor to perform these functions.
   b. An EMS reset relay input shall be supplied on the factory supplied terminal strip to permit remote cycling of power to the OEM controller for EMS for remote reboot.
   c. EMS contractor shall provide via hardwired EMS points for occupied/unoccupied command, emergency shutdown, and controller remote reset.
   d. All BACnet points shall be shown in gray and all EMS points in black.
   e. If any of these capabilities are not available in the packaged unit, the manufacturer shall provide alternative solution for approval to meet the intended need.
   f. The controller shall be furnished with a standard factory program used successfully on previous projects. Customized programs are not permitted.
2. BAS submittals shall show all controls for all equipment, including those that are furnished by manufacturers and clearly identify the distinction between manufacturer/EMS furnished, factory/field wired, BACnet integrated. EMS submittals shall be prepared and submitted after all HVAC equipment submittals have been approved and shall incorporate the approved equipment submittals into the EMS submittals.

1.09 QUALITY ASSURANCE

A. The BAS system shall be designed and installed, commissioned, and serviced by a manufacturer's authorized installer.

B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.

C. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and not custom designed specially for this project.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in **<<NFPA 70>>**, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Section 15, governing radio frequency electromagnetic interference and shall be so labeled.

F. Comply with **<<NFPA 90A>>**, "Installation of Air Conditioning and Ventilation Systems."

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1.10 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory-mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion.

1.11 COORDINATION

A. Control Wiring: The BAS manufacturer shall be responsible for all BAS and temperature control wiring for a complete and operable system. All wire and cable shall be plenum-rated and shall be in accordance with Division 26 specification sections and all local, state and national codes and ordinances.

B. Where plenum-rated BAS cable is routed in concealed, accessible spaces, the cable may be run in the cable trays or in J-Hooks provided under this section of the specifications. Where plenum-rated BAS cable is routed in exposed or inaccessible areas, it shall be run conduit provided under this section of the specifications.

C. Power Wiring:

1. Power wiring indicated (device and circuit designation indicated) on the drawings shall be provided under Division 26.
2. The BAS manufacturer shall be responsible for power wiring not indicated (device or circuit designation not indicated) on the Drawings. It shall be the BAS manufacturer's responsibility to review the Contract Documents to determine the extent of power wiring included in Division 26 and to provide additional power wiring as required. Work shall be in accordance with Division 26 specifications and all local, state and national codes and ordinances.
3. Where the contractor performing work under this section requires an additional circuit for power wiring to a device or panel under paragraph 2 above, an RFI shall be issued requesting approval to use an available circuit in the nearest panel. Once approval is granted, all wiring and conduit from the breaker to the device or panel shall be provided under this section of the specifications.

D. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. All conduits shall be concealed within walls and above ceilings unless indicated otherwise.

E. Coordinate installation of conduit to avoid cutting of finished surfaces.

F. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

G. Coordinate equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.

H. Coordinate equipment with Division 26 Section “Switchboards” to achieve compatibility with power monitoring and metering devices in that equipment.

I. Refer to Division 1 “General Commissioning Requirements” for Commissioning Plan requirements.

J. The Montgomery County Public Schools mechanical inspector shall be copied on all written correspondence between the Building Automation System Contractor and the Mechanical Contractor concerning corrective items, preliminary findings, and any other issues relating to execution of the automatic temperature controls.

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1.12 TEST AND GUARANTEE

A. Placing in service: Upon completion of the installation, calibrate equipment and verify transmission media operation before system is placed on line. All testing, adjusting, and calibrating shall be completed and systems shall be properly operating prior to acceptance by Owner. Cross check each control point by comparing the control command and the field controlled device, equipment.

B. Prior to final acceptance and authorization for final payment by the Owner, Energy Management Automation System inspections shall be performed as specified in PART 3 of this Section.

C. The entire control system shall be guaranteed free from all mechanical, electrical, and software defects for a period of two (2) years. The Energy Management Automation System (EMS) shall be guaranteed free from all mechanical, electrical, and programming (including graphics) defects for a period of five (5) years. During the two year warranty period, the Controls Contractor shall be responsible for the proper adjustments of all systems, equipment, and apparatus installed by him and do all work necessary to insure efficient and proper functioning of the systems hardware and software. For placing the controls system into warranty, the Controls Contractor shall arrange to meet with the Mechanical Contractor, the Mechanical Engineer, the Commissioning Authority, and the Owner for on-site inspection and demonstration.

D. For the end-of warranty, the Controls Contractor shall arrange to meet with the Owner within thirty (30) days prior to the specified end of the 2-year guarantee period for the purpose of compiling a list of items that require correction under specified guarantees. Should the Contractor fail to schedule the final meeting, then the 2-year controls system Guarantee shall be automatically extended until such time as the meeting takes place; and the Contractor shall be fully responsible for correcting such deficiencies as if they occurred under the original guarantee period.

E. During the additional 3-years guarantee (5 years total) for EMS parts and labor, the EMS Contractor shall be responsible for the repair and/or replacement of defective EMS hardware (Master Building Controller(s) and all Field Device Controller(s) and all EMS components such as sensors, actuators, transducers, relays, etc.) in response to notification of failures issued by MCPS. Where a failure has occurred that necessitates reloading of software, the work shall be performed by the Contractor. Final control devices such as valves, dampers, actuators, etc. shall be subject to the two year warranty only.

F. Over the two year guarantee period, the Contractor shall provide and install all software upgrades released by the manufacturer as applicable to the systems installed. At the end of the warranty period, the Contractor shall have installed the latest version of the software, updates and firmware available (not just the latest update of an old version).

1.13 CONTRACTOR CHECKLIST

A. Provide a checklist to the EMS Office with each invoice and acceptance request milestone. Use the completion checklist that confirms percent completion and edit as needed to include project steps. The goal is to be able to confirm completion status. Contractor to provide spreadsheet electronically in excel and pdf format.

1.14 PERMITS AND INSPECTIONS

A. Contractor shall be responsible for obtaining and paying for electrical permits for any power wiring performed in the execution of the controls work. Certificate of final inspection shall be delivered to the Owner upon completion of the work.

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1.15 SPARE PARTSTHE CONTRACTOR SHALL INCLUDE IN THE CONTROLS BID AN ALLOWANCE FOR SPARE PARTS EQUAL TO 2% OF THE BASE COST OF INSTALLATION; I.E. IF THE CONTRACTOR'S PROPOSED COST FOR THE CONTROLS INSTALLATION IS "X", THE SUBMITTED BID SHALL BE (1.02"X"). THE USE AND APPLICATION OF THE 2% SPARE PARTS ALLOWANCE SHALL BE SOLELY AT THE DISCRETION OF MCPS.

A. The Contractor shall include in the controls bid an allowance for spare parts equal to 2% of the base cost of installation; i.e. if the Contractor's proposed cost for the controls installation is "x", the submitted bid shall be (1.02"x"). The use and application of the 2% spare parts allowance shall be solely at the discretion of MCPS.

B. Contractor shall keep an accounting of the monies charged against the 2% spare parts allowance. When warranty date is officially confirmed, the contractor shall be responsible to maintain a documented accounting of what products were provided to MCPS under the 2% allowance and provide the accounting upon request. Prior to the end of the warranty, the Contractor shall provide a summary spreadsheet and signed documents showing a listing of the charges and a total amount used by MCPS.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers of EMS:
   1. HI Solutions.
   2. Schneider Electric StruxureWare.

B. Manufacturers of ATC Components:
   1. ACI.
   2. BAPI.
   3. Belimo.
   4. Functional Devices (RIB).
   5. Honeywell.
   6. Invensys.
   7. Johnson Controls.
   8. Kele.
   9. Kreuter.
   10. Serta.
   11. Schneider Electric.
   12. Siemens.

C. Control systems shall be installed by:
   1. Control Sources.
   2. Performance Controls.
   3. Pritchett Controls.

D. Controls Contractor shall have qualified service personnel on staff to respond in person at the project site within twenty-four (24) hours of receiving of service call from the Owner to the Contractors' office throughout the guarantee period. A no-heat or emergency condition shall require an immediate response.

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2.02 GENERAL

A. Materials and equipment installed shall be new and shall be approved by the Underwriters' Laboratories, Inc., for installation in each particular case where standards have been established. All basic electronic equipment shall be listed by Underwriters' Laboratories **<<UL 916>>** for energy management and be compliant with ANSI/ASHRAE BACnet Standard 135. Where any item of material or equipment is specified by proprietary name, trade name, or manufacturer, it is understood that the item named, or the equal thereof, is intended, subject to the approval of the Engineers. Any item substituted for that named shall be equal or better in quality, capacity or performance, and shall be suitable for the available space and required arrangement. It shall be the responsibility of the Contractor to furnish any and all data and samples including those of the specified item that the Engineers may require for him to determine the suitability of any substituted item. The approval by the Engineers of any item shall not relieve the Contractor of his responsibility for compliance with the specified requirements of the Specifications.

B. The products supplied and installed shall be standard components regularly manufactured for their intended use and shall have been tested and proven in actual use. Each product type shall be the equipment of a single manufacturer.

2.03 BAS/EMS COMPUTER HARDWARE

A. System Description: The control system shall consist of a high-speed, peer-to-peer network of DDC controllers, a control system server, and a web-based operator interface. System software shall be based on a server/thin client architecture, designed around the open standards of web technology. The control system server shall be accessed using a Web browser over the control system network, the owner's Ethernet-based, wide area network (WAN), and over the Internet. System shall use BACnet protocol for communication to the operator workstation, web server, and between control modules.

1. MCPS WAN: Internet-based network connecting multiple facilities with a central data warehouse and server, accessible via standard web-browser. This is an existing infrastructure and contractor is not required to configure any components of this WAN. Connection of a building's automation system to the WAN shall be at a single location with a single IP address.
2. Local Supervisory LAN: The Local Supervisory LAN shall be an Ethernet-based, 10/100 Mbps LAN connecting Primary Control LANs and OWSs. The LAN serves as the inter-BC gateway and OWS-to-BC gateway and communications path and as the connection point for the MCPS WAN.
3. Primary Controller LAN: High-speed, peer-to-peer communicating BACnet IP LAN used to connect the central MCPS BACnet Advanced Operator Workstation server to the BACnet Network and Building Controllers (BCs), Advanced Application Controllers (AACs), and Application Specific Controllers (ASCs) exclusively communicating control information. All networks shall be BACnet IP at all levels including terminal controllers.
4. Contractor shall provide Local Supervisory and Primary Controller LANs. LAN shall be **<<IEEE 802.3>>** Ethernet over Category 5E cable with switches and routers that support up to 1000 Mbps throughout. Exception: In cases where the EMS is enabling/disabling equipment via EMS with manufacturer's factory unit controls and an IP BACnet interface is confirmed in writing from the manufacturer as not available, RS485 BACnet wiring interface may be required to these units once approved by MCPS. These special cases shall be separated from the rest of the network and on its own branch of the LAN. Ethernet cable color shall be orange.
5. BACnet IP to be used at all network levels including terminal units. These shall be on a private LAN that allows controlled access from the MCPS network.

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6. Networking to equipment manufacturers packaged controls shall be on a separate communication bus from standard EMS controllers.

B. Remote Data Access: The system shall support the following methods of remote access to the building data.
   1. Browser-based access: Thin-client architecture to provide complete access to the control system via a Web browser. No special software other than a web browser shall be required to access graphics, point displays, and trends, configure trends, configure points and controllers, or to download programming into the controllers.
   2. Mobile device: Access via Web browser on mobile device with Android 2.3.3 or higher and Apple iOS 6 or higher operating systems.
   3. Must be able to connect remotely to the school EMS via a MCPS provided mobile broadband connection to the internet, with full access to all features. This will be used to allow access when the building loses power or internet connections are lost or as needed.

C. Performance Standards: System shall conform to the following minimum standards over network connections.
   1. Graphics shall display a minimum of 20 dynamic points with current data within 10 seconds and automatically refresh within every 15 seconds.
   2. Devices shall react to command of a binary object or begin reacting to command of an analog object within 10 seconds.
   3. An object that goes into alarm shall be annunciated at the workstation within 45 seconds.
   4. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per second.
   5. System shall report values with minimum end-to-end accuracy per “Electronic Sensors” article of this specification section.

D. Control System Server (CSS): Server specs must be per manufacturer’s recommendations and MCPS current server recommendations. Continue all such upgrades through the warranty period.
   1. The server shall conform to BACnet Advanced Workstation (B-AWS) device profile as specified in ASHRAE/ANSI 135 BACnet Annex L. Server shall reside on Owner’s WAN. Each standard browser connected to server shall be able to access all system information.
   2. Industry-standard hardware shall meet or exceed DDC system manufacturer’s recommended specifications and shall meet response times specified.
      a. Hard disk shall have sufficient memory to store a DDC database at least twice the size of the delivered systems databases and one year of trend data based on the points specified to be trended at their specified trend intervals.
      b. Provide additional hardware (serial, parallel, and network communication ports, video drivers, network interface cards, cabling, etc.) to facilitate all control functions and software requirements specified for the DDC system.

E. BACnet Network Controller (NC):
   1. The BACnet Building Network Controller shall contain its own microprocessor, RAM, battery, real-time clock, communication ports, and power supply. Battery shall provide for minimum 100 hour backup of all programs and data in RAM. The battery shall be sealed and self-charging. The network controller shall have a minimum of 4GB of storage space. All programming and stored data shall be retained in the event of a power loss, the controller’s non-volatile memory shall never lose program or configuration settings. Built-in rechargeable batter or capacitor maintains RAM memory for non-essential data only (i.e. trend logs). Upon restoration of power, all systems shall operate normally. While

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UPS power supplies are required, retaining programming shall not be dependent on those devices.

2. NC shall allow centralized overall system supervision, operator interface, management report generation, alarm annunciation, acquisition of trend data, and communication with control units. NC shall provide a thin-client graphical user interface to the BAS.
   a. Local Access: The network controller shall support local operator access using standard web browsers.
   b. Remote Access: A high-speed connection from the NC to MCPS WAN for remote operator access to the BAS using the standard web browsers.
   c. Standard web browsers minimally include Microsoft Internet Explorer, Mozilla Firefox, Google Chrome, and Apple Safari.
3. NC shall support the following communication protocols at a minimum:
   a. ASHRAE 135-2008 BACnet
      1) Point-to-Point (PTP)
      2) Master Slave/Token Passing (MS/TP)
      3) Ethernet
      4) BACnet IP (B/IP)
   b. Modbus RTU and TCP
   c. Simple Mail Transfer Protocol (SMTP)
   d. Simple Network Management Protocol (SNMP)
   e. Hyper Text Transfer Protocol (HTTP)
4. NC shall allow system operators to perform the following functions from the CSS, OWSs, and laptops:
   a. Configure systems.
   b. Monitor and supervise control of all points.
   c. Change control setpoints.
   d. Override input values.
   e. Override output values.
   f. Enter programmed start/stop time schedules.
   g. View and acknowledge alarms and messages.
   h. Receive, store and display trend logs and management reports.
   i. Upload/Download programs, databases, etc. as specified.
5. NC database and all necessary graphical user interface resources including animations are to be stored on the NC. Web-enabled applications that require system graphics to be stored on the client machines will not be acceptable.
6. NC shall support unlimited access by five (5) simultaneous clients.
7. Multiple NC devices shall be capable of being installed on the same BACnet internetwork without any separate server applications, separate network management or additional licensing. Browser clients shall have the ability to access any NC on the internetwork directly.
8. NC shall provide native BACnet communications directly with all BACnet devices on the local network.

F. BACnet Building Controller (BC) (Field Level Controllers)
   1. The BACnet BC(s) shall provide fully distributed control independent of the operational status of the NC and Control System Server (CSS). All necessary calculations required to achieve control shall be executed within the BC independent of any other device. All

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control strategies performed by the BC(s) shall be both operator definable and modifiable through the Operator Interfaces.

2. BCs shall perform overall system coordination, accept control programs, perform automated HVAC functions, control peripheral devices and perform all necessary mathematical and logical functions. BCs shall share information with the entire network of BCs and AACs/ASCs for full global control. Each controller shall permit multi-user operation from multiple workstations and portable operator terminals connected either locally or over the Primary Controller LAN. Each unit shall have its own internal RAM, non-volatile memory, microprocessor, battery backup, regulated power supply, power conditioning equipment, ports for connection of operating interface devices, and control enclosure. BCs shall be programmable from an operator workstation or portable operator terminal. BC shall contain sufficient memory for all specified global control strategies, user defined reports and trending, communication programs, and central alarming.
3. BCs shall be connected to Primary Controlling BACnet IP LAN.
4. All BCs shall be protected from any memory loss due to a loss of power by one or a combination of the following:
   a. Volatile RAM, where allowed for lower priority or temporary data, shall have a battery backup using a lithium battery with a rated service life of one hundred (100) hours, and a rated shelf life of at least five years. Self-diagnostic routine shall report an alarm for a low battery condition.
   b. EEPROM, EPROM, or NOVROM non-volatile memory.
   c. All programming and stored data shall be retained in the event of a power loss, the controller's non-volatile memory shall never lose program or configuration settings. Built-in rechargeable batter or capacitor maintains RAM memory for non-essential data only (i.e. trend logs). Upon restoration of power, all systems shall operate normally. While UPS power supplies are required, retaining programming shall not be dependent on those devices.
5. BC shall execute application programs, calculations, and commands via a microprocessor resident in the BC. The database and all application programs for each BC shall be stored in non-volatile or battery backed volatile memory within the BC and will be able to upload/download to/from the OWS and/or CSS. All BC point data, algorithms and application software shall be modifiable from the Operator Workstation.
6. BC shall provide buffer for holding alarms, messages, trends etc.
7. BC shall include self-test diagnostics, which allow the BC to automatically alarm any malfunctions, or alarm conditions that exceed desired parameters as determined by programming input.
8. BC shall contain software to perform full DDC/PID control loops.
9. Input-Output Processing:
   a. Digital Outputs (DO): Outputs shall be rated for a minimum 24 Vac or Vdc, 1 amp maximum current. Each shall be configurable as normally open or normally closed. Each output shall have an LED to indicate the operating mode of the output and a manual HOA switch to allow for override. Each DO shall be a discrete output from the BC's board (multiplexing to a separate manufacturer's board is unacceptable). Provide suppression to limit transients to acceptable levels.
   b. Analog Outputs (AO): AO shall be O-5 Vdc, 0-10 Vdc, and 4-20 mA. Provide zero and span calibration and circuit protection. D/A converters shall have a minimum resolution of 10 bits.
   c. Analog Inputs (AI): AI shall be O-5 Vdc, 0-10 Vdc, and 4-20 mA. Provide signal conditioning, and zero and span calibration for each input. Each input shall be a

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discrete input to the BC's board (multiplexing to a separate manufacturers board is unacceptable). A/D converters shall have a minimum resolution of 12 bits.

d. Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the BC and shall be isolated from the main board. Software multiplexing of an AI and resistors may only be done in non-critical applications and only with prior approval of Architect/Engineer.

e. Universal: Universal inputs or universal outputs configured on hardware and/or in software to serve as either analog or digital as specified above.

f. Each input/output shall have 24VAC over-voltage and short protection and LED indicator.

g. Each output point (analog and digital) shall have on-board integral physical Hand-Off-Auto (H-O-A) switch. H-O-A switch position shall be monitored and displayed in programming. Include this for all controllers except terminal units (VAV, FCU, etc.). If each controller has a built-in display that permits overrides as described here, that is an acceptable alternative.

10. A communication port for operator interface through a terminal shall be provided in each BC. It shall be possible to perform all program and database back-up, system monitoring, control functions, and BC diagnostics through this port. Standalone BC panels shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems or workstations.
11. Each BC shall be equipped with loop tuning algorithm for precise proportional, integral, derivative (PID) control. Loop tuning tools provided with the Operator Workstation software is acceptable. In any case, tools to support loop tuning must be provided such that P, I, and D gains are automatically calculated.
12. All analog output points shall have a selectable failure setpoint. The BC shall be capable of maintaining this failure setpoint in the event of a system malfunction, which causes loss of BC control, or loss of output signal, as long as power is available at the BC. The failure setpoint shall be selectable on a per point basis.
13. Slope intercepts and gain adjustments shall be available on a per-point basis.
14. BC Power Loss:
    a. Upon a loss of power to any BC, the other units on the primary controlling network shall not in any way be affected.
    b. Upon a loss of power to any BC, the battery backup shall ensure that the energy management control software, the Direct Digital Control software, the database parameters, and all other programs and data stored in the RAM are retained for a minimum of one hundred (100) hours. An alarm diagnostic message shall indicate that the BC is under battery power.
    c. Upon restoration of power within the specified battery backup period, the BC shall resume full operation without operator intervention. The BC shall automatically reset its clock such that proper operation of any time dependent function is possible without manual reset of the clock. All monitored functions shall be updated.
    d. Should the duration of a loss of power exceed the specified battery back-up period or BC panel memory be lost for any reason, the panel shall automatically report the condition (upon resumption of power) and be capable of receiving a download via the network and connected computer. In addition, the Owner shall be able to upload the most current versions of all energy management control programs, Direct Digital Control programs, database parameters, and all other data and programs in the memory of each BC to the operator workstation, system server, or local interface laptop.
15. BC Failure:

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a. Building Controller LAN Data Transmission Failure: BC shall continue to operate in stand-alone mode. BC shall store loss of communication alarm along with the time of the event. All control functions shall continue with the global values programmable to either last value or a specified value. Peer BCs shall recognize the loss, report alarm and maintain the LAN.

b. BC Hardware Failure: BC shall cease operation and terminate communication with other devices. All outputs shall go to their specified fail position.

16. Each BC shall be equipped with firmware resident self-diagnostics for sensors and be capable of assessing an open or shorted sensor circuit and taking an appropriate control action (close valve, damper, etc.).
17. A minimum of four levels of password protection shall be provided at each BC.
18. BCs shall be mounted on equipment, in packaged equipment enclosures, or wall mounted in a NEMA 1 enclosure, as specified elsewhere.

G. BACnet Advanced Application Controller (AAC) and Application Specific Controller (ASC)

1. AACs and ASCs shall provide intelligent, standalone control of HVAC equipment. AACs and ASCs shall have peer-to-peer network communications with each other and all other controllers on the BACnet Primary LAN. Each unit shall have its own internal RAM, non-volatile memory and will continue to operate all local control functions in the event of a loss of communications. Controllers shall connect to the LAN via a CAT5E rated connector via BACnet IP.
2. Each AAC and ASC shall include self-test diagnostics that allow the AAC/ASC to automatically relay to the network any malfunctions or abnormal conditions within the controller or alarm conditions of inputs that exceed desired parameters as determined by programming input.
3. AACs and ASCs shall include sufficient memory to perform the specific control functions required for its application and to communicate with other devices.
4. Each AAC and ASC must be capable of stand-alone direct digital operation utilizing its own processor, non-volatile memory, input/output, minimum 8 bit A to D conversion, voltage transient and lightning protection devices. All volatile memory shall have a battery backup of at least fifty (50) hours with a battery life of five years. All programming and stored data shall be retained in the event of a power loss, the controller's non-volatile memory shall never lose program or configuration settings. Built-in rechargeable batter or capacitor maintains RAM memory for non-essential data only (i.e. trend logs). Upon restoration of power, all systems shall operate normally. While UPS power supplies are required, retaining programming shall not be dependent on those devices.
5. All point data; algorithms and application software within an AAC/ASC shall be modifiable over the BACnet network. Control systems that utilize 'canned' programs or programmable read only memory (PROM) level application programming are not acceptable.
6. AAC and ASC Input-Output Processing:
   a. Digital Outputs (DO): Outputs shall be rated for a minimum 24 VAC or VDC, 1 amp maximum current. Each shall be configurable as normally open or normally closed. Each output shall have an LED to indicate the operating mode of the output. Each DO shall be a discrete output from the AAC/ASC's board (multiplexing to a separate manufacturer's board is unacceptable). Provide suppression to limit transients to acceptable levels.
   b. Analog Outputs (AO): AO shall be 0-5 Vdc, 0-10 Vdc, 4-20 mA. Provide zero and span calibration and circuit protection. D/A converters shall have a minimum resolution of 8 bits.

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c. Analog Inputs (AI): AI shall be 0-5 Vdc, 0-10Vdc, and 4-20 mA. Provide signal conditioning, and zero and span calibration for each input. Each input shall be a discrete input to the AAC/ASC's board (multiplexing to a separate manufacturers board is unacceptable). A/D converters shall have a minimum resolution of 8-10 bits depending on application.

d. Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the AAC/ASC and shall be isolated from the main board. Software multiplexing of an AI and resistors may only be done in non-critical applications and only with prior approval of Engineer.

e. Universal: Universal inputs or universal outputs configured on hardware and/or in software to serve as either analog or digital as specified above.

f. Each input/output shall have 24VAC over-voltage and short protection.

g. Each output shall have on-board integral physical Hand-Off-Auto (H-O-A) switch. H-O-A switch position feedback shall be monitored and displayed. Points to terminal unit controllers serving VAV's, FCU's, UV's, CUH's, WSHP's are exempted and do not require H-O-A switches.

7. AACs/ASCs shall be mounted on equipment, in packaged equipment enclosures, or wall mounted in a NEMA 1 enclosure, as specified elsewhere.

8. Terminal Unit Controllers: Terminal Unit Controllers are ASCs that may be hardware and software dedicated for the controlled terminal equipment with only ROM and EEPROM memory; battery back-up need not be provided. Controllers shall communicate on the BACnet Primary LAN and shall continue to operate upon loss of LAN communication. Each controller shall contain all intelligence, and analog and digital input/output control points required for hardware and software points and sequence specified. Optimization, warm-up/cool-down, and night set-back/set-up shall be performed by terminal unit controller with appropriate inputs from the LAN such as outdoor air temperature, zone schedules, summer/winter operation, etc. Unit controllers shall be furnished with enclosures and enclosures shall be plenum rated when ceiling located.

H. Expansion Modules

1. Input/output expansion modules shall have a minimum of 10 universal inputs, 8 universal outputs. Building Controller (BC) expansion module outputs shall be equipped with H-O-As and potentiometers.

2. Input expansion modules shall have a minimum of 16 universal inputs.

3. Only one expansion module per controller.

I. Override Panel:

1. Touch screen override panel shall have building floor plans graphics with control zones represented and identified. The operator shall be able to manually override the "OFF" Scheduled Start/Stop Zones. The program shall permit operator selection of zones and shall enable all related equipment for that particular zone. The program shall index the selected zone to an "ON" mode in a minimum of one-hour increments for a period of up to three hours in the override condition. Once overridden, the zone equipment shall operate in the occupied mode, including exhaust fan interlocks.

2. The graphic shall be served from the MCPS server and accessible from a standard browser and mobile device anywhere on the network. Provide school level password protection in order to access and activate overrides, but limits access to that school's override screens only.

3. Provide a tablet PC equivalent to a Microsoft Surface Pro to be set in Kiosk mode, mounted in wall enclosure. Include Intel Core i5-8GP and 128 GB solid state hard drive, screen size 12.3" Screen Resolution 2736 x 1824. Front camera 5 megapixel and back camera 8 megapixel. Provide with administrator and user level password to get out of

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kiosk mode. Include power supply. Mount tablet PC in Admin workroom in a locking mount (location to be coordinated with MCPS Energy Management).

J. Portable Operator Terminal (Laptop Computer): Portable Operator Terminal shall support system management by connection to the controllers, by connection via the Internet, and by dial-up communications while serving as the remote workstation.
   1. Provide one notebook personal computer (PC) with minimum Intel i5 processor, 2.66 GHz, 15" 1080p minimum display, Include 12 GB RAM and one 512 GB solid state hard drive. Provide 32 MB graphics card with 1080p resolution or better, minimum Three USB ports, 10/100 Base-T network card and CD-RW/DVD ROM Combo Drive. Meet factory software manufacturer's recommended specifications. Desktop is not Acceptable.
   2. Provide with a battery that will power the computer for a minimum of 8 hours.
   3. Provide a 10/100 LAN+56K CardBus Type III PC Card or USB to Internet adaptor.
   4. Provide minimum VGA active matrix display. 15" 1080p display.
   5. Laptop with Bluetooth 4.1 and wireless capable (dual band preferred).
   6. Provide carrying case, extra battery, and all required cables.
   7. Operating system shall be latest professional version of Microsoft Windows supported by BAS manufacturer. Provide the latest version of Microsoft Excel and Word software on the POT that is fully and permanently licensed. All software shall be at least the latest version available as of the date of contract completion; and at the end-of-warranty.
   8. Provide software, graphics and programming as specified herein after.
   9. Provide additional hardware, video drivers, etc., to facilitate all control functions and software requirements specified for the building automation system.
   10. Provide all controller configuration and interface software and/or plug ins for all devices applicable. All shall be loaded and functional. Provide all required interface cables required to connect to all networks, routers, controllers, etc.
   11. Wherever a POT connection point is not provided accessible in the same room as the device controlled, contractor shall provide a wireless system to permit configuration, testing and operation from within the room. Wireless system shall have the range to reliably communicate with the most remote room
   12. A POT (laptop) entirely compatible with the EMSs being installed for this contract shall be furnished.
   13. The POT shall be furnished with all the updated databases for the MCPS energy management systems installations previously completed by the contractor.

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2.04 EMS SOFTWARE

A. GENERAL:
   1. Functionality and Completeness: The Contractor shall furnish and install all software and programming necessary to provide a complete and functioning system as specified. The Contractor shall include all software and programming not specifically itemized in these Specifications, which is necessary to implement, maintain, operate, and diagnose the system in compliance with these Specifications.
   2. Configuration: The software shall support the system as a distributed processing network configuration.
   3. Licensing:
      a. Include licensing for all software packages at all required workstations. EMS licensing shall allow unlimited simultaneous users for access to all aspects of the system including system access, workstations, points, programming, database management, graphics etc. No restrictions shall be placed on the licensing. All operator interface, programming environment, networking, database management

and any other software used by the Contractor to install the system or needed to operate the system to its full capabilities shall be licensed and provided to the Owner.

b. All software shall be available on all Operator Workstations, Control System Servers, and Portable Operator Terminals. Provide all required hardware and software rights keys. Provide all required third-party software licenses. At least 2 sets of CDs shall be provided with backup software for all software provided so that the Owner may reinstall any software as necessary.

c. Upgrade all software packages to the release (version) in effect at the end of the Warranty Period.

4. Interoperability: System shall be capable of supporting interoperability utilizing BACnet objects over MS/TP and/or IP. Communication networks to BACnet controllers within each building shall normally be by the Controls Contractor MS/TP and not be reliant on MCPS IT network drops. BACnet IP connections to equipment may be employed under special circumstances, but require prior approval by MCPS Energy Management personnel.

5. A new software point naming standard shall be provided by MCPS upon request. All point naming implemented on the project shall follow this standard and must be approved by MCPS. This also applies to controller naming, folder naming, etc.

6. All controller naming in software must follow standards and as approved by MCPS. The naming must identify the school and the item of equipment controlled.

7. Select controllers with ample programming capacity such that upon completion no more than 50% of the programming space and memory usage is taken. This is to allow for future expansion.

B. CONTROLLERS:

1. Building Controller Software Residency: Each BC shall be capable of control and monitoring of all points physically connected to it. All software including the following shall reside and execute at the BC:

a. Real-Time Operating System software

b. Real-Time Clock/Calendar and network time synchronization

c. BC diagnostic software

d. LAN Communication software/firmware

e. Direct Digital Control software

f. Alarm Processing and Buffering software

g. Energy Management software

h. Data Trending, Reporting, and Buffering software

i. I/O (physical and virtual) database

j. Remote Communication software

2. AAC/ASC Software Residency: Each AAC/ASC shall be capable of control and monitoring of all points physically connected to it. As a minimum, software including the following shall reside and execute at the AAC/ASC.

a. Real-Time Operating System software

b. AAC/ASC diagnostic software

c. LAN Communication software

d. Control software applicable to the unit it serves that will support a single mode of operation

e. I/O (physical and virtual) database to support one mode of operation.

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3. Stand Alone Capability: BC shall continue to perform all functions independent of a failure in other NC/BC/AAC/ASC or other communication links to other BCs/AACs/ASCs. Trends and runtime totalizing shall be retained in memory. Runtime totalizing shall be available on all digital input points that monitor electric motor status.
4. Operating System: Controllers shall include a real-time operating system resident in ROM. This software shall execute independently from any other devices in the system. It shall support all specified functions. It shall provide a command prioritization scheme to allow functional override of control functions.
5. Network Communications: Each controller shall include software/firmware that supports networking on the BACnet LAN. Network support shall include the following:
    a. Building Controller/Primary LAN shall be a high-speed network designed and optimized for control system communication. If a Primary LAN communications trunk is severed, BCs shall reconfigure into two separate LANs and continue operations without interruption or Operator intervention.
    b. Controller communication software shall include error detection, correction, and re-transmission to ensure data integrity.
    c. Operator/System communication software shall facilitate communications between other BCs, all subordinate AACs/ASCs, Network Controller and LAN Interface Devices or Operator Workstations. Software shall allow point interrogation, adjustment, addition/deletion, and programming while the controller is on line and functioning without disruption to unaffected points. The software architecture shall allow networked controllers to share selected physical and virtual point information throughout the entire system.
6. Point Database/Summary Table: All points included in the typical equipment point list must be represented in a common, open protocol format. All points should be provided as BACnet standard analog, binary, schedule, or trend objects. Point/system database creation and modification shall be via a user-friendly, menu-driven program. System software shall support virtual or logic point (points not representing a physical I/O) creation. Software shall support virtual points with all services specified herein. Database software shall support definition of all parameters specified for a given point type. If database does not support all parameters software module shall be created and attached to the points which accomplish the respective function.
7. Diagnostic Software: Controller software shall include diagnostic software that checks memory and communications and reports any malfunctions.
8. Alarm/Messaging Software: Controller software shall support alarm/message processing and buffering software.
9. Application Programs: Controllers shall support and execute application programs. All Direct Digital Control software, Energy Management Control software, and application programming software templates shall be provided in a ‘ready-to-use’ state, and shall not require (but shall allow) Owner programming.
10. Security: Controller software shall support multiple level password access restriction as more fully specified below.
11. Direct Digital Control: Controller shall support application of Direct Digital Control Logic. All logic modules shall be provided pre-programmed with written documentation to support their application. Provide the following logic modules as a minimum:
    a. Proportional-Integral-Derivative (PID) control with analog and floating output
    b. Two Position control (Hi or Low crossing with deadband)
    c. Single-Pole Double-Throw relay
    d. Delay Timer (delay-on-make, delay-on-break, and interval)
    e. Hi/Low Selection

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f. Reset or Scaling Module
g. Logical Operators (And, Or, Not, Xor)

12. Psychrometric Parameters: Controller software shall provide preprogrammed functions to calculated and present psychrometric parameters (given temperature and relative humidity) including Enthalpy and Wet Bulb Temperature as a minimum.
13. Updating/Storing Application Data: Site-specific programming residing in volatile memory shall be uploadable/downloadable from an OWS or CSS connected locally, to the Primary LAN, to the Local Supervisory LAN and remotely via the internet and modem and telephone lines as applicable but all must be available. Initiation of an upload or download shall include all of the following methods: Manually, Scheduled, and Automatically upon detection of a loss or change.
14. Restart: System software shall provide for orderly shutdown upon loss of power and automatic restart upon power restoration. Volatile memory shall be retained; outputs shall go to programmed fail (open, closed, or last) position. Equipment restart shall include a user definable time delay on each piece of equipment to stagger the restart. Loss of power shall be alarmed at operator interface indicating date and time.
15. Time Synchronization: Operators shall be able to set the time and date in any device on the network that supports time-of-day functionality. The operator shall be able to select to set the time and date for an individual device, devices on a single network, or all devices simultaneously. Automatic time synchronization shall be provided.
16. Misc. Calculations: System software shall automate calculation of psychometric functions, calendar functions, kWh/kW, and flow determination and totalizing from pulsed or analog inputs, curve-fitting, look-up table, input/output scaling, time averaging of inputs and A/D conversion coefficients.
17. Application Programming: Application software shall be user programmable. General approaches to application programming shall be provided by one, or a combination, of the following conventions:
    a. Point Definition: provide templates customized for point type, to support input of individual point information. Use standard BACnet Objects as applicable.
    b. Graphical Block Programming: Manipulation of graphic icon ‘blocks’, each of which represents a subroutine, in a functional/logical manner forming a control logic diagram. Blocks shall allow entry of adjustable settings and parameters via pop-up windows. Provide a utility that shall allow the graphic logic diagrams to be directly compiled into application programs. Logic diagrams shall be viewable either off-line, or on-line with real-time block output values.
    c. Functional Application Programming: Pre-programmed application specific programs that allow/require limited customization via ‘fill-in-the-blanks’ edit fields. Typical values would be setpoints gains, associated point names, alarm limits, etc.
    d. Line Programming: Textual syntax-based programming in a language similar to BASIC designed specifically for HVAC control. Subroutines or functions for energy management applications, setpoints, and adjustable parameters shall be customizable, but shall be provided preprogrammed and documented.
    e. Provide a means for testing and/or debugging the control programs both off-line and on-line.
    f. Within the programming environment, provide clear text documentation of programming at each step of control logic which explains and clarifies the operation. Include an explanation of loop set up parameters clarifying hot it is tuned.

C. SYSTEM:
1. Energy Management Applications: System shall have the ability to perform all of the following energy management routines via preprogrammed function blocks or template

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programs. All programs shall be executed automatically without the need for operator intervention, and shall be flexible enough to allow operator customization. As a minimum provide the following whether or not required in the software:

a. Time-of-Day Scheduling (include mass scheduling via single schedule for all HS, MS, ES sites) Provide capability to permit BACnet schedule broadcasts to multiple sites.
b. Calendar-Based Scheduling
c. Holiday Scheduling
d. Temporary Schedule Overrides
e. Optimal Start/Optimal Stop-based on space temperature offset, outdoor air temperature, and building heating and cooling capacitance factors as a minimum
f. Night Setback and Morning Recovery Control, with ventilation only during occupancy
g. Economizer Control (enthalpy or dry-bulb)
h. Peak Demand Limiting / Load Shedding
i. Dead Band Control
j. The programming modifications can be accomplished in the workstations or system server.

2. Password Protection: Password must be Scalable: one login to all sites. Once logged in, user can access any school without logging in again. Adding or editing a password can be done one time for all schools. Passwords will be automatically distributed to and retained on each site's BC.
   a. Multiple-level password access protection shall be provided to limit workstation control, display and database manipulation capabilities as deemed appropriate for each user, based upon an assigned user name with a unique password.
   b. All passwords for the system shall be provided to the Owner including administrator, dealer, or factory level passwords.
   c. Passwords shall restrict access to all Control Units.
   d. Each user name shall be assigned to a discrete access level. A minimum of five levels of access shall be supported. Alternately, a comprehensive list of accessibility/functionality items shall be provided, to be enabled or disabled for each user.
   e. A minimum of 20 user names shall be supported and programmed per Owner's direction.
   f. Operators shall be able to perform only those commands available for the access level assigned to their user name.
   g. User-definable, automatic log-off timers of from 1 to 60 minutes shall be provided to prevent operators from inadvertently leaving interface device software on-line.
3. Alarm and Event Management Reporting:
   a. Alarm management shall be provided to monitor, buffer, and direct alarms and messages to operator devices and memory files. Each BC shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic, and prevent alarms from being lost. At no time shall a BC's ability to report alarms be affected by either operator activity at an Operator Workstation or local handheld device, or by communications with other panels on the network.
      1) Alarm Descriptor: Each alarm or point change shall include that point's English language description, and the time and date of occurrence. In addition to the alarm's descriptor and the time and date, the user shall be able to print, display and store an alarm message to more fully describe the alarm condition or direct operator response.

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2) Alarm Prioritization: The software shall allow users to define the handling and routing of each alarm by their assignment to discrete priority levels. Critical alarms, as defined herein after, shall be discrete from all other alarms. Users shall have the ability to manually inhibit alarm reporting for each individual alarm and for each priority level.

3) Alarm Report Routing: Each alarm priority level shall be associated with a unique user-defined list of operator devices including any combination of local or remote workstation, storage devices, cell phones, tablets. All alarms associated with a given priority level shall be routed to all operator devices on the user-defined list associated with that priority level unless directed otherwise by owner operators. For each priority level, alarms shall be automatically routed to a default operator device in the event that alarms are unable to be routed to any operator device assigned to the priority level.

4) Alarm Routing: System shall be capable of sending critical alarms text messages to operators' cell phones and tablets. Text messaging shall be configurable such that messages may only be sent during periods when the central energy management office is not manned. (Note: Intent is to continue to have all "alarm" conditions turn red on graphics screens and to continue to graphically display critical alarms as currently handled. Systems are to be capable of sending critical alarms text messages to cell phones & tablets, and if so directed by MCPS, to only send text messages at times and to phones/tablets designated by MCPS.)

b. It shall be possible for any operator to receive a summary of all alarms regardless of acknowledgement status; for which a particular recipient is enrolled for notification; based on current event state; based on the particular BACnet event algorithm (e.g. change of value, change of state, out of range, and so on); alarm priority; and notification class.

c. Alarm Historical Database: The database shall store all alarms and events object occurrences allowing applications to access the data using standard Microsoft Windows Data Services.

4. Trending:

a. The software shall display historical data in both a tabular and graphical format. The requirements of this trending shall include the following:

1) Provide trends for all physical points, virtual points and calculated variables.

2) The sample rate and data selection shall be selectable by the operator.

3) The trended value range shall be selectable by the operator.

b. Controllers incorporating PID control loops shall also provide for high resolution sampling in less than six second increments for verification of control loop performance.

c. Trend data shall be buffered at the BC, and uploaded to hard disk storage when archival is desired, required, or scheduled. Uploads shall occur based upon a user-defined interval, manual command, or automatically when the trend buffers become full.

d. Provide a time master that is installed and configured to synchronize the clocks of all devices supporting time synchronization. Synchronization shall be done using Coordinated Universal Time (UTC). All trend sample times, including BACnet connected controllers, shall be able to be synchronized. The frequency of time synchronization message transmission shall be selectable by the operator.

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e. Provide capability to quickly generate an all points summary report showing the current value of all points or in logical groups as selected by the operator. Must be capable of exporting data to a spreadsheet format.

5. Data Acquisition and Storage
   a. All points included in the typical equipment point list must be represented in a common, open or accessible format.
   b. Data from the EMS shall be stored in relational database format. The format and the naming convention used for storing the database files shall remain consistent across the database and across time. The relational structure shall allow for storage of any additional data points, which are added to the EMS in future. The descriptions of the tables, columns, domains, and constraints shall be provided for each database.
   c. The database shall allow applications to access the data while the database is running. The database shall not require shutting down in order to provide read-write access to the data. Data shall be able to be read from the database without interrupting the continuous storage of trend data being carried by the EMS.
   d. The database shall allow applications to access the data via Microsoft Windows standard data access services.
6. Totalizing
   a. The software shall support totalizing analog, digital, and pulsed inputs and be capable of accumulating, storing, and converting these totals to engineering units used in the documents. These values shall generally be accessible to the Operator Interfaces to support management-reporting functions.
   b. Totalizing of electricity use/demand shall allow application of totals to different rate periods, which shall be user definable.
   c. When specified to provide electrical or utility Use/Demand, the Contractor shall obtain from the local utility all information required to obtain meter data, including K factors, conversion constants, and the like.
7. Scheduling:
   a. Provide a graphic utility for user-friendly operator interface to adjust all operating schedules.
   b. Scheduling feature shall include multiple seven-day master and regular schedules, plus holiday, special, and “snow day” schedules. Each type of schedule shall have start time and stop time. Normal conventions shall be that “stop”, “unoccupied”, or “off” shall place the controlled building/zone/equipment in the unoccupied mode; “start”, “occupied”, or “on” shall place the controlled building/zone/equipment in the occupied mode. Default of the schedule shall be “off” (stop, unocc); operator entries shall be required to schedule equipment “on” (start, occ).
   c. Equipment shall be assigned to Zone schedules. Each and all zones shall be controllable by any of the five types of schedules in any combination and the schedules shall operate concurrently.
   d. Provide the ability to group user selected Zones for simultaneous scheduling. Intent is for user to be able enter a schedule that will be applied to multiple zones without having to either copy and paste schedule from one zone to another; e.g. user shall be able to select Zones 1, 3, & 5 and enter a schedule that applies to those zones while not impacting the schedules for non-selected zones.
   e. Schedule Types:
      1) Master Schedule: Provide a repeatable 7-day master schedule. All zones assigned to the Master Schedule shall respond to the daily on/off entered in that schedule. Each day schedule shall be able to have multiple on/off times. This schedule is construed as that which controls the building on a regular, daily

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basis. Each building shall be provided with 10-month and 12-month Master schedules.

2) Regular Schedule: Provide repeatable 7-day Regular schedules for each Zone. Each day of the schedule shall function with multiple on/off times. Regular schedules shall be used to provide “on” times in addition to those scheduled in the Master schedule.

3) Holiday Schedule: Holiday schedules shall temporarily modify the Master and Regular schedules. It shall be possible to schedule holidays a year in advance. Holidays shall be entered by date; Master and Regular schedules shall respond to the holiday schedule for the date entered.

4) Special event schedules are accomplished through built-in capabilities of BACnet schedule objects using a higher priority level to supersede other schedules.

5) "Snow Day" Schedule: Provide a single point command accessible to the Energy Management personnel so that when the "Snow day" command is issued, all assigned schools are placed in their local "snow day" schedules.

6) Include capability for mass Scheduling value using a higher priority that supersedes other schedules including chiller lockout. Operator can set one schedule and send it to multiple schools as selected in one operation.

f. A yearly calendar feature shall allow assignment of holidays and automatic reset of system real time clocks for transitions between daylight savings time and standard time.

g. Schedules shall reside in building controllers, not on the system server.

8. Operator Interface Graphic Software

a. Graphic software shall facilitate user-friendly interface to all aspects of the System Software. The intent of this specification is to require a graphic package that provides for intuitive operation of the systems without extensive training and experience. It shall facilitate logical and simple system interrogation, modification, configuration, and diagnosis.

b. Graphic software shall support multiple simultaneous screens to be displayed and resizable in a ‘Windows’-like environment. All functions excepting text entry functions shall be executable with a mouse.

c. Graphic software shall provide for multitasking such that third-party programs can be used while the OWS software is on line. Software shall provide the ability to alarm graphically even when operator is in another software package.

d. Operating system software shall be latest version of Microsoft Windows supported by the EMS manufacturer.

e. The software shall allow for Owner creation of user-defined, color graphic displays of geographic maps, building plans, floor plans, and mechanical and electrical system schematics. These graphics shall be capable of displaying all point information from the database including any attributes associated with each point (i.e., engineering units, etc.). In addition, operators shall be able to command equipment or change setpoints from a graphic through the use of the mouse.

f. The operator interface shall allow users to access the various system graphic screens via a graphical penetration scheme by using the mouse to select from menus or ‘button’ icons. Each graphic screen shall be capable of having a unique list of other graphic screens that are directly linked through the selection of a menu item or button icon.

g. Dynamic physical point values shall automatically updated at a minimum frequency of 4 updates per minute without operator intervention. Point value fields shall be

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displayed with a color code depicting normal, abnormal, override and alarm conditions.

h. Each displayed point shall be individually enabled/disabled to allow mouse-driven override of digital points or changing of analog points. Such overrides or changes shall occur in the control unit, not just in the workstation software. The graphic point override feature shall be subject to password level protection. Points that are overridden shall be reported and displayed in a coded color. The report message shall include the operator's user name. A list of points that are currently in an override state shall be available through menu selection.

i. Graphic development and generation software shall be provided to allow the user to add, modify, or delete system graphic displays. Contractor shall provide libraries of pre-engineered screens and symbols depicting standard air handling unit and energy recovery unit components (e.g. fans, cooling coils, filters, dampers, heat exchangers, etc.), mechanical system components (e.g., pumps, chillers, cooling towers, boilers, ground water system, etc.), complete mechanical systems (e.g. constant volume-terminal reheat, heat pump, etc.) and electrical symbols. Graphic Development Package shall use a mouse or similar pointing device to allow the user to define symbols, position items on graphic screens, attach physical or virtual points to a graphic, define background screens, define connecting lines and curves; locate, orient and size descriptive text, define and display colors for all elements, establish correlation between symbols or text and associated system points or other displays, create hot spots or link triggers to other graphic displays or other functions in the software.

j. New points displayed on OWS graphic screen shall appear automatically on the identical graphic screen served by the web-server with no further programming or file transfer required.

k. Graphics software must be compatible with Touchscreen Tablet PC.

l. Upon logging in with a lower level access login, access can be restricted to selected graphics only.

D. SET-UP: Specific applications to be provided are as follows:

1. Passwords: Passwords for system access control shall be provided in at least five levels. All higher level passwords can also perform all functions of lower level passwords. Contractor shall assist Owner's operators with assigning user names, passwords and password levels. Levels shall be set up akin to the following; actual extent of level of access shall be coordinated with MCPS Energy Management Supervisor:

a. Level 1 (Administrator): View, add, change and delete user names, passwords, password levels; all unrestricted system capabilities including all network management functions.

b. Level 2: (Programmer): Configure system software, modify control unit programs, modify graphic software; essentially unrestricted except for viewing or modifying user names, passwords, password levels.

c. Level 3: (Senior Technician): Override output points, change setpoints, change equipment schedules, exit BAS software to use third party programs.

d. Level 4: (Technician): Acknowledge alarms, temporarily override equipment schedules.

e. Level 5: (Viewer): View only all graphic displays, trend point data.

2. Trend Analysis Reporting:

a. Trends shall initially be set-up and programmed by the Contractor for 15 minute sampling intervals. Trends shall be stored in an open database that can be imported to third party software. Trends shall be in text spreadsheet style format. (Note: Spec

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requirement for delivering trends for review at hourly intervals prior to walks-thru has not changed.)

b. Seventy two (72) hours of trends shall be constantly run and stored on site in the controller where the points are contained. Trends shall be viewable in real time; i.e. the previous 24 hours shall be viewable commencing with the latest trend stored at the time the operator elects to view trends. Each 24-hour trend shall be automatically saved at the system server.

c. Changing the time interval of trend samples, e.g. from 15 minutes to 1 minute, shall be achievable in blocks; not requiring point-by-point time interval entries. For example, it shall be possible to change the entire building trends from 15 minutes to 1 minute interval by one time interval entry. Similarly, if a select group of trends for a mechanical system, such as all points associated with an air handling unit, are to be changed; the block of selected points shall all be changed by a single time interval entry.

d. Trend printing shall provide point data according to an interval (length determined by user). Print a column header with point designation and engineering units for each point. Print the time and point data information in its respective column for all values for that point.

e. Trends set-up for initial system punch-out shall be retained in programming. Thirty-one (31) days of hourly trends shall be continuously stored on the automation system server. Trends shall be savable to CD as a 31-day group and/or selectively by operator command.

f. Access to trended data shall be achievable from graphic screens and/or menus.

g. Recovery or printing of trends shall be a multi-tasking function so that recovery or printing of trends from one facility does not prevent simultaneous access to another facility on the same server.

h. Provide Change-of-Value type trends for all binary point values with at least 500 samples.

i. Formatting of Trends: Provide spreadsheet format with all points for each unit, organized with approved point names. Group points together that naturally belong together (i.e. command and status, supply air temp and its setpoint. Standardize on a format and use it consistently. Submit sample formats for each unit type for approval in advance.

3. Overrides:

a. Refer to the building zone override section in this specification. Provide a touch screen graphic for manual override of the "OFF" for all Scheduled Start/Stop Zones. Locate the override touch screen in the Administration Area, coordinate location with MCPS Energy Management. Provide the necessary software to start any desired zone's equipment by touch screen. The program shall permit operator selection of zones and shall enable all related equipment for that particular zone. The program shall index the selected zone to an "ON" mode in a minimum of one-hour increments per push for a maximum override period of 6 hours. Once overridden, the zone equipment shall operate in the occupied mode, including exhaust fan interlocks.

b. Timed override feature shall allow an operator to temporarily change the state of scheduled equipment. An override command shall be selectable to apply to an individual unit, all units assigned to a given master schedule, or to all units in a building. Timed override shall terminate at the end of an operator selectable time, or at the end of the scheduled occupied/unoccupied period, whichever comes first. A password level that does not allow assignment of master schedules shall allow a timed override feature.

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c. Provide equipment override programs for all energy recovery units, air handling units, rooftop units, and heating and ventilating units. Program shall allow operator to override DOAS, RTU, or HVU “Off” command to enable individual units for operation without overriding Zone command. Duration of override shall be for 3 hours. Intent is to allow DOAS, RTUs, or HVUs to run for maintenance servicing without requiring other equipment in the zone to operate as would be required if the Zone were overridden on.

d. Provide two (2) single point outdoor air damper overrides. Intent is to allow the EMS operator to command all outdoor air intake dampers controlled by EMS to be closed by a single command.

1) One OAD Override shall close all outdoor air dampers and shut down all Dedicated Outdoor Air Systems (DOASs). Intent is prevent any outdoor air entering the building thru the HVAC equipment. Label this override: “Global OAD OR”

2) The other OAD Override shall close all outdoor air dampers, but not shut down DOASs. Label this override: “Partial OAD OR”.

e. Provide a single point Emergency Shutdown override. Intent is to allow the EMS operator to command all equipment off.

f. Override shall be possible for analog or time clock values for a given period of time, until a given time or permanently. Overrides may be cleared at the keyboard or through programmable user functions.

4. Alarms Reporting:

a. Alarms shall be displayed in red on graphics and shall include all critical alarms as well as status and temperature alarm points designated by MCPS and/or as called for on systems points lists.

b. Critical Alarms: Building impending freeze alarm, EMS failure alarms, and building electrical power irregularities alarm shall be displayed at the Energy Management Office.

1) Building impending freeze alarm:

(a) Alarm condition shall be whenever outdoor air temperature is below 40°F (adjustable) and when the central plant is in the heating mode, and shall be generated when the heat pump loop water return temperature drops below 45°F (adjustable) for 40 minutes.

(b) Generated when both main and stand-by heating hot water pumps or both main and stand-by dual temperature pumps are showing off status when outdoor air temperature is below 40°F.

(c) Impending freeze alarm message shall read out on the display as "Low Loop Temperature" and give the name of the school or facility experiencing this condition.

(d) This alarm shall also be provided to MCPS Security Division via hardwire connection to the Security System installed at the building. Provide a contact output and coordinate interconnection with MCPS Security System; MCPS Security Division will connect to EMS provided relay and monitor this output through their own system's hardware and software.

(e) Critical alarms as approved by MCPS, shall be sent via email to EMSalerts@mcpsmd.org and their respective Depot (Bethesda: BMDalerts@mcpsmd.org, Clarksburg: CMDalerts@mcpsmd.org, and Randolph: RMDalerts@mcpsmd.org) and others as provided. Send depots only the alarms within their areas. Verify email addresses with MCPS prior to programming.

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2) Incoming electrical power irregularities alarm shall be generated by the EMS monitoring of incoming phase, voltage, and frequency and display a message reading "In-coming Power Problem" upon sensing an alarm condition and identify the school or facility experiencing the problem.
3) Energy management systems system failure alarm reading "EMS System Failure" and identify the school or facility experiencing the problem.
4) Pump failures
5) Boilers (as generated by boiler manufacturer's controller)

5. Graphics: Provide graphics as follows:
   a. Color schemes and text:
      1) Normal text shall be black on a neutral colored box background. Normal conditions shall be displayed in normal text. Examples of normal conditions are temperature, pressure, humidity, etc. that are within setpoints; commands that are per programming and not overridden; status that gels with command (e.g. "Off" status is normal when the command is "Off"); etc.
      2) Alarm conditions shall be displayed in red text on a neutral background box or black text with red background; i.e. red color shall only be used for alarm conditions. Examples of alarm conditions are temperature, pressure, humidity, etc. that are outside of setpoints; commands that are not per programming and not overridden; status that does not equal command (e.g. "Off" status when the command is "On"); etc. For space temperatures, alarm conditions shall be when actual temperature is more than 2°F below the heating setpoint and when actual temperature is more than 2°F above cooling setpoint. For supply air temperatures, alarm condition shall be when actual temperature is ±5°F of setpoint. Pressure and humidity alarms shall be with actual is ±10% of setpoint.
      3) Overridden conditions shall be displayed in black text with bright yellow background box.
      4) BACnet mapped points from equipment manufacturers' controllers (i.e. control points not hardwired by EMS) shall be black text on a grey colored box background. Intent is for graphics to allow the operator to readily distinguish between EMS hard wired points and 3rd party BACnet mapped points. Any screens with BACnet points specified to be in gray shall also have a notation on the screen that "gray points are via BACnet".
      5) The foregoing color schemes are to be consistent throughout the project and no other color schemes (or techniques such as blinking) are to be utilized for text.
      6) Point data, attributes, and commands shall be displayed in and labeled with descriptive text; i.e. temperature in ºF, CO2 in ppm, humidity in %, etc.; modulating dampers and valves in % open, VFD speeds in %. Two-position on/off operations shall be displayed as on/off; open/closed shall be displayed as open/closed; alarm conditions shall be alarm/normal.
      7) Graphic backgrounds shall not be black nor any other dark color. Backgrounds shall be light colored as approved by MCPS.
   b. Links: Provide a display linking function so that clicking an object associated with the link changes the display to a new display. Data and attributes for points selected with the mouse shall be accessed; security settings shall limit the dynamic information displayed or capability of making changes. For example:
      1) A mouse click on a digital output text box (command) or on a digital input text (status) shall open a "pop-up" screen with data pertinent the point. It shall be possible to override the command or status from the pop-up screen.

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2) A mouse click on an analog input text (temperature, pressure, humidity, etc.) or on an analog output text (damper command, VFD command, etc.) shall open a “pop-up” screen with data pertinent to the point. It shall be possible to override the input or output value from the pop-up screen; and it shall also be possible to change setpoints from the pop-up screen.
3) Duration of point override shall be selectable from the pop-up screen. Point may be overridden indefinitely, requiring operator action to remove the override; or point may be overridden for an adjustable time interval so that the point automatically returns to automatic control at the end of the timed interval.
4) Overridden points shall be displayed with bright yellow backgrounds in the pop-up screens.

c. Transfers: All screens shall have “transfer buttons”, icons, or navigation “trees” to expedite graphic interrogations and for quick navigation to other functions such as reverting to “central plant”, “home”, “back”, “trends”, “notepad”, etc
1) Back button shall revert to the previous page.
2) Each screen shall have a Home button. The Home button will revert to the specific school’s Home Page. The Main Menu button on the school’s Home Page shall revert to the server sign-in screen which lists all schools on the system.
3) Each screen shall have a Note Pad accessible into which the operator may enter text and save.
4) The name of the school shall appear on every school specific screen.
5) On each graphic, include button to open PDF control drawing showing full details for that unit (flow diagram, sequence, controller wiring, point details, safety interlocks, power supply, etc.). Provide a separate PDF showing that unit only for every unit. Typical units may all link to a single PDF if identical.
6) Individual unit Graphics for Tech troubleshooting: For each piece of equipment, show controller schematic drawing on a graphic screen showing current value dynamically for all points, setpoints, and values. Show the current status of all program modes (i.e. occupied/unoccupied). Refer to latest MCPS browser guide for examples.
7) In place of Notepad, provide editable spreadsheet file in MS Excel for technicians to add notes for all equipment. Provide one tab for every unit and include the spreadsheets with controller details and points details as described in this specification.
8) On every graphic in the school, add button to open sequence for that unit only in an Excel file format. Coordinate layout with MCPS standard. EF’s may be grouped into one file.

d. At a minimum, the graphics provided shall include:
1) Adding the school to the MCPS Dashboard. Dashboard work shall be done under this contract subcontracting to the approved dashboard vendor. This contract includes coordinating the interface to the dashboard and responding to requests for coordination such as point naming, BACnet priorities, etc. Make all programming preparations necessary so the school can be integrated into the new MCPS Dashboard programming which collects key points for all schools to a single web-based platform. Coordinate with the vendor doing the dashboard programming and provide information and programming interface in the BACnet protocol. Refer to the Brinjac PDF file “2018 Dashboard Graphics Guidelines” and the associated Brinjac Dashboard specification for the interface details.

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2) Where EMS systems have been switched to another manufacturer, it is the responsibility of the Contractor whose system is replaced to remove all schools from the MCPS associated graphics screens, this is to be considered a retroactive requirement for all schools that have not been previously removed.
3) Server Sign-in: At sign-in to the server, the initial screen shall be the MCPS Dashboard. The dashboard and all associated screens and linkages are described in the 2018 MCPS Dashboard Guidelines. Links to all schools shall be provided on the dashboard.
4) On each graphic, include button to open PDF control drawing showing full details for that unit (flow diagram, sequence, controller wiring, point details, safety interlocks, power supply, etc.). Provide a separate PDF showing that unit only for every unit. Typical units may all link to a single PDF if identical.
5) Individual unit Graphics for Tech troubleshooting: For each piece of equipment, show the controller wiring schematic drawing on a graphic screen showing the current value dynamically for all input/output points. Show the current status of all program modes (i.e. occupied/unoccupied). Refer to latest MCPS browser guidelines for examples.
6) In place of Notepad, provide editable spreadsheet file in MS Excel for technicians to add notes for all equipment. Provide one tab for every unit and include the spreadsheets with controller details, control sequences and points details as described in this specification.
7) Wherever room numbers are displayed on graphics, show the final actual room numbers.
8) Label the function of each coil and device shown on graphics (i.e. Dual Temp Coil).
9) General Graphics Requirements:
   (a) All graphics to show arrows for direction of flow and label what is being supplied (i.e. HWS to Bldg). All equipment such as pumps, coils, fans, etc. shall indicate function and pump number (i.e. HW Pump-3 or DTW Pump-5) in clear English terms.
   (b) All setpoints shall be on graphics.
   (c) On all graphics, such as plant, Ahu, terminal unit, etc. Show valve with correct piping for HWS, CHWS, DTS, etc. Identify % open or % closed.
   (d) The requirements of the revised latest Brinjac graphics guideline document and the most recent graphics checklist are included in this specification.
   (e) For all equipment provide a button that opens the sequence of operation for that item of equipment only in a text format. Exhaust fan sequences may all be on one file. The file must be editable by the operator for cases where a sequence changes. These text files must be automatically backed up along with the server backups without any extra steps.
   (f) With multi-state points, English language operating mode descriptor (and operating codes, if used) shall be displayed for Manufacturer's controlled equipment.
   (g) Provide one link in navigation tree to open the complete ATC drawing set. In addition, each system graphic shall include a button that opens only those ATC controller pages related to that system including the flow diagram, controller details, sequence, etc. for that unit.
   (h) For all points include text on graphic clarifying where a point is a "Command" or a "Status" or a "Setpoint", etc. to differentiate the point type.

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Show English language point identifiers on graphics in lieu of symbols. Differentiate between the meaning of Command vs Enable.

(i) All documentation shall be accessible from the graphics – control drawings, product data sheets, wiring as-builts, mechanical drawings (provided by Moseley Architects). All such files shall be in searchable PDF format and shall be fully searchable to locate text within the document.

(j) Add notes on graphics where possible to explain how things are controlled.

(k) Show communication cable runs on zone floor plan graphics, but only visible when hovering on a button will show communication bus on floor plan graphic. Alternatively, a duplicate of the zone floor plan with the communication cables is acceptable. Each separate bus must be in a different color.

(l) The navigation tree for StruxureWare projects shall precisely emulate the one on Cabin John Middle School.

(m) Display status of all control modes (i.e. Occupancy, Summer/Winter, economizer enable, etc.)

(n) In addition, each system shall include a button that opens only those ATC drawing pages related to that system (i.e. flow diagram, sequence, controller details, index tables, etc.)

(o) Engineer's review consists of the following: (1) One review upon receipt of the graphics checklist; (2) two follow up reviews after punch list items are corrected; (1) cross check when graphics are deemed acceptable. Reviews in excess of the above are to be considered chargeable to the Contractor.

10) School Home Page: Transferring to a specific school's home page, the home page shall present a picture of the facility along with its name, main office and building services phone numbers. The picture to be used shall be furnished by MCPS. The home page shall be displayed upon operator activity time-outs. Page displays and functions shall be as follows:

(a) Critical Alarms status shall be displayed in text, "Alarm" or "Normal".

(b) Building KWH (and KW when available) shall be displayed.

(c) Button and text links from this page shall be used to transfer to:

(1) Building floor and roof plans

(2) Central plant graphics

(3) Exhaust fans screen

(4) HVAC equipment screen

(5) Main menu (reverts to server sign-in page)

(6) As-built control drawings (complete set), all control product data sheets, all installation drawings and mechanical drawings, etc. These buttons for documents shall be in the navigation screen if the system allows, otherwise provide buttons on the main screen.

(7) Summer/Winter Changeover.

(d) Display the on/off status of the Master schedule on the school home page.

(e) Display plant supply temperature(s) on the building home main screen.

(f) Buttons on this screen, protected with highest password, shall be provided with the following functions:

(1) "SCHEDULE" button shall transfer to Schedules summary screen. Currently active building schedule shall be displayed in a dynamic box

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that, when clicked, shall enable the operator to change building from occupied to unoccupied and vice-versa. Display the on/off status of the Master schedule on the school home page.

(2) "Global OAD OR" button, representing "outdoor air dampers override". Function shall command all outdoor air dampers in a facility closed and commanding Energy Recovery Units to off (closing outdoor air intakes).

(3) "EMERG" button shall provide emergency shut-down of building. Activation of the button shall turn all equipment off; button shall turn red when activated.

(4) "SUMMER-WINTER" button to command the Summer/Winter Changeover Program indexing of the building systems to "Summer Mode" or "Winter Mode": The active mode shall be displayed in the command box; text shall identify the command box as "S-W Switch". The entire school can be switched from this one button with built in safeties and error proof programming. The switch shall be capable of the following:

1. All equipment shall be enabled/disabled for proper summer or winter operation as indicated on the switch.

2. All devices such as automatic changeover valves, pneumatic pressure settings, etc. shall be commanded to their correct position.

3. DX cooling for specific zones such as administration, media center and computer Labs shall be enabled appropriately; DX cooling for non-critical areas such as Multipurpose rooms shall be enabled in the Winter mode only when the OA temperature is above 60°F.

4. Multiple Central Plants (including Heat Pump Plants): The mode of operation in each plant will be determined by the summer/winter button on the Home Page and will be indicated in a box on each individual plant screen.

5. On schools where there is no summer/winter changeover, the label shall say "No Changeover".

(5) PLM Override: This button disables the PLM Curtailment program for the individual school by the MCPS Operator Only. This button shall be accessible only by an operator with the highest level password.

(6) "NOTEPAD" button shall open notepad to allow text notes to be entered.

(7) "TRENDS" button shall display in text the last 72 hours trends of outdoor air temperatures, central plant operations, zone temperatures. Zone temperatures trended for zones with multiple space temperatures shall use the worst case space temperature (coldest space during heating, hottest space during cooling).

(g) A "Disabled Objects List" box consisting of buttons labeled "Inputs", "Outputs", "Numerics", and "Programs". Clicking on a button shall display the pertinent disabled or overridden objects.

(h) A "Central Plant Status" box displaying applicable central plant temperatures; clicking on a temperature shall transfer to the central plant. Temperatures to be displayed are:

(1) Heating Water Plant: Heating Water Supply & Return

(2) Water Source Heat Pump System: Heat Pump Loop Water Supply & Return

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(i) An “Energy Management Communications Status” graphic displaying:
(1) On-Line status of proprietary LAN’s main building controller and BACnet router (as applicable), and
(2) On-Line status of HVAC equipment manufacturer’s BACnet controllers (as applicable)

11) Building Floor Plans: The link from the school’s home page to building floor plans shall provide color coded floor plans of the facility; each floor plan shall be fitted on a screen. Displayed on the floor plan:
(a) Zone identified by number
(b) “ON/OFF” zone status.
(c) Worst case space temperature within the Zone: On the main floor plan do not show the worst-case temperature, but rather make a block turn red when the alarm limits are exceeded (68/78 deg) so operator can go to zone screen for detail. If the temperature reading is out of range, <35°F or >100°F, the system shall consider these values as erroneous and shall show the block in orange. Define worst case as lowest in winter Mode and highest in summer Mode. Systems that do not have a defined summer/winter such as water source heat pumps shall switch summer/winter at 65°F.
(d) Text identification of zones, correlating zone numbers to specified zone names: e.g. Zone 1 Administration, Zone 4 Classrooms, Zone 9 Main Gym, etc.
(e) Active Displays and Links:
(1) Outdoor air temperature shall be displayed. Temperature display shall be a dynamic point that when clicked, shall allow the operator (with highest password) to override OAT value.
(2) Central plant status (Heating On, Cooling Off, etc.) shall be displayed. Dynamic button(s) shall transfer to the pertinent central plant when clicked.
(3) Buttons shall link to:
1. Other floor plans and roof plan
2. Zone Schedules
3. Exhaust Fan Screen
4. Trend button shall provide trends as described for the Home page.
5. Home, Back, Notepad as previously specified.
(f) Clicking on a Zone on the graphic floor plan shall transfer to a screen pertinent to that zone.
(g) Show all EMS panel locations on zone floor plan graphics.

12) Central Plant Graphics:
(a) Central plant graphics shall have real time values and setpoints displayed in locations on the graphic representative of the sensing device or controlled equipment location.
(b) Central plant graphics shall take the form of:
(1) One screen showing all central plant equipment for simple systems (e.g. Dual Temp Plant, Water Source Heat Pump Condenser Water Plant)
(2) One screen showing all data pertinent to the heating cycle (Heating Plant) and one showing all data pertinent to the cooling cycle (Chiller

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Plant) on more complex plants; i.e. multiple chillers, 4-pipe systems, etc. Condenser water systems for water cooled chillers should be portrayed on the same screen as the chiller plant.

(3) Graphic flow diagrams shall be those that were approved in the controls submittal, modified per As-Built conditions.

(c) Outdoor air temperature and humidity shall be displayed

(d) Buttons shall be provided to display the central plant control sequences of operation and the control panels diagrams.

(e) Trend button shall display 72 hours of hourly trends of all points portrayed on the screen.

(f) Home, Back, Notepad as previously specified.

(g) Show piping with different colors: HW is red, condenser and tower water is green.

13) Exhaust Fans Screen(s): A text screen shall be provided listing all exhaust fans under EMS control with commands, status, and programming code listed. This screen shall be accessed via "button" from school's home page, building's floor plans, and HVAC equipment screens.

(a) Indication shall be given as to fan control program:

(1) "C" shall indicate a fan programmed to run continuously during the occupied mode

(2) "S" shall indicate a separate schedule not associated with a zone

(3) "E" shall indicate an economizer cycle fan

(4) "L" shall indicate a fan under local control (wall switch, thermostat)

(5) "P" shall indicate a fan with some other controlling program not covered above

(b) Trend button shall provide 72 hours of hourly trends for exhaust fans displayed on the screen.

(c) Home, Back, Notepad as previously specified.

14) HVAC Equipment Screen:

(a) A text screen shall be provided listing all major HVAC air handling equipment under EMS control (DOASs, ERUs, AHUs, HVUs, etc.) by equipment designation (i.e. AHU-1, ERU-3, HV-A, etc.). The following information shall be provided:

(1) Zone to which the equipment is assigned shall be listed.

(2) Active Zone schedule (Occupied or Unoccupied)

(3) Equipment's supply fan command and status

(4) Equipment's supply air temperature

(b) Clicking on the Equipment's name shall transfer to the graphic screen for that unit.

(c) Clicking on the Zone listing shall transfer to the Zone floor plan.

(d) Provide equipment maintenance override button for each unit. Program shall allow operator to override the unit's "Off" command to enable individual units for operation without overriding Zone command. Duration of override shall be for 3 hours. Intent is to allow ERUs, AHUs, or HVUs to run for maintenance servicing without requiring other equipment in the zone to operate as would be required if the Zone were overridden on. On/Off indication for the override shall be provided.

(e) Home, Back, Notepad as previously specified.

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15) Roof Plan Screen: Screen shall depict building roof and show rooftop HVAC equipment and exhaust fans. Primary purpose of the plan is for equipment location. Transfers from this screen shall be: Home, Back, Exhaust Fans, HVAC Equipment, and to building floor plans. Roof plan shall indicate EF local control versus EMS control with different graphic scheme following format on roof plans. On roof plans, show exhaust fan commands and status points. Status turns red if in alarm.

16) Navigation through building graphics shall, in general, continue to follow a simple hierarchy similar to the following:

(a) Zone Screens: Mouse click on a zone from the building floor plan shall transfer to a screen of that zone.

(1) Zone screens shall display:

1. Zone name (and floor if Zone is comprised of more than one floor and requires multiple screens).

2. The Zone floor plan(s) with walls delineated. Where Zone is comprised of more than one floor and requires more than one screen, transfer button(s) shall be provided to access the other floors of the Zone without backing out of the Zone level screens.

3. Occupied/unoccupied status. This shall be in a dynamic box that allows the operator to change the command.

4. Space sensors locations and values (temperature, humidity, CO2, etc.). Clicking on the unit ID label within the Zone screen shall provide a pop-up screen displaying all pertinent data for that particular sensor and the equipment it controls.

5. Air handling and incremental equipment within the zone shall be symbolically shown and identified. Basic data pertinent to the AHU, DOAS, ERU, HVU serving the Zone shall be displayed; i.e. (Supply fan status, supply air temperature)

6. Exhaust fans interlocked with the Zone shall be displayed if located within the Zone boundaries.

7. EMS control panels (other than terminal equipment controllers) located within the Zone boundaries shall be shown and identified.

8. Simple duct runs shall be shown when it is not obvious as to which rooms are served by a piece of HVAC equipment.

9. Electric circuits for terminal equipment shall be shown and labeled where control of the equipment is by contactor interruption of circuits.

10. Outdoor air temperature

(2) Links, Transfer buttons:

1. Zone Schedule: transfers to the scheduling page for the zone

2. AHU(s), DOAS(s), ERU(s), HVU(s), etc. that serve the Zone shall be in buttons that transfer to the related equipment's screen.

3. Buttons shall be provided to transfer to terminal (VAVs, UVs, HPs, etc.) equipment screens pertinent to equipment in the zone.

4. Transfer to the building exhaust fans screen(s).

5. Home, Back, Notepad as previously specified.

6. Trend button shall provide 72 hours of hourly trends for Zone's space temperatures (humidity, CO2, etc.) and setpoints.

(b) Major Equipment Screens (AHUs, DOASs, ERUs, HVUs, etc.): Accessing equipment screens shall be achievable from multiple locations; i.e. from the

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"HVAC Equipment" screen, from Zone floor plans, from incremental equipment screens. Equipment screens shall:

(1) Display the flow control diagram for the equipment (AHU, ERU, etc.); flow diagram shall be that approved in the controls submittal, modified per As-Built conditions. All sensing, monitoring, and control points shall be displayed in real time at their symbolic locations and shall include:

1. Temperatures, humidity, CO2, etc.

2. Controlling setpoints (i.e. supply air temp; static pressure, outdoor airflow, etc.)

3. All points shall be in dynamic boxes that allow overriding of commands and values.

4. BACnet mapped and displayed points from equipment manufacturer controllers shall be limited to those specified. Controlling temperature setpoints (discharge or space) shall be displayed as read-only.

5. English language operating mode descriptor (and operating codes, if used) shall be displayed for Manufacturer's controlled equipment. For example, the display for a DOAS that is enabled/disabled and indexed occupied/unoccupied by the EMS shall show in what mode the manufacturer's controller is operating; e.g. "Occupied, heating (22)"; "Unoccupied, dehumidification (39)".

(2) List interlocked exhaust fans with status and controlling legend. Button shall be provided to transfer to the building exhaust fans screen(s).

(3) Outdoor air conditions shall be displayed; i.e. temperature, humidity, enthalpy as applicable. For systems capable of economizer or enthalpy optimization, display whether Econ is enabled or disabled in a box that can be overridden by operator.

(4) Timed Override button shall allow operator to change equipment command from occupied to unoccupied and vice-versa.

(5) Links shall be provided to:

1. Sequence of operations; sequences shall be editable and changes savable.

2. Controller(s) diagram(s) consistent with As-Built documents

Central plant(s)

3. Zone floor plan to which the equipment is assigned

4. Terminal equipment (VAVs, FCUs, UVs, HPs, etc.) associated with the AHU, ERU, DOAS

5. Trend button shall bring up 72 hours of hourly trends of all points displayed on the screen

6. Home, Back, Notepad as previously specified.

(6) Label the coils to show their function (i.e. water source heat pump)

(7) In addition to all BACnet points from manufacturer's units, EMS contractor shall provide via hardwired EMS points for occupied/unoccupied command, emergency shutdown, controller remote reset, fan status(s), supply temperature, return temperature and where applicable mixed air temperature sensors.

(c) Terminal Equipment (Heat Pumps, Unit Ventilators, Fan Coils, Cabinet Heaters, etc.) Screens: Accessing terminal equipment screens shall be achievable from Zone floor plans and from related major air handling

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equipment screens. Terminal units: use numbering that follows provided floor plans. Generally these should indicate the zone number the unit is in (i.e. Vav-5-23 is for zone 5). If such numbering is not on the contract documents, create such numbering following the standard. Assign numbering and reference on floor plan and all equipment tables.

(d) Terminal equipment screens shall:

(1) Display a typical equipment diagram illustrating flow and all sensing, monitoring, and control points.

(2) In table form, display all like terminals in a Zone; transfer buttons to additional screens shall be provided if needed to accommodate all of the terminals in the zone. Rather than using “more” button, provide separate buttons to each additional screen for direct access. The operating parameters shall be displayed. All points shall be in dynamic boxes that allow overriding of commands and values. Parameter headers should be descriptive to allow easy interpretation Where room sensor sliders exist, actual adjusted heat setpoint and actual cool setpoint (+/-2 deg) must be shown in addition to initial programmed heat and cool setpoints which are adjustable without override from the graphic. The slider adds +/- 2 deg to both the programmed heat and cool setpoints to calculate the two adjusted setpoints. Data to be shown includes:

(3) Water Source Heat Pumps:

1. Space temperature; heating setpoint, cooling setpoint, and actual
2. Fan command and status
3. Reversing valve command (or heat/cool indication)
4. Compressor command and status
5. Supply air temperature
6. Condenser water valve command, end switch status

(4) The AHU supplying the terminals, DOAS/ERU associated with the terminals, etc. shall be identified and be in a transfer button that brings up the AHU, DOAS, ERU screen. The AHU, DOAS, ERU supply fan status, supply air temperature, supply static pressure shall be displayed.

(5) Display outdoor air temperature.

(6) Links shall be provided to:

1. Terminal’s sequence of operations; sequences shall be editable and changes savable.
2. Central plant(s). Central plant links shall be pertinent to the terminal equipment; i.e. water source heat pumps shall have link to condenser water plant.
3. Zone floor plan to which the equipment is assigned
4. The AHU, DOAS, ERU, etc. associated with the terminals.
5. Trend button for the screen shall bring up 72 hours of hourly trends of all points displayed on the screen. Trend button shall be provided for each terminal that will display 72 hour trends only for that specific terminal.
6. Home, Back, Notepad as previously specified.

(7) Label the coils to show their function (i.e. water source heat pump)

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(8) In addition to all BACnet points from manufacturer's units, EMS contractor shall provide via hardwired EMS points for occupied/unoccupied command, emergency shutdown, controller remote reset, fan status(s), supply temperature, return temperature and where applicable mixed air temperature sensors.

e. Symbol conventions shall be consistent with existing current MCPS graphics and symbols list included with this section and/or per contract drawings.

f. Graphics portrayed on a screen shall be scaled to fit the screen so that all diagrams and data are viewable without scrolling.

g. Changes made at a controller level shall be automatically reflected in the associated graphic.

6. Access to trended data shall be achievable from graphic screens. Each graphic screen shall be provided with a "trend" button. Clicking on the button will display pop-up window with the trends displayed in text form for all points germane to the graphic screen displayed.

7. On-line notepad: Provide on-line notepad accessible from systems graphic screen. Notepad shall have two functions:

   a. Sequence of operations as approved in "As-Built" documents shall be provided. Sequence shall be displayed when notepad is accessed from equipment graphic screen; e.g. when viewing the graphic screen for an air handling unit, clicking on the "Notepad" button will display a "pop-up" window with the text of the sequence of operation pertinent to that AHU. On-screen editing and saving of the sequence shall be possible.

   b. Notes, in addition to sequences of operations, may be entered and saved

8. Database Management: Copies of the current database and/or the most recently saved database shall be stored. The age of the most recently saved database is dependent on the user-defined database save interval. Save/restore/download function of database shall be demonstrated during Head-End punch-out at Energy Management central office and again at the End-of-Warranty.

9. "Snow day": Program a "snow-day" command so that, by a single command from the operator, all remote Energy Management Automation Systems shall be placed in their local special "snow day" schedules.

10. Contractor shall install all software and links on the school's computer located in the Building Service Manager's office to allow access to EMS from that computer.

11. Audit Trail: Provide an Audit Trail to automatically record the time, date, user, and action for all user changes made via Web Browser clients. Audit Trail shall be school/building specific, data retained for one year and retrievable by operator command.

12. Overridden Points: Provide a school/building specific record of currently overridden points retrievable by operator command.

2.05 CONTROL WIRING

A. No control voltage, either temperature or interlock, shall exceed 120 VAC. Color code or number all wires whether individual or in cables, for identification. Work shall be in compliance with the National Electric Code and as follows:

B. Minimum size conduit shall be 1/2" EMT.

C. Minimum line voltage, size wire shall be #14 and in accordance with hardware manufacturers' recommendations for signal wiring.

D. Control wiring to starters shall conform to Para. 430-74 of the National Electric Code.

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E. Control cabling shall conform to NEC 725-2b and NEC 760-2b fire protective signaling, and U.L. classified as a low smoke flame retardant cable suitable for installation in plenums and environmental spaces. Maximum allowable voltage shall be 24V. Cable shall be stranded wire type. Shielding shall be provided on cable wiring where required to preclude interference from or to building electronic components and/or systems.

F. CAT5e or CAT6 cables shall be color coded to differentiate separate loops.

2.06 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters and Resistance Temperature Detectors and Transmitters:

1. Electronic, RTD copper wound or Balco wire wound types, 1000 ohm at 70°F, or thermistor resistance sensor, maximum 10,000 ohms at 77°F.
2. Sensors shall be of a configuration to accurately sense temperature of medium (water or air) over the full range of piping, duct, casing, or equipment; i.e. eliminate errors due to stratification by apply averaging sensors to five to twenty four feet, six to twelve inch probes, etc.
3. All mixed air temperature sensors in air handling and energy recovery unit casings shall be 8’ avg. elements, minimum.
4. End to End Accuracy from sensor to operator interface:
   a. Space Temperature: Plus or minus 1.0° F.
   b. Ducted Air Temperature: Plus or minus 1.0° F.
   c. Outside Air Temperature: Plus or minus 2.0° F.
   d. Water Temperature: Plus or minus 1.0°F.
5. Wire: Twisted, shielded-pair cable.
6. Insertion Elements in Ducts: Single point, 6 to 12 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
7. Averaging Elements in Ducts: 5 feet to 24 feet long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft.
8. Insertion Elements for Liquids: Brass or stainless steel socket with minimum insertion length of 2-1/2 inches.
9. Room Sensor Cover Construction: Manufacturer's standard locking covers.
   a. Set-Point Adjustment: Slider for 2 degrees F software limited adjustment. Surface mounted Zone sensors that only monitor temperature and do not perform temperature control of equipment shall not have setpoint adjusters.
   b. Set-Point Indication: No thermometer or display.
   c. Thermometer: Concealed.
   d. Color: Manufacturer’s standard.
   e. Orientation: Vertical.
   f. Override: None.
10. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
11. Space Sensor Guards: Provide heavy-duty, cast aluminum, hinged guards with security screws and lock for sensors located in Corridors, Storerooms, Gyms, Locker Rooms, Kitchen, Cafeteria/Dining, Multi-purpose rooms. Guards shall be equal to Honeywell model TG511D/1004.

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12. Specific Sensor Type Locations: In corridors, storerooms, gyms, locker rooms, kitchen, cafeteria/dining, multi-purpose, restrooms, stairs and lobbies, provide flush mounted sensors or vandal-proof guards.

C. Enthalpy Sensors: Sensing element shall be combination bimetal/nylon suitable for duct mounting; 16 to 40 BTU/lb dry air range.

D. Humidity Sensors: Capacitance or bulk polymer resistance type.
   1. Accuracy: 5 percent full range with linear output.
   2. Room Sensor Range: 10 to 90 percent relative humidity.
   3. Room Sensor Cover Construction: Manufacturer's standard locking covers.
      a. Color: Manufacturer’s standard.
      b. Orientation: Vertical.
   4. Outside-Air Sensor: 10 to 90 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of 0 to 185 deg F.
   5. Duct-Mounted: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 10 to 90 percent operating range, and single- or double-pole contacts.

E. Pressure Transmitters/Transducers:
   1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input and temperature-compensated.
      a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
      b. Output: 4 to 20 mA.
      c. Building Static-Pressure Range: -0.25 - to 0.25-inch wg.
      d. Duct Static-Pressure Range: 0- to 3-inch wg.
   2. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
   3. Differential Pressure Sensing in Piping: Pressure sensors for control of Variable Frequency Drives on pumping systems shall be of the solid state type with by-pass valve, isolation valves, snubbers and vents in a NEMA 1 cast aluminum housing; externally accessible zero and span adjustments; 4-20 mA output, -40° to +200° F operating temperature range, temperature compensated. Water pressure sensor shall have end-to-end accuracy of plus or minus 1 psi.
   4. Pressure Transmitters: Direct acting for gas or liquid service; range suitable for system; linear output 4 to 20 mA.

F. Overall combined system repeatability of sensors, controllers and readout devices for a particular application shall be plus or minus 2% of full scale of the operating range. Repeatability of overall combined system of sensor, controller and readout device in a control loop application will be plus or minus 5% of full scale of the operating range. Long-term electronic drift shall not exceed 0.4% per year.

2.07 PRESSURE SWITCHES

A. Air flow pressure switches shall be differential type adjustable between .07 to 3" W.G., single pole double throw switching mechanism.

B. Water flow:
   1. Pressure switches shall be differential type adjustable between 0 to 60 PSIG; single pole double throw switching mechanism.
   2. Paddle switches shall be single pole double throw switching mechanism, stainless steel paddle, equal to Kele F61 Series.

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2.08 CARBON DIOXIDE SENSORS AND TRANSMITTERS

A. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output, for wall mounting. LCD, digital display indicating CO2 concentrations in PPM. Measurement range of 0-2000 PPM with less than 5% drift over 5 years. 5 year calibration interval. Vaisala GMD20 or approved equal for duct mounting and Vaisala GMW90 or approved equal for wall mounting.

1. Space Sensor Guards: Provide heavy-duty, cast aluminum, hinged guards with security screws and lock for sensors located in the Gyms, Cafeteria/Dining, and Multi-purpose rooms.

2.09 THERMOSTATS

A. Thermostats: Electric thermostats shall be two position type as dictated by the control sequence. The thermostats shall utilize fast responding bi-metal elements to make and break heavy duty silver contacts and shall be housed under a metal cover. The thermostat shall be completely adjustable and all adjustments shall be concealed. Thermostats shall have locking metal covers with Allen head screws. The thermostat temperature control point adjuster shall be provided with variable adjustment limits. Heavy metal tamper proof guards shall be provided where thermostats are installed in public areas or where subject to damage.

B. Low-Temperature Protection Thermostats: Provide low-temperature protection thermostats of automatic-reset type, with sensing elements 8'-0" or 20'-0" in length. Provide thermostat designed to operate in response to coldest 1'-0" length of sensing element, regardless of temperature at other parts of element. Support element properly to cover entire duct width. Provide separate thermostats for each 25 sq. ft. of coil face area or fraction thereof.

2.10 ACTUATORS

A. Approved Manufacturers:

1. Belimo AF and LF series.
2. Delta.
3. Siemens.

B. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.

1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.

C. Electronic Actuators:

1. Valves: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
2. Dampers: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
3. Coupling: V-bolt and V-shaped, toothed cradle.
4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
6. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
7. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.

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8. Temperature Rating: Minus 22 to plus 122 degrees F.
9. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 degrees F.

2.11 CONTROL VALVES

A. Control Valves: Control valves shall be two-way or three-way pattern as shown, constructed for tight shutoff and shall operate satisfactorily against system pressures and differentials. Valves with size up to and including 2" shall be "screwed" type with 250 psi static pressure body rating; 2-1/2" and larger valves shall be flanged.

B. Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
   1. Proportional control valves shall be sized for a maximum pressure drop of 5 psig at rated flow (except as noted).
   2. Valves for condenser water shut-off are normally 2-way line size; 3-way line size valves are used to accommodate minimum condenser water flow.
   3. All valves are to be provided by controls contractor except those that may be integral to manufacturer’s equipment.

2.12 DAMPERS

A. Dampers: AMCA-rated, parallel for two-position control or opposed-blade design for modulating control; damper blades shall not be less than 16 gauge galvanized steel with maximum blade width of 10 inches and length of 48 inches. Dampers over 48 inches wide shall be equipped with a jack shaft to provide sufficient force throughout the intended operating range.
   1. Operating Temperature Range: From minus 40 to plus 200 degrees F.
   2. Edge Seals: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 40 in. x lbf; when tested according to **<<AMCA 500-D>>**.
   3. Dampers shall have black enamel finish or galvanized with nylon bearings.

B. Damper Actuators:
   1. Approved Manufacturers:
      a. Belimo AF and LF series.
      b. Delta.
      c. Siemens.
   2. All actuators shall be electric/electronic. Actuator shall be sized to operate dampers with sufficient reserve power to provide smooth modulating action. Modulating motors shall be of the synchronous type.
   3. Actuator shall have manual override.
   4. Spring return actuators shall be provided for all actuators associated with equipment introducing outdoor air for freeze protection or as otherwise indicated.
   5. End switches shall be provided as required by sequences of operation and drawings.

2.13 SMOKE DETECTORS

A. New smoke detectors indicated shall be installed under this Section.

B. Wiring from smoke detectors to fire alarm system shall be under Division 28.

C. Wiring from smoke detectors to mechanical equipment shall be under this Section.

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2.14 FLOW METERS

A. Manufacturer: Onicon F-1110 turbine type with 4-20mA or 0-10VDC output linear to flow measured or approved equal for piping 2-1/2 inches and larger. Belimo FM series ultrasonic type with 0-10VDC output or approved equal for piping 2 inches and smaller.

B. Provide complete hardware necessary to enable insertion and removal of the meter without system shutdown.

C. End to end accuracy of flow meter shall be plus or minus 2% of actual value.

2.15 POWER MONITORING

A. Phase-voltage monitor shall be equal to Motor Saver Model MS250A providing two distinct alarm relay outputs; one shall be used by the controls system, MCPS Security will connect to the other.

B. Current operated switches shall be Kele 4CT, Diversified Electronics CT Series, or equal.

C. UPS/Surge protection shall be provided for all master building control panels and phone lines; APC Model BF-350 or equal. Metal-oxide varisters equal to Kele DTK Series shall be provided for all application control panels (unit controllers need not have surge protection). UPS power supplies shall be installed to allow being unplugged for replacement (not hard wired).

D. Control Voltage Transformer: Provide UL listed control voltage transformers and control voltage supply network to serve all electronic control requirements. Transformers shall be equal to Honeywell Series AT.

2.16 POWER METERING

A. Smart Meter: Schneider Electric METSEPM5560 (PM5560). An equivalent may be considered at the discretion of MCPS based on product features, functionality and interoperability. Power Monitor/Smart Meter must be able to integrate to EMS Schneider Electric Power Monitoring Server. Must be able to broadcast as a standalone device through a mobile broadband when power is loss at the facility. Meter and broadband must be energized through a building emergency circuit breaker.

2.17 CONDENSATE OVERFLOW SWITCHES

A. Sensor/switch to be installed in condensate pans to detect clogged drains, equal to Grainger 3XY17.

2.18 CURRENT TRANSFORMERS

A. Construction type shall be split core and capable of being used on existing wiring. Ratio error < 1% at rated current; Phase error < 2° at rated current. Device shall be of suitable amperage capacity for the application and shall provide a linear output signal. The device shall be compatible with the controls system it is to be connected to, and shall be UL Listed.

2.19 CONTROL ENCLOSURES

A. Enclosures shall be made of 14-gauge steel that is powder coated (gray). It shall be NEMA 1 rated and UL listed. Hinged cover shall have slotted flush latch. Acceptable manufacturers are Hoffman, Siemens or equivalent.

PART 3 EXECUTION

3.01 PROJECT MANAGEMENT

A. Provide a designated project manager who will be responsible for the following:

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1. Construct and maintain project schedule
2. On-site coordination with all applicable trades and subcontractors
3. Authorized to accept and execute orders or instructions from owner/architect
4. Attend project meetings as necessary to avoid conflicts and delays
5. Make necessary field decisions relating to this scope of work
6. Coordination/Single point of contact.

3.02 EXAMINATION

A. Verify that power supply is available to control units and operator workstation.

B. Verify that duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.03 INSTALLATION

A. General: Install systems and materials in accordance with manufacturer's instructions and roughing-in drawings and details on drawings. Install electrical components and use electrical products complying with requirements of applicable Division-26 sections of these specifications. Mount controllers at convenient locations and heights.

B. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.

C. Connect and configure equipment and software to achieve sequence of operations indicated on the drawings.

D. Equipment and Control:
   1. On all 3rd party controlled equipment (DOASs, RTUs, Split Systems, etc.) provide a signal relay to show positive status of the enable command.
   2. All command/enable points must have a corresponding status. Exhaust fans controlled individually shall have a current switch; groups of fans controlled by a single digital output shall have a signal relay for status (same for terminal equipment).

E. Room Type Temperature Sensors and Thermostats:
   1. Install electronic temperature sensors at all locations where room or zone temperature control is placed on the EMS, electric type thermostats elsewhere. Sensors and thermostats shall be located as indicated on drawings. Where a sensor or thermostat has been inadvertently left off of the drawings, the Contractor shall obtain direction from the Engineer as to location. No change in contract price shall be made for providing thermostats or sensors not indicated on drawings.
   2. Electronic wall mounted room temperature sensors shall be provided with a blank cover without thermometer or display. Temperature setpoint adjuster shall be provided on all wall mounted space temperature sensors except:
      a. Those that are flush mounted
      b. Those that only monitor temperature and do not perform temperature control of equipment (i.e. equipment with local and/or manufacturer’s controls/thermostats).
      c. Local adjustments shall be software limited to ±2°F above/below the programmed heating/cooling setpoints.
   3. Space temperature sensors in Locker Rooms, Storerooms, Corridors, Gym, Dining/Cafeteria/Multi-Purpose Room, Kitchen shall be flush mounted in wall or protected with suitable vandal-proof guards. Guards shall be mounted independent of sensors.
   4. Wall mounted temperature sensors and thermostats shall be located for accurate room temperature sensing, i.e. away from supply air stream; mount with centerline 46" above

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finished floor. Space temperature sensors and thermostats shall be suitably insulated from the surfaces in which they are installed so that the sense true space air temperature unaffected by such things as wall mass. Coordinate location of sensor/thermostat with work of other trades so sensor/thermostat does not conflict with or is obstructed by such items as blackboards, bleachers, bookcases, etc. Conceal all control wiring located in finished spaces; the use of wiremold is prohibited. Paint inside of rough-in box purple.

5. All space or zone sensors shall be labeled. Labels shall contain the zone reference and unit number. On the face of the cover, the label shall be made with a professional grade label maker; an additional label on the backer plate shall be made with a permanent marker. Sensor naming conventions shall be such as to readily identify the physical sensor on site to its address in the automation system without the need for a cross referencing index.
6. Furnish and install electric wall mounted thermostats for cabinet unit heaters and temperature controlled exhaust fans not indicated as being by DDC; provide guards for thermostats located in corridors, stairwells.
7. Electrical Contractor is responsible for roughing in outlet boxes and conduit for the installation of space or zone temperature sensors. Control Contractor shall provide coordination for locations and quantities.
8. Surface mounted humidity sensors, CO2 sensors and remote mounted manufacturer's controls (ex. For RTUs/DOASs) in Gym, Multi-Purpose Room, stairwells, and public corridors shall be protected by suitable vandal-proof guards. Guards shall be mounted independently of sensors. Guards shall be provided by the ATC Contractor for both EMS/ATC devices and those provided by the equipment manufacturer.

F. Duct and Immersion Type Sensors: Securely mount sensors and capillaries and position to measure correct average temperature. Thermally isolate air sensing elements from brackets and supports so that response is to air temperature only. Temperature sensors for piping shall be installed in wells.

G. Outdoor Air Temperature, Humidity, Carbon Dioxide:
1. Install an outdoor air temperature sensor and humidity sensor (separate sensors) on North facing wall with sunshield at a location not subject to damage or vandalism. These sensors shall provide backup values when the Internet is down.
2. The EMS shall utilize the outdoor air temperature and humidity values that are broadcast over the Internet for all outdoor air temperature references for all automation programs except as noted for rooftop equipment. If the values are not available over the Internet due too a communication issue, the outdoor air temperature and humidity values from sensors on the North facing wall shall be used.
3. Install CO2 sensor at roof level when comparative demand ventilation sequences are utilized.

H. Piping Differential Pressure Sensors: Locations of sensors controlling pumps' VFDs shall be identified both at the pumps' VFDs and at the sensors. Laminated plate shall be installed at the pumps VFDs defining sensors locations in the building; e.g. DPS-1 at AHU-2, DPS-2 in corridor ceiling at Room XXX. Sensors concealed above ceiling shall have ceiling plate installed identifying sensor.

I. Contactors and Relays: Installation of control contactors, relays, etc. shall be such as to not interfere with the required access for servicing of equipment and/or factory installed control devices.

J. Wiring:
1. The term "control wiring" is defined to include providing of wire, conduit and miscellaneous materials as required for mounting and connecting electric control devices. All wiring shall

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be installed in conduit and in accordance with the electrical specifications except as otherwise noted.

2. Except for short apparatus connections, run conduit and air tubing parallel to or at right angles to the building structure. Conceal conduit in finished spaces. Pressure test tubing and correct leaks by re-making joints.
3. Do not run conduit concealed under insulation or inside ducts. Mount control devices, conduit located on ducts or apparatus with external insulation on stand-off support to avoid interference with insulation.
4. Run wire connecting devices on or in control cabinets parallel with the sides of the cabinet neatly racked to permit tracing, using Panduit or equivalent system. Rack connections bridging a cabinet door along the hinge side and protect from damage. Provide grommets, sleeves or vinyl tape to protect wires from sharp edges of panels, conduit, and other items.
5. Where any new wiring is installed and penetrates a rated fire or smoke barrier, the wiring shall be run in conduit and the area around the conduit penetration of the barrier shall be thoroughly sealed with fire stopping material.
6. Number-code or color-code conductors, excluding those used for local individual room controls, appropriately for future identification and servicing of control system.
7. Control cable installation is permitted in concealed accessible areas not subjected to mechanical damage or excessive temperature or humidity conditions. Plenum grade cable and wiring shall be used in ceiling cavities.
8. Control wiring shall be run concealed above ceilings and concealed where drywall partitions or other cavity type walls exist. Contractor shall patch and finish wall and ceiling surfaces to match existing. Where wiring cannot be run concealed due to the existence of solid masonry partitions, exposed wiremold or wiring trough in finished spaces shall be run when permitted by MCPS.
9. Install all control wires/cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours. Secure and support wires/cables by straps, staples, or similar fittings designed and installed to avoid damage to wires/cables; support wires/cables from building structure independent from work of other trades such as ductwork, piping, conduit. Secure wires/cables at intervals not exceeding 60” and not more than 12” from cabinets, boxes, or fittings.

K. Automatic Dampers: Furnish all automatic dampers except those as may be provided as a component of manufactured equipment. Installation of dampers shall be by the sheet metal contractor under the supervision of the controls contractor.

L. Wells: Contractor shall coordinate with the Mechanical Subcontractor the location of temperature sensing wells in the central piping system. All sensor bulbs in water lines shall be installed in separable wells, packed with heat conductive compound.

M. Valves: Control valves are to be provided by the controls contractor for field mounting. Valves may be furnished to equipment manufacturers for factory installation at Contractor’s option and coordination.

N. H-O-A Switches:
   1. Leave starter “Hand” positions wired and operational.
   2. When connecting to exhaust fans with motor operated dampers, connect so that damper opens in both hand and automatic positions.

O. Warning Labels: The Contractor shall assure that warning labels are affixed to starters, disconnects, etc. that are under control of the EMS.

P. Safeties:

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1. Freeze protection: Furnish and install freeze protection thermostats in each air handling unit as required by sequences of operation. Freezestats shall have twenty two foot non-averaging sensing elements. Install the sensing element in a serpentine manner across the face of the protected coil. If the sensing element senses temperature below the set point of the freeze stat over any one foot section, the unit supply air fan shall stop. Valves and dampers controlled by freeze protection thermostats shall be spring return to fail-safe.
2. Smoke detectors and smoke dampers: Furnished by Divisions 23 & 26 and installed by the mechanical contractor. Control interlock wiring for the smoke detectors and dampers shall be by the controls contractor so that, upon sensing products of combustion or closure of smoke damper, associated equipment fans shall stop, outdoor dampers shall close. Equipment shall not be able to restart until smoke detector has been reset, smoke damper opened. Must be Labeled.
3. All safeties shall be hard-wired and independent of automation system relay coil circuits.

Q. Ethernet and telephone line to the vicinity of the EMS Network Controller and Ethernet drop to the Touchscreen Override Panel shall be installed by the General Contractor. MCPS allocates a maximum of five (5) ethernet drops and IP addresses for EMS system use.

R. Incoming Power Monitoring: Furnish and install new Motor Saver 250A.
1. Contractor shall be responsible for providing a 3-phase breaker to accommodate monitoring incoming building electrical power.
2. Power Monitoring contacts shall be closed indicating fully normal operation. Upon a loss of power or phase interruption to the device or a building power phase alarm, the contract shall open indicating an alarm. This applies both to the connections to security and to EMS. When power is lost to the monitoring device the contacts will open indicating an alarm.
3. Contractor shall contact the MCPS Energy Management Office if there is a question as to which terminals are to be utilized. Corrections to the wiring cannot be accomplished by inverting the signal thru Software will NOT BE ACCEPTED.

S. Power Metering: Smart Meter shall be wired and integrated into Schneider Electric Power Monitoring Server for global utility usage monitoring and peak load implementation. Integrate this into the Schneider power monitor server at MCPS.

T. Power for EMS Controllers:
1. EMS controllers shall be wired to dedicated electrical power circuits. EMS Contractor shall provide switches at each control panel to serve as a panel disconnect; a panel may consist of multiple controllers within a single enclosure. Each panel shall be fuse protected.
2. Terminal unit controllers: Where dedicated 120V power circuits are not provided for terminal controllers, power to the controllers may be obtained from the power feed to the equipment they control. Power to the EMS controller must be taken ahead of the terminal equipment's disconnect so that the controller remains powered though the unit's power may be turned off. Provide disconnects and transformers for the controller power.
3. DOASs, H&Vs, ERUs, RTUs, and similar HVAC equipment controllers shall be wired independent of the equipment power such that the controller shall remain powered when the power to the equipment is disconnected.
4. All panels with 120V power supply shall be surge protected; UPS shall be provided for all Network or master Building Controllers.

U. Controller Enclosures:
1. In general, controllers shall be mounted in hinged door NEMA 1 enclosures with a latch. Controller terminal strips wiring terminations, power feeds and protection shall be within the enclosure. Hinged door enclosures shall not be required when controller is mounted

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within HVAC incremental unit equipment enclosure (i.e. within console cover for heat pump, unit ventilator, etc.).

2. Put temporary wiring diagrams in controller enclosures during construction; permanent diagrams to be put in cabinets prior to initial on-site Performance Verification.

V. Spare Points/System Expansion:

1. Central plant equipment and global inputs (outdoor air, building power, system pumps, etc.) shall be on controllers in a single enclosure. A minimum of one spare AO, AI, DO, and DI shall be provided among the central plant equipment controllers.
2. Building wide, provide for a system minimum of 10% spare capacity of each type of point (digital input, digital output, analog input, analog output). This may be achieved by the installation of additional panels or expansion boards.
3. Controllers and controls network shall be capable of expanding network to include all shell spaces in addition to the 10% spare capacity.

W. Control System Server (CSS) shall be installed at MCPS Energy Management office; coordinate with Energy Management personnel. New server hardware need not be provided if server was installed under previous contract and currently operates properly and meets current MCPS requirements.

X. Contractor's option: Contractors have the option of placing certain equipment/systems under local controls or controlling via DDC and the EMS. The Points List defines the minimum requirements for system/equipment to be controlled via the EMS. Systems/equipment not included on the Points List, unless specifically excluded, may be provided with local controls or DDC. For example:

1. Thermostatically controlled exhaust fans are not included in the Points List, but are not specifically excluded. Contractors have the option of including thermostatically controlled exhaust fans in the DDC system or installing local electric thermostats.
2. Air Conditioning Units (Dry Food Storage, Computer Wire Closets, Elevator Machine Room, etc.) are not included in the Points List and are specifically excluded from EMS control. They are to be furnished completely with manufacturer's controls.

Y. Wiring of Manufacturer Devices: EMS contractor is responsible for installing and completing the wiring of equipment manufacturer supplied control devices such as space thermostats, interlocking wiring between condensate overflow switches and fans, variable refrigerant flow system communication wiring, etc.

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3.04 SYSTEM ARCHITECTURE

A. Controller locations:

1. Locate Override Touchscreen in Work Room in Administration.
2. Locate the system building controller (with ethernet and phone connections) in the Building Services Manager's Office.
3. Locate controllers and enclosures within mechanical or electrical equipment rooms. On special exception with approval by MCPS given prior to submitting a bid, controllers and enclosures may be located within storage rooms. In no case shall controllers, other than terminal unit controllers, be located above ceilings. All controllers not located in mechanical/electrical rooms or in incremental equipment enclosures must have locations approved by MCPS prior to Shop Drawing submittal.
4. Controller(s) installed for global inputs and control of central water systems; i.e. sidewall outdoor air sensor, electric pulse metering, phase monitor, boilers, chillers, system pumps, etc. shall be installed in the Building Services Manager's Office unless shown otherwise on contract drawings. Control points for geothermal water system points (pumps,

temperatures) shall be in the global/central plant controller, or may be installed in an enclosure in the Pump Room.

5. Heat Pump unit controllers shall be:
   a. Vertical units: Field installed, wall mounted in the equipment closet in an enclosure. Controllers shall not be mounted inside of units' casings. Where two or more controllers are installed adjacent to one another, they may be installed in a single enclosure.

B. Point and software configurations within controllers:
   1. Global input points; central plants:
      a. Global input points, i.e. sidewall outdoor air temperature, phase monitor, electric pulse metering, shall be located in a single controller.
      b. All central plant points; i.e. heating water system, chilled water system, condenser water system, shall be located in a single controller. Where central plant points exceed the capacity of a single controller, additional controller(s) and/or expansion board(s) may be used; however, controllers shall be housed in a single enclosure.
   2. Controllers shall be configured such that all points and control strategies required for proper control of a particular mechanical system shall be resident within the one controller; i.e. stand-alone architecture. The only acceptable exceptions to this architecture are:
      a. The cases where the mechanical system control points requirements exceed the point capacity of a single controller, and
      b. Control points for exhaust fans need not be located in same controllers of the systems with which they are interlocked.
      c. Automation systems employing expansion modules to provide additional control points to base controller shall be limited to not more than one expansion module per base controller.

C. Controllers shall be numbered sequentially.
   1. Where it is required to have multiple controllers controlling a mechanical system, all system points shall be in sequentially numbered panels. For example, if an energy recovery unit requires points in two controllers, the points shall be in sequentially numbered panels; e.g. Controllers #3 & #4, not Controllers #3 & #18.
   2. All controllers serving equipment within a Zone shall be sequentially numbered. For example, if a Zone has fourteen heat pumps, the unit controllers shall be sequentially numbered; e.g. Controller #11, #12, #13 . . . #22, #23, #24.

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3.05 SEQUENCES OF OPERATIONS

A. General:
   1. Satisfying this and all other sections of the specifications shall enable the Contractor to implement the control sequences specified on the drawings through the combination of electric and electronic hardware, software, and programming.
   2. Contractor shall perform all system adjusting, tuning, programming, etc., to provide the Owner with an operating control system that will function as described.
   3. Control sequences defined shall not be construed as absolute final sequences, i.e. Owner shall be able to reconstruct sequencing through program modifications at his discretion. Therefore, sequencing defined shall constitute the initial control strategies to be installed by Contractor.
   4. Other Programs
      a. Minimum ON/OFF times (all outputs).

b. Save and restore functions for dumping all memory to external storage device and back.

B. Sequences of Operation shall be as specified on contract drawings.

C. Economizer Operation (when controlled by the EMS):

1. Enthalpy Optimizer: When the central plant is in the mechanical cooling mode, economizer operation can reduce system cooling requirements when the outdoor air enthalpy levels and outdoor air dry-bulb conditions are within limits. The initial limits (adj.) set by MCPS are 26 BTU/Lbmda for enthalpy; 70 degrees F (Adj.) for dry-bulb temperature.
   a. If the outdoor air dry-bulb temperature and enthalpy are below the limits stated above, the outdoor air damper shall be allowed to modulate open beyond the minimum position to maintain temperature control, in conjunction with mechanical cooling. Conversely, if the outdoor air dry-bulb temperature and enthalpy are above limits stated above, the outdoor air damper shall not be allowed to open beyond the minimum position (except for demand control ventilation.)
   b. The enthalpy, or total heat, is the sum of the latent heat and sensible heat. Dry-bulb sensor inputs in conjunction with relative humidity input shall be used to calculate the enthalpy. The outdoor enthalpy is to be calculated using the outdoor air dry-bulb temperature and humidity values broadcast over the Internet for the school's location; values from the sensors located on the North wall shall be utilized when the internet is down.
2. Dry-bulb Economizer: When the central plant is not in the mechanical cooling mode, or mechanical cooling is not available (DX or chilled water), and the outdoor air temperature is <70 degrees F (Adj.), economizer control of air handling systems shall be in effect to modulate outdoor air dampers beyond minimum, subject to a min. discharge air temperature; outdoor air dampers shall not open beyond minimum unless the heating coil control valve is closed to the heating coil.

D. PLM Curtailment: During the cooling season, from Monday thru Friday, from 3:55 PM to 5:00 PM, June __ thru August __, the EMS shuts off the systems via a Special Schedule that is activated by a PLM Enable button on the MCPS Main Page as follows:

1. Schools with Heat Pump Loops:
   a. All HVAC equipment in the Zones shall be turned off.
   b. Administration and Media Center: MCPS Operator shall make the determination to include or exclude the Administration and Media Center in the shutdown.
   c. The main circulating pump serving the heat pump loop shall remain on.
   d. Auxiliary equipment such as the cooling tower and associated pump(s) shall be turned off.
   e. All exhaust fans and ventilation equipment (including DOASs and ERUs) under EMS control shall be turned off.
   f. Override panel shall be disabled.
2. Schools with Variable Refrigerant Systems:
   a. All HVAC equipment in the Zones shall be turned off.
   b. All exhaust fans and ventilation equipment (including DOASs and ERUs) under EMS control shall be turned off.
   c. Override panel shall be disabled.
3. At the conclusion of the curtailment period, the equipment that needs to run, shall start sequentially, with the Central Plant (where applicable) starting first.

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4. The MCPS Operator at the Turkey Thicket Drive Facility shall exclude a school from the curtailment by pushing a PLM Disable Button on the individual School Home Page. The Operator may also override certain areas or zones on where the systems are able to operate without chilled water. The exceptions will be on a special list of schools.

3.06 POINTS LIST, FLOW DIAGRAMS, SEQUENCES

A. The Input/Output Summary Table shown on the contract drawings represents the minimum requirements control points listing, alarm, and software functions to be included in the project.

B. Sequences of operation, flow diagrams, and points list are complementary. All control strategies shall be satisfied even if some of the required control points, alarm, or software have been inadvertently left off of the points list or diagrams. Similarly, control points, alarm, and software strategies indicated on the points list shall be provided even if a written sequence or flow diagram device has been inadvertently omitted.

3.07 COORDINATION WITH TAB

A. The Controls Contractor shall allocate 8 man-hours to the testing and balancing procedures; providing a competent technician to assist the TAB Contractor. This time shall be in addition to that required for start-up and testing of the controls, and for the time required to respond to any punch list generated by the TAB Contractor or to the Commissioning process.

B. Controls Contractor shall obtain piping and system pressure setpoints from the TAB Contractor for controlling pump and fan VFDs; setpoints shall be documented in controls As-Builts.

C. Controls Contactor shall coordinate minimum outdoor air damper positions with TAB contractor and assure that balanced minimum damper position is permanently marked on damper shaft or at damper blades.

3.08 PLACING IN SERVICE AND ACCEPTANCE:

A. Placing in service:

1. Upon completion of the installation, calibrate equipment and verify transmission media operation before system is placed on line. All testing, adjusting, and calibrating shall be completed and systems shall be properly operating prior to acceptance by Owner. Cross check each control point by comparing the control command and the field controlled device, equipment.
2. EMS Contractor shall be present and participate in the start-up of DOASs, ERUs, RTUs and H&V. Control sequences of operations and coordination of interlocks with equipment manufacturers' controls/safeties shall be demonstrated to the satisfaction and acceptance of MCPS, the design team, and the commissioning authority.

B. Prior to final acceptance and authorization for final payment by the Owner, Control System "punch list" inspections shall be made by representatives of the Owner's construction, maintenance, and energy management departments. This is not to preclude that punch lists shall be made by the Contractor to check the completion of his work prior to final "punch lists" inspection. The punch lists inspections shall be in three parts. An inspection shall be performed and punch list (Installation Punch List) prepared regarding the physical installation of the EMS equipment, wiring, etc., and separate punch list shall be prepared regarding the graphics interface (Graphics Punch List); and a third punch list shall be prepared regarding the software programming and systems performance verification at the site (Site Performance Verification Punch List).

1. Graphics Acceptance:
   a. Contractor shall perform self-review of graphics prior to requesting graphics review by Engineer. At a minimum, prior to requesting a Graphics/Programming Punch List inspection, all required "head end" software and graphics at the server shall be

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installed and functioning; graphics shall be accessible and demonstrated at the school. This work shall be performed prior to building occupancy.

b. Graphics checklist, provided by the Engineer to Contractor shall be completed by Contractor and returned to Engineer indicating that the Graphics are ready for review by Engineer. Engineer will provide review comments to Contractor. Contractor shall acknowledge that any corrective work cited in the review comments has been completed. Engineer will validate Contractor's response and acknowledge acceptance of Graphics when appropriate.

c. Engineer's review consist of the following: (1) One review upon receipt of the graphics checklist; (2) two follow up reviews after punch list items are corrected; (1) cross check when graphics are deemed acceptable. Reviews in excess of the above are to be considered chargeable to the Contractor.

2. Prior to requesting a Site Performance Verification Punch List inspection, all specified software and control strategies shall have been loaded into the computers at the facility to be inspected. It is recognized that not all software programming may be fully "debugged" at the time of Punch List inspections; however, the EMS Contractor shall be able to demonstrate that all required software strategies are installed and that equipment is being controlled by those strategies. To facilitate punch outs of installations, the Contractor shall have their software completely loaded and functional and a complete set of trends shall have been submitted to the Engineer and Commissioning Authority for review. Engineer shall not review trends until Head-End software and graphics have been approved by MCPS Energy Management personnel.

3. A minimum of two (2) complete sets of trends shall be submitted for review. Trends must be delivered to the Engineer and Commissioning Authority at least fourteen (14) days prior to a scheduled on-site performance verification of the facility. Provide a hardcopy and an electronic copy. Trends shall be submitted illustrating systems operations when the building is operating in the cooling mode (summer) and the heating mode (winter). The intent of this is to determine whether installed software is functioning and equipment performing as intended.

   a. Central plant and global control points must be included in all runs of trends.

   b. Trends shall be presented at hourly intervals for a 24 hour period, unless directed otherwise. Systems being monitored shall be operated with an occupancy schedule; i.e. indications that a system was scheduled off for the 24 hours of the trends and remained off are of no value. Occupancy schedules, zone overrides, and all system setpoints (both calculated and manual inputs) shall be provided with the trends and shall be in accordance with MCPS Energy Management standards and/or directions. Trends shall be submitted in hardcopy and electronically with English language point descriptor column header, engineering units provided for each point (e.g. °F, ppm, %RH, CFM, psig, amps, etc.); lengthy point path names as column headers are not acceptable. Print the time and point data information in its respective column for all values for that point. Digital points (commands and statuses) shall be presented as On/Off, Open/Closed (not 0/1); damper, valves shall be trended as % open (not 2-10 or 4-20); temperatures shall be in °F to tenths of a degree.

   c. Formatting of Trends: Provide spreadsheet format with all points for each unit, organized with approved point names. Group points together that natural belong together (i.e. command and status, supply air temp and its setpoint. Standardize on a format and use it consistently. Submit sample formats for each unit type for approval in advance.

      1) The trends shall be organized as follows:

         (a) Zone Schedules, Overrides, etc.

         (b) Central Plant(s) Data

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(c) Zone 1 thru Zone X (all equipment associated with each zone to be trended in a group; not scattered throughout)

(d) Building Exhaust (they can be shown with the associated zone equipment or in a group at the end of the trends.)

2) Extraneous points shall not be trended i.e. allow boiler, allow chiller.

3) Trends for equipment shall be organized and consistent from device to device i.e. fan command, fan status, OA damper, space temp, cfm, etc., shall be in the same position device to device.

4) If more than a single page is required for a piece of equipment, do not repeat data on the subsequent pages.

d. Prior to submitting a set of trends to MCPS, the Contractor shall perform a self-review to identify and correct problems. Where trends indicate problems, discrepancies, and/or deficiencies and the Contractor has performed corrections, partial trends may be submitted as addenda or inserts with the original set of complete building trends indicating that the problem has been corrected. For example, if the complete set of building trends largely indicates that the control system functions properly, but an air handling unit was not running when commanded on; an addendum or insert trend for this air handling unit may be provided with the original complete set that indicates proper operations after the unit was made to run. All global and central plant points shall be included for the time period of the addendum trends. Include contractor review comments with trends submission.

e. To assure that trends suitably demonstrate appropriate operations, heating trends shall be run when outdoor air drops to an occurrence of at least 35°F during the trend period, cooling season trends can be run whenever outdoor air rises to an occurrence of at least 85°F during the trend period.

f. Predicated upon the discrepancies discerned by the engineer's review of trends, subsequent complete or partial trends may be required.

g. The following constitutes those items that, at a minimum and as applicable, shall be included in a trend submittal:

1) Outdoor air: Dry-bulb temperature, humidity, CO2, enthalpy (wall and roof locations)

2) Phase, Voltage: Trends should indicate time and duration of any occurrence of power interruption and normal power resumption.

3) Incoming Power: Kw, Kwh

4) Overrides: Run status

5) Hot Water Heating Systems:

(a) Supply water temperature actual and setpoint

(b) Return water temperature

(c) Mixing valve command

(d) Pumps commands, status

(e) Boilers

(1) Controller enable/disable or Boiler enable/disable

(2) Setpoint adjust

(3) Boiler temperature

(4) Header temperature

(5) Actual run status (fuel valve)

(6) Alarm

(f) Low loop alarm

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6) Heat Pump Loop
   (a) Supply water temperature actual and setpoint
   (b) Return water temperature
   (c) HX entering water temperature
   (d) Pumps commands, status
   (e) Low loop alarm
7) Cooling Tower:
   (a) Pumps commands, status
   (b) Condenser water valve command
   (c) Tower fan: Command, Status, VFD speed & alarm
   (d) Tower leaving water temperature
   (e) Tower return water temperature
8) Incremental Units (UVs, FCUs, CUHs)
   (a) Space temperature actual and setpoint
   (b) Supply air temperature
   (c) Supply fan command and status
   (d) Cooling command
   (e) Heating valve command
   (f) Cooling valve command
   (g) Zone temperatures where applicable
   (h) FC/UV circuits enable/disable and command status where applicable
9) Heat Pumps:
   (a) Reversing valve command
   (b) Fan command and status
   (c) Discharge & space temperatures
   (d) Failure alarm
   (e) Heat Pump Loop valve command and status
   (f) Compressor command & status
10) H&V (DDC and BACnet points as applicable to unit configuration & function)
   (a) Outdoor and recirc air dampers commands
   (b) Supply fan command and status
   (c) Space temperature actual and setpoint
   (d) Space air temperature
   (e) Furnace commands
11) DOAS/ERU (DDC and BACnet points as applicable to unit configuration & function)
   (a) Enable/disable command
   (b) Occupied/unoccupied command
   (c) Supply and exhaust fan statuses, exhaust fan speed
   (d) Alarm status
   (e) Outdoor air temperature, humidity, & dewpoint
   (f) Supply air temperature
   (g) Exhaust air temperature
   (h) Space temperature, humidity, CO2

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(i) Controlling setpoint (supply, space or effective temperature and/or humidity)
(j) Outdoor air / recirc dampers positions
(k) Recovery wheel command
(l) Compressors statuses; VFD scroll output
(m) Hot gas reheat valve position
(n) Outdoor airflow (cfm)
(o) Operating mode (occ/unocc, econ, dehumid, etc.)

12) Variable Refrigerant Systems (DDC and BACnet points)
(a) Occupied/unoccupied command
(b) EMS zone temperature
(c) General alarm status
(d) Individual space temperatures and setpoints
(e) Fan-coils on/off
(f) Fan-coils heating/cooling mode

13) Exhaust Fans (where EMS controlled and/or monitored):
(a) Scheduled run/enabled status
(b) Actual run status or enabled status

4. A minimum of two (2) on-site inspections for punch-out of software and systems operations shall be performed. The inspections shall occur with the building and/or central plants operating in either the mechanical heating or cooling mode. A follow-up on-site inspection shall occur while building and/or central plants are operating in the opposite season. If scheduled delivery of the project falls during a period in which a central plant is not operating or outdoor air temperatures are not conducive to witnessing comprehensive heating or cooling operations, EMS punch out will be delayed until such time as the central plant has been operating under EMS control for at least one week and outdoor air temperatures are such as to afford witnessing of heating or cooling operations. Example: an 85°F day in April will not provide acceptable cooling mode trends or building HVAC operations if chiller plant was not in operation. Initial acceptance of the EMS to start the warranty in the heating or cooling mode is conditional. Final acceptance shall be predicated on acceptance of the EMS in the subsequent seasonal operations; i.e. to maintain the warranty, the EMS must function properly in both modes.
a. EMS site inspections shall be made jointly with the EMS Engineer, Energy Management Office Representative and the designated Representative from the Division of Construction.
b. Prior to performing on-site inspections, trends and draft As-Built control drawings shall have been submitted and reviewed. All deficiencies cited from trends and As-Built reviews conveyed to the contractor shall be corrected and attested in writing by the contractor prior to on-site inspection.
c. Contractor shall be represented at the on-site demonstration by at a minimum by one programmer and one technician knowledgeable of the programming and installation at the facility.
d. Functionality of mobile device interface shall be demonstrated at the initial on-site software and operation inspection.

C. Over the two year guarantee period, a complete EMS trend shall be submitted by the Contractor four times a year to MCPS for their review. The submission of trends may be increased or decreased pursuant to their evaluation; i.e., decreased if all is well, increased if problems exist. Prior to submitting a trend to MCPS, the Contractor shall perform a self review

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to identify and correct problems. The intent of trend reviews during the guarantee period by MCPS is fine tuning of the EMS, not debugging. The trends shall contain all of the points cited hereinbefore for Punch-Out trends. These items shall be enforced by EMS and DOC together during punchout phase with commissioning agent.

3.09 GRAPHICS

A. Provide dynamic graphic screens as previously specified. Phase pertinent graphics shall be accessible to MCPS operating and maintenance personnel on-site prior to initial occupancy of each completed phase.

3.10 INSTRUCTIONS AND DOCUMENTATION

A. Installation Documentation:
   1. Provide software documentation so all software programs may be easily referenced from summary sheets which compare control programs with hardware controlled and wiring. Documentation shall include complete point identification including terminal number, symbol, engineering units, and control program reference number; field information including location, device type and function, electrical parameters and installation drawing number, location of EMS control hardware.
   2. Maintain a complete set of control drawings separate from those being used for installation at the site. The express purpose of these drawings will be to record any and all changes made. The Contractor shall mark these prints showing any change whatsoever.
   3. Electrical circuits used to power EMS panels shall be identified on EMS As-Built installation drawings. Panel and circuit number powering the EMS panel shall be permanently marked inside the EMS cabinets. Circuits shall be marked in electrical panels and on panel schedules, noted “EMS, Do Not Turn Off”.
   4. Provide complete maintenance and program manual at the initial acceptance inspection. Maintenance manuals shall include complete wiring diagrams, parts lists, etc., so as to enable the Owner to perform any and all service, maintenance, troubleshooting, inspection, testing, etc. as may be necessary and/or required. Program manuals shall provide complete description of programming language including commands, editing and writing control programs, algorithms, printouts and logs, mathematical calculations, passwords, instructions on modifying any control algorithm or parameter, verifying errors or status, changing passwords, and initiating or disabling programs.
   5. At the completion and initial acceptance of the project, the Contractor shall furnish to the Owner:
      a. Two (2) installation manuals in 3-hole binders, 8-1/2” x 11” paper with project identified on cover and spline. Each binder shall have:
         1) Project controls specifications
         2) Copies of addenda, RFIs and responses
         3) As-built control drawings, panel layouts, and sequences (folded 11” x 17”)
         4) Color coded zoning floor plan, 8-1/2" x 11".
         5) As-built installation/distribution building floor plan(s) drawings showing panel locations, communication wiring runs, power sources, etc. (folded 11”x17”).
      b. Provide a 64GB USB Flash Drive 3.0 (or better) with all of the above, programs and data base.
      c. Copy of the binder and 64GB USB Flash Drive 3.0 shall also be provided to the Engineer.

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d. (2) additional 11" x 17" color coded zone maps (laminated) shall be provided for retention at the school – (1) copy provided in a binder; (1) copy mounted in a frame in a location designated by MCPS.

e. As-built control drawings are to be turned over to MCPS electronically on a 64GB USB drive in the program they were created in (i.e. Visio) as well as AutoCAD DWG drawing format.

6. Attach laminated copy of each pertinent control drawing(s) to the interior of the controllers' enclosure door. Control drawing(s) shall include controller diagram with control points identified, controlled equipment flow diagram(s) and sequence(s) of operation.

B. Instructions: Instruct the Owner's representative in all the necessary procedures for satisfactory operation, maintenance, and programming of the controls systems. Instruction shall be by competent personnel totally familiar with the systems installed. Training sessions shall consist of at least eight (8) hours in response to Owner scheduling.

1. An additional allowance of forty (40) hours of training per school shall be provided to MCPS Energy Management and/or Maintenance personnel as requested through the 12 months following the award of contract. This training would include, but not limited to refresher training, hardware installation, troubleshooting, demonstrations of shortcuts, programming tips, graphics assistance, retrieval of data such as min and max values of cfm, etc. Unused training would be credited towards Factory Training at the hourly rate in this contract. The additional training would not be limited to the schools within this bid group. This must be done onsite, at EMS office or at school with an EMS representative present.

END OF SECTION 230900

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SECTION 230934
VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Variable-frequency motor controllers for low-voltage (600 V and less) AC motor applications.

B. Overcurrent protective devices for motor controllers, including overload relays.

1.02 RELATED REQUIREMENTS

A. Section **<< 033000 - Cast-in-Place Concrete>>**: Housekeeping pads.

B. Section **<< 230529 - Hangers and Supports for HVAC Piping and Equipment>>**.

C. Section **<< 230548 - Vibration and Seismic Controls for HVAC>>**.

D. Section **<< 230553 - Identification for HVAC Piping and Equipment>>**: Identification products and requirements.

E. Section **<< 260526 - Grounding and Bonding for Electrical Systems>>**.

F. Section **<< 262813 - Fuses>>**.

1.03 REFERENCE STANDARDS

A. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code).

B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.

D. NEMA IA 10039 - Control Circuit and Pilot Devices.

E. NEMA IA 10030 - Industrial Control and Systems: Enclosures.

F. NEMA IS 10033 - Industrial Control and Systems: Adjustable-Speed Drives.

G. NEMA IS 10034 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.

H. NEMA IS 10035 - Application Guide for AC Adjustable Speed Drive Systems.

I. NEMA ICS 61800-2 - Adjustable Speed Electrical Power Drive Systems, Part 2: General Requirements-Rating Specifications for Low Voltage Adjustable Frequency AC Power Drive Systems.

J. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).

K. NEMA MG 00001 - Motors and Generators.

L. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems.

M. NFPA 70 - National Electrical Code.

N. UL 98 - Enclosed and Dead-Front Switches.

O. UL 508A - Industrial Control Panels.

P. UL 61800-5-1 - Standard for Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety Requirements – Electrical, Thermal, and Energy (Ed. 2).

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1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate work to provide motor controllers suitable for use with actual motors to be installed.
   2. Coordinate work to provide controllers and associated wiring suitable for interface with control devices to be installed.
   3. Coordinate arrangement with dimensions and clearance requirements of actual equipment to be installed.
   4. Verify with manufacturer that conductor terminations are suitable for use with conductors to be installed.
   5. Notify **<<Architect>>** of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>**, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.

C. Shop Drawings: Indicate dimensions, voltage, controller sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include dimensioned plan and elevation views of controllers and adjacent equipment with required clearances indicated.
   2. Include wiring diagrams showing factory and field connections.
   3. Identify mounting conditions required for equipment seismic qualification.

D. Derating Calculations: Indicate ratings adjusted for applicable service conditions.

E. Specimen Warranty: Submit sample of manufacturer's warranty.

F. Manufacturer qualification statement.

G. Installer qualification statement.

H. Maintenance contractor qualification statement, if different entity from installer.

I. Manufacturer's equipment seismic qualification certification.

J. Manufacturer's certification that products meet or exceed specified requirements.

K. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

L. Source quality control test reports.

M. Manufacturer’s detailed field testing procedures.

N. Field quality control test reports.

O. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
   1. Include contact information for entity providing contract maintenance and trouble call-back service.

P. Executed Warranty: Submit documentation of final executed warranty completed in **<<Owner>>**'s name and registered with manufacturer.

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Q. Maintenance contracts.

R. Project Record Documents: Record actual installed locations of controllers and final equipment settings.
   1. Include nameplate data of actual installed motors and associated overload relay selections and settings.
   2. Motor Circuit Protectors: Include magnetic instantaneous trip settings.

S. Maintenance Materials: Furnish following for **<<Owner>>**'s use in maintenance of project.
   1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
   2. Electronic Trip Circuit Breakers: Provide **<< one; or _____>>** portable test set.
   3. Indicating Lights: **<< Two; or _____>>** of each different type.
   4. Air Filters: **<< Two; or _____>>** of each different type.
   5. See Section **<< 262813>>** for requirements for spare fuses and spare fuse cabinets.

1.06 QUALITY ASSURANCE

A. Comply with requirements of **<<NFPA 70>>**.

B. Maintain copy of each referenced document that prescribes execution requirements at project site.

C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum **<< three; or _____>>** years**<< documented; _____; or None - N/A>>** experience.
   1. Authorized service facilities located within **<< 200 miles; _____ miles; or _____>>** of project site.

D. Installer Qualifications: Company with minimum **<< three; or _____>>** years**<< documented; _____; or None - N/A>>** experience with variable-frequency motor control systems of similar size, type, and complexity**<< ; manufacturer's authorized installer; ; _____; or None - N/A>>**.

E. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

1.09 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Provide minimum five years manufacturer warranty (parts and labor) covering repair or replacement due to defective materials or workmanship.

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PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ABB**<< ; _____; or None - N/A>>**: www.abb.com/#sle.

B. Danfoss**<< ; _____; or None - N/A>>**: www.danfoss.com/#sle.

C. Yaskawa America, Inc; **<< ; _____; or None - N/A>>**: www.yaskawa.com/#sle.

D. Trane

E. Eaton.

F. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

G. Source Limitations: Furnish variable-frequency motor controllers and associated components produced by a single manufacturer and obtained from a single supplier.

2.02 VARIABLE-FREQUENCY MOTOR CONTROLLERS

A. Provide variable-frequency motor control system consisting of required controller assemblies, operator interfaces, control power transformers, instrumentation and control wiring, sensors, accessories, system programming, etc. as necessary for complete operating system.

B. Provide products listed, classified, and labeled as suitable for purpose intended.

C. Controller Assemblies: Comply with **<<NEMA IS 10033>>**, **<<NEMA IS 10034>>**, and **<<NEMA ICS 61800-2>>**; list and label as complying with **<<UL 61800-5-1>>** or **<<UL 508A>>** as applicable.

D. Provide controllers selected for actual installed motors and coupled mechanical loads in accordance with **<<NEMA IS 10035>>**, **<<NEMA MG 00001>>** Part 30, and recommendations of manufacturers of both controller and load, where not in conflict with specified requirements; considerations include, but are not limited to:

1. Motor type (e.g., induction, reluctance, and permanent magnet); consider **<<NEMA MG 00001>>** design letter or inverter duty rating for induction motors.
2. Motor load type (e.g., constant torque, variable torque, and constant horsepower); consider duty cycle, impact loads, and high inertia loads.
3. Motor nameplate data.
4. Requirements for speed control range, speed regulation, and braking.
5. Motor suitability for bypass starting method, where applicable.

E. Single Controllers Serving Multiple Motors:

1. Control Method: Scalar/volts per hertz; do not use vector control method.
2. Provide separate overload relay for each motor; provide auxiliary contacts and control wiring as required to shut down controller upon trip of any single overload relay.
3. Consider combined length of motor leads for cable length limits.

F. Devices on Load Side of Controller: Suitable for application across full controller output frequency range.

G. Operating Requirements:

1. Input Voltage Tolerance: **<< Plus/minus 10 percent of nominal; or _____>>**.
2. Input Frequency Tolerance: **<< Plus/minus 5 percent of nominal; or _____>>**.
3. Efficiency: Minimum of **<< 96 percent; _____ percent; or _____>>** at full speed and load.
4. Input Displacement Power Factor: Minimum of **<< 0.96; or _____>>** throughout speed and load range.

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5. Overload Rating:
   a. Variable Torque Loads: Minimum of **<< 110 percent of nominal; _____ percent of nominal; or _____>>** for 60 seconds.
   b. Constant Torque Loads: Minimum of **<< 150 percent of nominal; _____ percent of nominal; or _____>>** for 60 seconds.

H. Power Conversion System: Microprocessor-based, pulse width modulation type.
   1. **<< Diode-based, 6-pulse type; Diode-based, 12-pulse type; Diode-based, 18-pulse type; IGBT-based active front end type; Matrix converter type; or _____>>** unless otherwise indicated.

I. Control System:
   1. Provide microprocessor-based control system for automatic control, monitoring, and protection of motors. Include sensors, wiring, and connections necessary for functions and status/alarm indications specified.
   2. Provide integral operator interface for controller programming, display of status/alarm indications, fault reset, and local control functions**<< including motor run/stop, motor forward/reverse selection, motor speed increase/decrease, and local/remote control selection; _____; or None - N/A>>**.
   3. Control Functions:
      a. Control Method: **<< Selectable vector and scalar/volts per hertz; Scalar/volts per hertz; or _____>>** unless otherwise indicated.
         1) Scalar/Volts per Hertz Control: Provide **<< fixed voltage boost; IR compensation; or _____>>** for improved low-speed torque.
         2) Vector Control: Provide selectable autotuning function.
      b. Adjustable acceleration and deceleration time; linear and S-curve ramps; selectable coast to stop.
      c. Selectable braking control; **<< DC injection or flux braking; or _____>>**.
      d. Adjustable minimum/maximum speed limits.
      e. Adjustable pulse width modulation switching carrier frequency.
      f. Adjustable motor slip compensation.
      g. Selectable autorestart after noncritical fault; programmable number of time delay between restart attempts.
   4. Status Indications:
      a. Motor run/stop status.
      b. Motor forward/reverse status.
      c. Local/remote control status.
      d. Output voltage.
      e. Output current.
      f. Output frequency.
      g. DC bus voltage.
      h. Motor speed.
   5. Protective Functions/Alarm Indications:
      a. Overcurrent.
      b. Motor overload.
      c. Undervoltage.
      d. Overvoltage.
      e. Controller overtemperature.

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f. Input/output phase loss.
g. Output short circuit protection.
h. Output ground fault protection.

6. Inputs:
   a. Digital Input(s): **<< Three; or _____>>**.
   b. Analog Input(s): **<< Two; or _____>>**.
7. Outputs:
   a. Analog Output(s): **<< One; or _____>>**.
   b. Relay Output(s): **<< Two; or _____>>**.
8. Communications: Compatible with connected systems. Provide accessories necessary for proper interface.
   a. Serial Communications: **<< RS-485; or _____>>**; support for **<< Modbus RTU; BACnet MS/TP; or _____>>** protocol.
   b. Ethernet Communications: Support for **<< Modbus TCP; BACnet IP; and _____>>** protocol.
   c. Remote Monitoring Capabilities:
      1) Motor run/stop status.
      2) Hand-off-auto status.
      3) Fault information.
      4) Discrete input/output status.
      5) Analog input/output values.
   d. Remote Control Capabilities:
      1) Motor run/stop command.
      2) Hand-off-auto selection.
      3) Speed adjustment.
      4) Fault reset.
9. Features:
   a. Password-protected security access.
   b. Event log.

J. Power Conditioning/Filtering:
   1. Provide **<< DC link choke or input/line reactor; DC link choke and input/line reactor; or _____>>** for each controller unless otherwise indicated or required.
   2. Reactor Impedance: **<< 3 percent; 5 percent; or _____>>**, unless otherwise indicated or required.

K. Packaged Controllers: Controllers factory-mounted in separate enclosure with externally operable disconnect and specified accessories.
   1. Disconnects: **<< Circuit breaker or disconnect switch type; Circuit breaker type; Disconnect switch type; or _____>>**.
      a. Disconnect Switches: Fusible type or nonfusible type with separate input fuses.
      b. Provide externally operable handle with means for locking in OFF position. Provide safety interlock to prevent opening cover with disconnect in ON position with capability of overriding interlock for testing purposes.
      c. Provide auxiliary interlock for disconnection of external control power sources where applicable.
   2. Provide door-mounted remote operator interface.

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L. Service Conditions:
1. Provide controllers and associated components suitable for operation under following service conditions without derating:
a. Altitude: Less than **<< 3,300 feet>>**.
b. Ambient Temperature: Between **<< 32 degrees F>>** and **<< 104 degrees F>>**.
2. Provide controllers and associated components suitable for operation at indicated ratings under service conditions at installed location.

M. Short Circuit Current Rating:
1. Provide line/input reactors where specified by manufacturer for required short circuit current rating.

N. Conductor Terminations: Suitable for use with conductors to be installed.

O. Enclosures:
1. Comply with **<<NEMA IA 10030>>**.
2. **<<NEMA EN 10250>>** Environment Type or Equivalent **<<IEC 60529>>** Rating: **<< Unless otherwise indicated, as specified for following installation locations:; As indicated on drawings.; or _____ .>>**
a. Indoor Clean, Dry Locations: **<< Type 1 or Type 12; or _____>>**.
b. Outdoor Locations: **<< Type 3R or Type 4; or _____>>**.
c. Hazardous/Classified Locations: **<< Type 7/9; or _____>>**, as required for classification of installed location.
3. Finish: **<< Manufacturer's standard unless otherwise indicated; or _____>>**.
4. Cooling: Forced air or natural convection as determined by manufacturer.
5. Enclosure Space Heaters:
a. Provide in each controller enclosure installed **<< outdoors; in unconditioned indoor spaces; and _____>>**.
b. Size according to manufacturer's recommendations for worst case ambient temperature to prevent condensation.
c. Heater Control: **<< Thermostat; Humidistat; or _____>>**.
d. Heater Power Source: Provide connection to **<< transformer factory-installed in enclosure; suitable external branch circuit as indicated or as required; or _____>>**.

2.03 OVERCURRENT PROTECTIVE DEVICES

A. Overload Relays:
1. Provide overload relays and, where applicable, associated current elements/heaters selected for actual installed motor nameplate data, in accordance with manufacturer's recommendations and **<<NFPA 70>>**; include consideration for motor service factor and ambient temperature correction, where applicable.
2. Comply with **<<NEMA ICS 2>>**.
3. Inverse-Time Trip Class Rating: **<< Class 20 unless otherwise indicated or required; As indicated on drawings; or _____>>**.
4. Trip-free operation.
5. Visible trip indication.
6. Resettable:
a. Employ **<< automatic reset; remote reset; or _____>>**.
7. Solid State Overload Relays:

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a. Adjustable full load current**<< ; minimum range of 2 to 1; ; _____; or None - N/A>>**.
b. Phase loss protection**<< ; selectable; ; _____; or None - N/A>>**.
c. Phase imbalance protection**<< ; selectable; ; _____; or None - N/A>>**.
d. Ambient temperature insensitive.
e. Thermal memory.
f. Trip test function.
g. Provide isolated alarm contact.

B. Fusible Disconnect Switches:
1. Description: Quick-make, quick-break, dead-front fusible switch units complying with **<<NEMA BS 31047>>**, and listed and labeled as complying with **<<UL 98>>**; ratings, configurations, and features as indicated or as required.
2. Fuse Clips: As required to accept indicated fuses.
a. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
3. Provide externally operable handle with means for locking in OFF position. Provide means for locking switch cover in closed position. Provide safety interlock to prevent opening of cover with switch in ON position with capability of overriding interlock for testing purposes.

2.04 ACCESSORIES

A. Auxiliary Contacts:
1. Comply with **<<NEMA IA 10039>>**.
2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking**<< , plus one normally open (NO) and one normally closed (NC) spare contact for each bypass motor starter, minimum; , _____; or None - N/A>>**.

2.05 SOURCE QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.
B. Factory test controllers in accordance with **<<NEMA ICS 61800-2>>**.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that ratings of controllers are consistent with indicated requirements.
C. Verify that mounting surfaces are ready to accept controllers.
D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Install in accordance with **<<NEMA IS 10034>>** and manufacturer's instructions.
C. Do not exceed manufacturer's recommended maximum cable length between controller and motor.

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D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and **<<NFPA 70>>**.

E. Provide required support and attachment in accordance with Section **<< 230529>>**.

F. Provide required seismic controls in accordance with Section **<< 230548>>**.

G. Install controllers plumb and level.

H. Unless otherwise indicated, mount floor-mounted controllers on properly sized **<< 3 inch; 4 inch; or _____>>** high concrete pad constructed in accordance with Section **<< 033000; or _____>>**.

I. Provide grounding and bonding in accordance with Section **<< 260526>>**.

J. Install field-installed devices, components, and accessories.

K. Provide fuses complying with Section **<< 262813>>** for fusible switches as indicated.

L. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

M. Set field-adjustable settings of controllers and associated components according to installed motor requirements, in accordance with recommendations of manufacturers of controller and load.

N. Identify controllers in accordance with Section **<< 230553>>**.

3.03 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Provide services of manufacturer's authorized representative to **<< observe installation and assist in inspection and testing; perform inspection and testing; or _____>>**. Include manufacturer's reports with submittals.

C. Inspect and test in accordance with **<<NETA ATS>>**, except Section 4.

D. Perform inspections and tests listed in **<<NETA ATS>>**, Section 7.17. Insulation-resistance test on control wiring listed as optional is **<< not required; required; or _____>>**.

E. Fusible Switches: Perform inspections and tests listed in **<<NETA ATS>>**, Section 7.5.1.1.

F. Test for proper interface with other systems.

G. Correct deficiencies and replace damaged or defective controllers or associated components.

H. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from controller enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

A. See Section **<< 017800 - Closeout Submittals>>**, for closeout submittals.

B. See Section **<< 017900 - Demonstration and Training>>**, for additional requirements.

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C. Demonstration: Demonstrate proper operation of controllers to **<<Owner>>**, and correct deficiencies or make adjustments as directed.

D. Training: Train **<<Owner>>**'s personnel on operation, adjustment, and maintenance of controllers and associated devices.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of **<< two hours; or _____>>** of training.
3. Instructor: **<< Manufacturer's authorized representative; or _____>>**.
4. Location: **<< At project site; or _____>>**.

3.07 PROTECTION

A. Protect installed controllers from subsequent construction operations.

3.08 MAINTENANCE

A. See Section **<< 017000 - Execution and Closeout Requirements>>**, for additional requirements relating to maintenance service.

END OF SECTION 230934

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SECTION 230993
SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other sections.

1.02 RELATED REQUIREMENTS

A. Section **<< 019113 - General Commissioning Requirements>>**: Commissioning requirements that apply to all types of work.

B. Section **<< 230913 - Instrumentation and Control Devices for HVAC>>**.

1.03 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Sequence of Operation Documentation: Submit written sequence of operation for entire HVAC system and each piece of equipment.

1. Preface: 1 or 2 paragraph overview narrative of the system describing its purpose, components and function.
2. State each sequence in small segments and give each segment a unique number for referencing in Functional Test procedures; provide a complete description regardless of the completeness and clarity of the sequences specified in Contract Documents.
3. Include at least the following sequences:
   a. Start-up.
   b. Warm-up mode.
   c. Normal operating mode.
   d. Unoccupied mode.
   e. Shutdown.
   f. Capacity control sequences and equipment staging.
   g. Temperature and pressure control, such as setbacks, setups, resets, etc.
   h. Detailed sequences for all control strategies, such as economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
   i. Effects of power or equipment failure with all standby component functions.
   j. Sequences for all alarms and emergency shut downs.
   k. Seasonal operational differences and recommendations.
   l. Interactions and interlocks with other systems.
4. Include initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
5. For packaged controlled equipment, include manufacturer's furnished sequence of operation amplified as required to describe the relationship between the packaged controls and the control system, indicating which points are adjustable control points and which points are only monitored.

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C. Control System Diagrams: Submit graphic schematic of the control system showing each control component and each component controlled, monitored, or enabled.
   1. Label with settings, adjustable range of control and limits.
   2. Include flow diagrams for each control system, graphically depicting control logic.
   3. Include the system and component layout of all equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
   4. Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.
   5. Include all monitoring, control and virtual points specified in elsewhere.
   6. Include a key to all abbreviations.

D. Points List: Submit list of all control points indicating at least the following for each point.
   1. Name of controlled system.
   2. Point abbreviation.
   3. Point description; such as dry bulb temperature, airflow, etc.
   4. Display unit.
   5. Control point or setpoint (Yes / No); i.e. a point that controls equipment and can have its setpoint changed.
   6. Monitoring point (Yes / No); i.e. a point that does not control or contribute to the control of equipment but is used for operation, maintenance, or performance verification.
   7. Intermediate point (Yes / No); i.e. a point whose value is used to make a calculation which then controls equipment, such as space temperatures that are averaged to a virtual point to control reset.
   8. Calculated point (Yes / No); i.e. a “virtual” point generated from calculations of other point values.

E. Designer's Qualification Statement.

F. Project Record Documents: Record actual locations of components and setpoints of controls, including changes to sequences made after submission of shop drawings.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 TO BE EDITED BY DESIGN TEAM

END OF SECTION 230993

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SECTION 232113
HYDRONIC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hydronic system requirements.
B. Heating water and glycol piping, buried.
C. Heating water and glycol piping, above grade.
D. Chilled water piping, buried.
E. Chilled water piping, above grade.
F. Condenser water piping, buried.
G. Condenser water piping, above grade.
H. Equipment drains and overflows.
I. Pipe hangers and supports.
J. Unions, flanges, mechanical couplings, and dielectric connections.
K. Valves:
    1. Ball valves.
    2. Check valves.
L. Flow controls.

1.02 RELATED REQUIREMENTS

A. Section **<< 078400 - Firestopping>>**.
B. Section **<< 083100 - Access Doors and Panels>>**.
C. Section **<< 099123 - Interior Painting>>**.
D. Section **<< 230516 - Expansion Fittings and Loops for HVAC Piping>>**.
E. Section **<< 230719 - HVAC Piping Insulation>>**.
F. Section **<< 232500 - HVAC Water Treatment>>**: Pipe cleaning.

1.03 REFERENCE STANDARDS

A. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.
B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
D. ASME B16.51 - Copper and Copper Alloy Press-Connect Pressure Fittings.
E. ASME B31.9 - Building Services Piping.
A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators.
B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

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C. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.

D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

E. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

F. ASTM A536 - Standard Specification for Ductile Iron Castings.

G. ASTM B32 - Standard Specification for Solder Metal.

H. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

I. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).

J. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

K. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

L. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

M. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

N. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.

O. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

P. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

Q. ASTM F3226/F3226M - Standard Specification for Metallic Press-Connect Fittings for Piping and Tubing Systems.

R. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

S. AWS D10.12M/D10.12 - Guide for Welding Mild Steel Pipe.

T. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems.

U. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings.

V. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

W. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast.

X. AWWA C606 - Grooved and Shouldered Joints.

Y. IAPMO (UMC) - 2024 Uniform Mechanical Code.

Z. IAPMO/ANSI/CAN Z1117 - Standard for Press Connections.

AA. ICC (IMC) - International Mechanical Code.

BB. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

1.04 ADMINISTRATIVE REQUIREMENTS

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A. Preinstallation Meeting: Conduct a preinstallation meeting**<< one week; at least one week; _____; or None - N/A>>** prior to the start of the work of this section; require attendance by all affected installers.

B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Welders Certificate: Include welders certification of compliance with **<< ASME BPVC-IX; AWS D1.1/D1.1M; or _____>>**.

C. Product Data:
   1. Include data on pipe materials, pipe fittings, valves, and accessories.
   2. Provide manufacturers catalog information.
   3. Indicate valve data and ratings.

D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

E. Project Record Documents: Record actual locations of **<< valves; or _____>>**.

F. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum **<< three; or _____>>** years of**<< documented; or None - N/A>>** experience.

B. Date stamp all castings used for coupling housings, fittings, valve bodies, etc. for quality assurance and traceability.

C. Coupling Manufacturer:
   1. Perform on-site training by factory-trained representative to the Contractor's field personnel in the proper use of grooving tools and installation of grooved joint products.
   2. Periodic job site visits by factory-trained representative to ensure best practices in grooved joint installation.
   3. A distributor's representative is not considered qualified to perform the training.

D. Welder Qualifications: Certify in accordance with **<< ASME BPVC-IX; AWS D1.1/D1.1M; or _____>>**.
   1. Provide certificate of compliance from **<< authority having jurisdiction,; or _____>>** indicating approval of welders.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

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1.08 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with **<<ASME B31.9>>** and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:

1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
2. Use only yellow brass nipples whenever jointing dissimilar metals.
3. Grooved mechanical joints **<< may be used in accessible locations only; are required in accessible locations and not permitted in other locations; are required in all locations; may be used in any location; are not permitted in any location; or only used in accessible locations and should not be used in mechanical rooms>>**
   a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by **<<Architect>>**.
   b. Grooved mechanical connections and joints comply with **<<AWWA C606>>**.
      1) Ductile Iron: Comply with **<<ASTM A536>>**, Grade 65-45-12.
      2) Steel: Comply with **<<ASTM A106/A106M>>**, Grade B or **<<ASTM A53/A53M>>**.
   c. Use rigid joints unless otherwise indicated.
4. Provide pipe hangers and supports in accordance with **<< ASME B31.9; MSS SP-58; or _____>>** unless indicated otherwise.

C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use **<< flanges; unions; grooved couplings; or _____>>** to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.

D. Valves: Provide valves where indicated:

1. Provide drain valves where indicated, and if not indicated, provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use **<< 3/4 inch; or ____ inch>><< gate; ball; or ____>>** valves with cap; pipe to nearest floor drain.
2. On discharge of **<< condenser water; or _____>>** pumps, use spring-loaded check valves.
3. Isolate equipment using butterfly valves with lug end flanges or grooved mechanical couplings.
4. For throttling, bypass, or manual flow control services, use **<< globe; ball; butterfly; or _____>>** valves.
5. For throttling and isolation service in chilled and condenser water systems, use only butterfly valves.
6. In **<< heating water; chilled water; condenser water; or _____>>** systems, butterfly valves may be used interchangeably with gate and globe valves.
7. For shut-off and to isolate parts of systems or vertical risers, use **<< gate; ball; butterfly; or _____>>** valves.
8. For throttling service, use plug cocks. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.

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E. Welding Materials and Procedures: Comply with **<<ASME BPVC-IX>>**.

2.02 HEATING WATER<< AND GLYCOL; OR NONE - N/A>> PIPING, BURIED

A. Steel Pipe: **<<ASTM A53/A53M>>**, Schedule 40, black**<< , with AWWA C105/A21.5 polyethylene jacket, or double layer, half-lapped polyethylene tape; , _____; or None - N/A>>**.
   1. Fittings: **<<ASTM A234/A234M>>**, wrought steel welding type**<< with double layer, half-lapped polyethylene tape; _____; or None - N/A>>**.
   2. Joints: Welded in accordance with **<<AWS D10.12M/D10.12>>**.
   3. Casing: **<< Closed glass cell insulation; Polyurethane insulation with high-density polyethylene jacket and heat shrink sleeves; or _____>>**.

B. Steel Pipe Sizes **<< 12 inches>>** and Greater: **<<ASTM A53/A53M>>**, **<< 3/8 inch>>** wall, black**<< with AWWA C105/A21.5 polyethylene jacket, or double layer, half-lapped polyethylene tape; _____; or None - N/A>>**.
   1. Fittings: **<<ASTM A234/A234M>>**, wrought steel welding type**<< with double layer, half-lapped polyethylene tape; None - N/A; or _____>>**.
   2. Joints: Welded in accordance with **<<AWS D10.12M/D10.12>>**.
   3. Casing: **<< Closed glass cell insulation; Polyurethane insulation with high density polyethylene jacket and heat shrink sleeves; or _____>>**.

C. Copper Tube: **<<ASTM B88>>** (**<<ASTM B88M>>**), **<< Type K; Type L; or _____>>**, drawn temper.
   1. Fittings: **<<ASME B16.22>>**, wrought copper.
   2. Mechanical Press Sealed Fittings: **<<ASME B16.51>>** or **<<IAPMO/ANSI/CAN Z1117>>**, **<<ICC (IMC)>>**, and **<<IAPMO (UMC)>>** approved, with EPDM seals.
      a. Manufacturers:
         1) Bonomi North America, Inc**<< ; BONOMI PRESS; ; _____; or None - N/A>>**: www.bonominorthamerica.com/#sle.
         2) FNW**<< ; Copper Press; ; _____; or None - N/A>>**: www.fnw.com/#sle.
         3) Mueller Streamline, Co**<< ; PRS; ; _____; or None - N/A>>**: www.muellerstreamline.com/#sle.
         4) NIBCO INC**<< ; Press System; ; _____; or None - N/A>>**: www.nibco.com/#sle.
         5) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
   3. Joints: **<< Solder, lead free, ASTM B32 HB alloy (95-5 tin-antimony), or tin and silver.; Braze, AWS A5.8M/A5.8 BCuP copper/silver alloy.; or _____ .>>** (15% silver)
   4. Casing: **<< Closed glass cell insulation; Polyurethane insulation with high density polyethylene jacket and heat shrink sleeves; or _____>>**.

2.03 HEATING WATER<< AND GLYCOL; OR NONE - N/A>> PIPING, ABOVE GRADE

A. Steel Pipe: **<<ASTM A53/A53M>>**, Schedule 40, black, using one of the following joint types:
   1. Welded Joints: **<<ASTM A234/A234M>>**, wrought steel welding type fittings; **<<AWS D10.12M/D10.12>>** welded.
   2. Threaded Joints: **<<ASME B16.3>>**, malleable iron fittings.
   3. Grooved Joints: **<<AWWA C606>>** grooved pipe, fittings of same material, and mechanical couplings.

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4. Mechanical Press Sealed Fittings: **<<ASTM F3226/F3226M>>**, **<<ICC (IMC)>>**, and **<<IAPMO (UMC)>>** approved, with EPDM seals.
   a. Manufacturers:
      1) Mueller Streamline, Co**<< ; STL; ; _____; or None - N/A>>**: www.muellerstreamline.com/#sle.
      2) NIBCO INC**<< ; Bench Press; ; _____; or None - N/A>>**: www.nibco.com/#sle.
      3) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Steel Pipe Sizes **<< 12 Inches>>** and Greater: **<<ASTM A53/A53M>>**, **<< 3/8 inch>>** wall, black, using one of the following joint types:
   1. Welded Joints: **<<ASTM A234/A234M>>**, wrought steel welding type fittings; **<<AWS D10.12M/D10.12>>** welded.
   2. Threaded Joints: **<<ASTM A536>>** ductile iron fittings.
   3. Grooved Joints: **<<AWWA C606>>** grooved pipe, fittings of same material, and mechanical couplings.

C. Copper Tube: **<<ASTM B88>>** (**<<ASTM B88M>>**), **<< Type K; Type L; or _____>>**, drawn temper, using one of the following joint types:
   1. Solder Joints: **<<ASME B16.18>>** cast brass/bronze or **<<ASME B16.22>>** solder wrought copper fittings.
      a. Solder: **<<ASTM B32>>** lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
      b. Braze: **<<AWS A5.8M/A5.8>>** BCuP copper/silver alloy. (15% silver)
   2. Grooved Joints: **<<AWWA C606>>** grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.
   3. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
   4. Mechanical Press Sealed Fittings: **<<ASME B16.51>>** or **<<IAPMO/ANSI/CAN Z1117>>**, **<<ICC (IMC)>>**, and **<<IAPMO (UMC)>>** approved, with EPDM seals.
      a. Manufacturers:
         1) Apollo Valves**<< ; _____; or None - N/A>>**: www.apollovalves.com/#sle.
         2) Bonomi North America, Inc**<< ; BONOMI PRESS; ; _____; or None - N/A>>**: www.bonominorthamerica.com/#sle.
         3) FNW**<< ; Copper Press; ; _____; or None - N/A>>**: www.fnw.com/#sle.
         4) Mueller Streamline, Co**<< ; PRS; ; _____; or None - N/A>>**: www.muellerstreamline.com/#sle.
         5) NIBCO INC**<< ; Press System; ; _____; or None - N/A>>**: www.nibco.com/#sle.
         6) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.04 CHILLED WATER PIPING, BURIED

A. Steel Pipe: **<<ASTM A53/A53M>>**, Schedule 40, black**<< with AWWA C105/A21.5 polyethylene jacket, or double layer, half-lapped polyethylene tape; None - N/A; or _____>>**.
   1. Fittings: **<<ASTM A234/A234M>>**, wrought steel welding type**<< with double layer, half-lapped polyethylene tape; _____; or None - N/A>>**.
   2. Joints: Welded in accordance with **<<AWS D10.12M/D10.12>>**.

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3. Casing: **<< Closed glass cell insulation; Polyurethane insulation with high density polyethylene jacket and heat shrink sleeves; or _____>>**.

B. Steel Pipe Sizes **<< 12 Inches>>** and Greater: **<<ASTM A53/A53M>>**, **<< 3/8 inch>>** wall, black**<< with AWWA C105/A21.5 polyethylene jacket, or double layer, half-lapped polyethylene tape; _____; or None - N/A>>**.
1. Fittings: **<<ASTM A234/A234M>>**, wrought steel welding type**<< with double layer, half-lapped polyethylene tape; None - N/A; or _____>>**.
2. Joints: Welded in accordance with **<<AWS D10.12M/D10.12>>**.
3. Casing: **<< Closed glass cell insulation; Polyurethane insulation with high density polyethylene jacket and heat shrink sleeves; or _____>>**.

C. Copper Tube: **<<ASTM B88>>** (**<<ASTM B88M>>**), **<< Type K; Type L; or _____>>**, drawn temper.
1. Fittings: **<<ASME B16.22>>**, wrought copper.
2. Mechanical Press Sealed Fittings: **<<ASME B16.51>>** or **<<IAPMO/ANSI/CAN Z1117>>**, **<<ICC (IMC)>>**, and **<<IAPMO (UMC)>>** approved, with EPDM seals.
   a. Manufacturers:
      1) Bonomi North America, Inc**<< ; BONOMI PRESS; ; _____; or None - N/A>>**: www.bonominorthamerica.com/#sle.
      2) FNW**<< ; Copper Press; ; _____; or None - N/A>>**: www.fnw.com/#sle.
      3) Mueller Streamline, Co**<< ; PRS; ; _____; or None - N/A>>**: www.muellerstreamline.com/#sle.
      4) NIBCO INC**<< ; Press System; ; _____; or None - N/A>>**: www.nibco.com/#sle.
      5) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
3. Joints: **<< Solder, lead-free, ASTM B32 HB alloy (95-5 tin-antimony), or tin and silver.; Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.; or _____ .>>**
4. Casing: **<< Closed glass cell insulation; Polyurethane insulation with high density polyethylene jacket and heat shrink sleeves; or _____>>**.

D. Ductile Iron Pipe: **<<AWWA C151/A21.51>>**.
1. Fittings: **<<AWWA C110/A21.10>>**, ductile iron, standard thickness.
2. Joints: **<<AWWA C111/A21.11>>**, Styrene-butadiene rubber (SBR) or vulcanized SBR gasket with **<< 3/4-inch>>** diameter rods.

2.05 CHILLED WATER PIPING, ABOVE GRADE

A. Steel Pipe: **<<ASTM A53/A53M>>**, Schedule 40, black; using one of the following joint types:
1. Welded Joints: **<<ASTM A234/A234M>>**, wrought steel welding type fittings; **<<AWS D10.12M/D10.12>>** welded.
2. Threaded Joints: **<<ASME B16.3>>**, malleable iron fittings.
3. Grooved Joints: **<<AWWA C606>>** grooved pipe, fittings of same material, and mechanical couplings.
4. Mechanical Press Sealed Fittings: **<<ASTM F3226/F3226M>>**, **<<ICC (IMC)>>**, and **<<IAPMO (UMC)>>** approved, with EPDM seals.
   a. Manufacturers:
      1) Mueller Streamline, Co**<< ; STL; ; _____; or None - N/A>>**: www.muellerstreamline.com/#sle.

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2) NIBCO INC**<< ; Bench Press; ; _____; or None - N/A>>**: www.nibco.com/#sle.
3) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Steel Pipe Sizes **<< 12 Inches>>** and Greater: **<<ASTM A53/A53M>>**, **<< 3/8 inch>>** wall, black; using one of the following joint types:
1. Welded Joints: **<<ASTM A234/A234M>>**, wrought steel welding type fittings; **<<AWS D10.12M/D10.12>>** welded.
2. Threaded Joints: **<<ASTM A536>>** ductile iron fittings.
3. Grooved Joints: **<<AWWA C606>>** grooved pipe, fittings of same material, and mechanical couplings.

C. Copper Tube: **<<ASTM B88>>** (**<<ASTM B88M>>**), **<< Type K; Type L; or _____>>**, drawn temper.
1. Solder Joints: **<<ASME B16.18>>** cast brass/bronze or **<<ASME B16.22>>**, solder wrought copper fittings.
a. Solder: **<<ASTM B32>>** lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
b. Braze: **<<AWS A5.8M/A5.8>>** BCuP copper/silver alloy. (15% silver)
2. Grooved Joints: **<<AWWA C606>>** grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.
3. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
4. Mechanical Press Sealed Fittings: **<<ASME B16.51>>** or **<<IAPMO/ANSI/CAN Z1117>>**, **<<ICC (IMC)>>**, and **<<IAPMO (UMC)>>** approved, with EPDM seals.
a. Manufacturers:
1) Apollo Valves**<< ; _____; or None - N/A>>**: www.apollovalves.com/#sle.
2) Bonomi North America, Inc**<< ; BONOMI PRESS; ; _____; or None - N/A>>**: www.bonominorthamerica.com/#sle.
3) FNW**<< ; Copper Press; ; _____; or None - N/A>>**: www.fnw.com/#sle.
4) Mueller Streamline, Co**<< ; PRS; ; _____; or None - N/A>>**: www.muellerstreamline.com/#sle.
5) NIBCO INC**<< ; Press System; ; _____; or None - N/A>>**: www.nibco.com/#sle.
6) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.06 CONDENSER WATER PIPING, BURIED

A. PVC Pipe: **<<ASTM D1785>>**, Schedule 80, or **<<ASTM D2241>>**, SDR 21 or 26.
1. Fittings: **<<ASTM D2466>>** or **<<ASTM D2467>>**, PVC.
2. Joints: Solvent welded in accordance with **<<ASTM D2855>>**.

2.07 CONDENSER WATER PIPING, ABOVE GRADE

A. PVC Pipe: **<<ASTM D1785>>**, Schedule 80, or **<<ASTM D2241>>**, SDR 21 or 26.
1. Fittings: **<<ASTM D2466>>** or **<<ASTM D2467>>**, PVC.
2. Joints: Solvent welded in accordance with **<<ASTM D2855>>**.

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2.08 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: **<<ASTM A53/A53M>>**, Schedule 40 galvanized; using one of the following joint types:
   1. Threaded Joints: Galvanized cast iron, or **<<ASME B16.3>>** malleable iron fittings.

B. Copper Tube: **<<ASTM B88>>** (**<<ASTM B88M>>**), Type **<< K (A); M (C); L (B); or _____>>**, drawn; using one of the following joint types:
   1. Solder Joints: **<<ASME B16.18>>** cast brass/bronze or **<<ASME B16.22>>** solder wrought copper fittings; **<<ASTM B32>>** lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver. (15% silver)

C. PVC Pipe: **<<ASTM D1785>>**, Schedule 40, or **<<ASTM D2241>>**, SDR 21 or 26.
   1. Fittings: **<<ASTM D2466>>** or D2467, PVC.
   2. Joints: Solvent welded in accordance with **<<ASTM D2855>>**.

2.09 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with **<<MSS SP-58>>**.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using **<<MSS SP-58>>** recommendations.
   2. Hangers for Pipe Sizes **<< 1/2 to 1-1/2 Inches>>**: **<< Malleable iron; Carbon steel; or _____>>**, adjustable swivel, split ring.
   3. Hangers for Cold Pipe Sizes **<< 2 Inches>>** and Greater: Carbon steel, adjustable, clevis.
   4. Hangers for Hot Pipe Sizes **<< 2 to 4 Inches>>**: Carbon steel, adjustable, clevis.
   5. Hangers for Hot Pipe Sizes **<< 6 Inches>>** and Greater: Adjustable steel yoke, cast iron roll, double hanger.
   6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
   7. Multiple or Trapeze Hangers for Hot Pipe Sizes **<< 6 Inches>>** and Greater: Steel channels with welded spacers and hanger rods, cast iron roll.
   8. Wall Support for Pipe Sizes to **<< 3 Inches>>**: Cast iron hook.
   9. Wall Support for Pipe Sizes **<< 4 Inches>>** and Greater: Welded steel bracket and wrought steel clamp.
   10. Wall Support for Hot Pipe Sizes **<< 6 Inches>>** and Greater: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
   11. Vertical Support: Steel riser clamp.
   12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
   13. Floor Support for Hot Pipe Sizes to **<< 4 Inches>>**: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
   14. Floor Support for Hot Pipe Sizes **<< 6 Inches>>** and Greater: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
   15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
   16. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
   17. Inserts: Malleable iron case of**<< galvanized; None - N/A; or _____>>** steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

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B. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge-shaped grooves in header piping to permit support and hanging in accordance with **<<ASME B31.9>>**.

C. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:

1. Bases: High-density polypropylene.
2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
3. Steel Components: Stainless steel or carbon steel hot-dip galvanized after fabrication in accordance with **<<ASTM A123/A123M>>**.
4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion-resistant material.
5. Height: Provide minimum clearance of **<< 6 inches; or _____ inches>>** under pipe to top of roofing.
6. Manufacturers:
   a. PHP Systems/Design**<< ; _____; or None - N/A>>**: www.phpsd.com/#sle.
   b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.10 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe of **<< 2 Inches>>** and Less:

1. Ferrous Piping: **<< 150 psi>><< brass; malleable iron; or _____>>**, **<< threaded; sweat; press; or _____>>**.
2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe **<< 2 Inches>>** and Greater:

1. Ferrous Piping: **<< 150 psig>>** forged steel, slip-on.
2. Copper Piping: Bronze.
3. Gaskets: **<< 1/16 inch>>** thick, preformed neoprene.

C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.

1. Dimensions and Testing: In accordance with **<<AWWA C606>>**.
2. Mechanical Couplings: Comply with **<<ASTM F1476>>**.
3. Housing Material: **<< Ductile iron; or _____>><< , galvanized; or None - N/A>>** complying with **<<ASTM A536>>**.
4. Gasket Material: EPDM suitable for operating temperature range from **<< minus 30 degrees F>>** to **<< 230 degrees F>>**.
5. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
6. When pipe is field grooved, provide coupling manufacturer's grooving tools.

D. Dielectric Connections:

1. Only use dielectric yellow brass nipples.

2.11 BALL VALVES

A. Manufacturers:

1. Anvil International**<< ; _____; or None - N/A>>**: www.anvilintl.com/#sle.

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2. Apollo Valves**<< ; _____; or None - N/A>>**: www.apollovalves.com/#sle.
3. Shurjoint Piping Products, Inc**<< ; _____; or None - N/A>>**: www.shurjoint.com/#sle.
4. Victaulic Company**<< ; _____; or None - N/A>>**: www.victaulic.com/#sle.
5. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Where piping/ valve is insulated, provided extensions on operators as required for instthickness.

C. Up To and Including **<< 2 Inches>>**:
1. **<< Bronze; Stainless steel; Brass; or _____>><< one; or two>>** piece body, **<< chrome plated brass; stainless steel; or _____>>** ball, teflon seats and stuffing box ring, lever handle**<< with balancing stops; None - N/A; or _____>>**, **<< solder; threaded; or _____>>** ends**<< with union; None - N/A; or _____>>**. Full port.

D. Over **<< 2 Inches>>**:
1. **<< Ductile iron; Cast steel; or _____>>** body, chrome plated**<< stainless; or None - N/A>>** steel ball, **<< teflon; Virgin TFE; or _____>>** seat and stuffing box seals, **<< lever handle; gear operated; or _____>>**, **<< flanged; grooved; or _____>>** ends, rated to **<< 800 psi; or ____ psi>>**. Ful

2.12 SWING CHECK VALVES

A. Manufacturers:
1. Anvil International**<< ; _____; or None - N/A>>**: www.anvilintl.com/#sle.
2. Apollo Valves**<< ; _____; or None - N/A>>**: www.apollovalves.com/#sle.
3. Shurjoint Piping Products, Inc**<< ; _____; or None - N/A>>**: www.shurjoint.com/#sle.
4. Victaulic Company**<< ; _____; or None - N/A>>**: www.victaulic.com/#sle.
5. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Up To and Including **<< 2 Inches>>**:
1. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, **<< solder; threaded; or _____>>** ends.

C. Over **<< 2 Inches>>**:
1. Iron body, **<< bronze; or _____>>** trim, **<< stainless steel; bronze; bronze faced rotating; or _____>>** swing disc, renewable disc and seat, **<< flanged; grooved; or _____>>** ends.

2.13 SPRING LOADED CHECK VALVES

A. Manufacturers:
1. Anvil International**<< ; _____; or None - N/A>>**: www.anvilintl.com/#sle.
2. Shurjoint Piping Products, Inc**<< ; _____; or None - N/A>>**: www.shurjoint.com/#sle.
3. Victaulic Company**<< ; _____; or None - N/A>>**: www.victaulic.com/#sle.
4. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer, or threaded lug ends.

2.14 AUTOMATIC FLOW-CONTROL VALVES

A. Manufacturers:
1. Bell & Gossett
2. Flow Design, Inc.

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3. Griswold Controls
4. Hays Fluid Controls
5. Nexus
6. NuTech Hydronic Speciality Products
7. Pro Hydronic Specialties
8. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Factory set to maintain constant flow with plus or minus 10 percent over system pressure fluctuations. Each valve shall have an identification tag attached by chain, and be factory marked with the zone or equipment identification, valve number, and flow rate. Valve shall be line size and as follows:
1. Gray-iron or brass body, designed for 175 psig at 200 deg F or; brass or ferrous-metal body, designed for 300 psig at 250 deg F.
2. Stainless steel or nickel chrome plated brass, tamperproof, self-cleaning, piston-spring assembly, or polyphenylsulfone orifice seat with polymer diaphragm (Hays) easily removable for inspection or replacement.
3. "Y" or other configuration permitting cartridge replacement without valve removal for sizes 2" and smaller.
4. Unions and isolation valves or other configuration permitting cartridge replacement with valve removal for sizes larger than 2".
5. Flow and pressure differential adjustable by cartridge replacement.
6. Minimum pressure differential shall not exceed 2 psi. (Unless otherwise indicated)
7. Maximum pressure differential shall not be less than 32 psi. (Unless otherwise indicated)
8. Flow rates shall be as indicated on equipment schedules on the drawings.
9. Valves shall be installed in return piping.
10. Ball valves and unions included as part of a valve package may be used in place of ball valves and unions specified and indicated on the drawings only when in positions indicated. Ball valves shall be provided with a solid stainless-steel ball.
11. Provide a #20 mesh Y-strainer with blow-down valve and garden hose connection between the supply side valve and equipment

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. **<< Bevel plain end ferrous pipe.; None - N/A; or _____ .>>**

B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare piping connections to equipment using jointing system specified.

E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

F. After completion, fill, clean, and treat systems. See Section **<< 232500>>** for additional requirements.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

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B. Install heating water, glycol, chilled water, condenser water, and engine exhaust piping to **<<ASME B31.9>>** requirements.

C. PVC Pipe: Make solvent-welded joints in accordance with **<<ASTM D2855>>**.

D. Route piping in orderly manner, parallel to building structure, and maintain gradient.

E. Install piping to conserve building space and to avoid interference with use of space.

F. Group piping whenever practical at common elevations.

G. Sleeve pipe passing through partitions, walls, and floors.

H. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified**<< in Section 078400; in Section _____; _____; or None - N/A>>**.

I. Slope piping and arrange to drain at low points.

J. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section **<< 230516>>**.
   1. Flexible couplings may be used in header piping to accommodate thermal growth, thermal contraction in lieu of expansion loops.
   2. Use flexible couplings in expansion loops.

K. Grooved Joints:
   1. Install in accordance with the manufacturer's latest published installation instructions.
   2. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.

L. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over **<< 4 inches>>**.
   4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut **<< above; flush with top of; recessed into and grouted flush with; or _____>>** slab.

M. Pipe Hangers and Supports:
   1. Install in accordance with **<< ASME B31.9; ASTM F708; MSS SP-58; or _____>>**.
   2. Support horizontal piping as scheduled.
   3. Install hangers to provide minimum **<< 1/2-inch>>** space between finished covering and adjacent work.
   4. Place hangers within **<< 12 inches>>** of each horizontal elbow.
   5. Use hangers with **<< 1-1/2 inches>>** minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   6. Support vertical piping at every**<< other; None - N/A; or _____>>** floor. Support riser piping independently of connected horizontal piping.
   7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
   8. Provide **<< copper plated hangers and supports for copper piping; sheet lead packing between hanger or support and piping; or _____>>**.

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9. Prime coat exposed steel hangers and supports.**<< See Section 09 9123.; _____; or None - N/A>>** Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

N. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. See Section **<< 230719>>**.

O. Provide access where valves and fittings are not exposed. **<< Coordinate size and location of access doors with Section 083100 .; None - N/A; or _____ .>>**

P. Use eccentric reducers to maintain top of pipe level.

Q. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welds.

R. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. See Section **<< 099123>>**.

S. Install valves with stems upright or horizontal, not inverted.

3.03 PIPING APPLICATIONS

A. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Schedule 40 PVC or CPVC plastic pipe and fittings with solvent-welded joints.
1. Exceptions where PVC, CPVC, and other forms of plastic are not permitted:
2. Jails/Prisons.
3. Plenums.
4. Locations prohibited by codes or standards.

B. Air-Vent Piping:
1. Inlet: Same as service where installed.
2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

C. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

D. Miscellaneous: Same materials and joining methods as connecting service.

3.04 HANGERS AND SUPPORTS

A. Hanger Spacing for Copper Tubing.
1. **<< 1/2 Inch>>** and **<< 3/4 inch>>**: Maximum span, **<< 5 feet>>**; minimum rod size, **<< 1/4 inch>>**.
2. **<< 1 Inch>>**: Maximum span, **<< 6 feet>>**; minimum rod size, **<< 1/4 inch>>**.
3. **<< 1-1/2 Inches>>** and **<< 2 Inches>>**: Maximum span, **<< 8 feet>>**; minimum rod size, **<< 3/8 inch>>**.
4. **<< 2-1/2 Inches>>**: Maximum span, **<< 9 feet>>**; minimum rod size, **<< 3/8 inch>>**.
5. **<< 3 Inches>>**: Maximum span, **<< 10 feet>>**; minimum rod size, **<< 3/8 inch>>**.
6. **<< 4 Inches>>**: Maximum span, **<< 12 feet>>**; minimum rod size, **<< 1/2 inch>>**.
7. **<< 6 Inches>>**: Maximum span, **<< 14 feet>>**; minimum rod size, **<< 1/2 inch>>**.
8. **<< 8 Inches>>**: Maximum span, **<< 16 feet>>**; minimum rod size, **<< 5/8 inch>>**.
9. **<< 10 Inches>>**: Maximum span, **<< 18 feet>>**; minimum rod size, **<< 3/4 inch>>**.
10. **<< 12 inches>>**: Maximum span, **<< 19 feet>>**; minimum rod size, **<< 7/8 inch>>**.

B. Hanger Spacing for Steel Piping.

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1. **<< 1/2 Inch>>**, **<< 3/4 Inch>>**, and **<< 1 Inch>>**: Maximum span, **<< 7 feet>>**; minimum rod size, **<< 1/4 inch>>**.
2. **<< 1-1/4 Inches>>**: Maximum span, **<< 8 feet>>**; minimum rod size, **<< 3/8 inch>>**.
3. **<< 1-1/2 Inches>>**: Maximum span, **<< 9 feet>>**; minimum rod size, **<< 3/8 inch>>**.
4. **<< 2 Inches>>**: Maximum span, **<< 10 feet>>**; minimum rod size, **<< 3/8 inch>>**.
5. **<< 2-1/2 Inches>>**: Maximum span, **<< 11 feet>>**; minimum rod size, **<< 3/8 inch>>**.
6. **<< 3 Inches>>**: Maximum span, **<< 12 feet>>**; minimum rod size, **<< 3/8 inch>>**.
7. **<< 4 Inches>>**: Maximum span, **<< 14 feet>>**; minimum rod size, **<< 1/2 inch>>**.
8. **<< 6 Inches>>**: Maximum span, **<< 17 feet>>**; minimum rod size, **<< 1/2 inch>>**.
9. **<< 8 Inches>>**: Maximum span, **<< 19 feet>>**; minimum rod size, **<< 5/8 inch>>**.
10. **<< 10 Inches>>**: Maximum span, **<< 20 feet>>**; minimum rod size, **<< 3/4 inch>>**.
11. **<< 12 Inches>>**: Maximum span, **<< 23 feet>>**; minimum rod size, **<< 7/8 inch>>**.
12. **<< 14 Inches>>**: Maximum span, **<< 25 feet>>**; minimum rod size, **<< 1 inch>>**.
13. **<< 16 Inches>>**: Maximum span, **<< 27 feet>>**; minimum rod size, **<< 1 inch>>**.
14. **<< 18 Inches>>**: Maximum span, **<< 28 feet>>**; minimum rod size, **<< 1-1/4 inches>>**.
15. **<< 20 Inches>>**: Maximum span, **<< 30 feet>>**; minimum rod size, **<< 1-1/4 inches>>**.

C. Hanger Spacing for Plastic Piping: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

END OF SECTION 232113

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SECTION 232113.33
GROUND-LOOP HEAT-PUMP PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Ground-coupled heat exchanger and connections to building piping system, serving:
   1. Hydronic piping system specified in Section **<< 232113>>**.
   2. Refrigerant piping system specified in Section **<< 232300>>**.
   3. Heat pump specified in Section **<< _____>>**.
   4. Desuperheater, to supply hot water, specified in Section **<< _____>>**.

1.02 RELATED REQUIREMENTS

A. Section **<< 232113 - Hydronic Piping>>**: Building heating piping system.

B. Section **<< 232300 - Refrigerant Piping>>**: Copper piping and fittings for direct exchange ground-coupled heat exchanger.

C. Section **<< 312316.26 - Rock Removal>>**: Procedures for removal of rock during execution of work of this section.

D. Section **<< _____>>** - Water-to-Air Heat Pumps.

1.03 REFERENCE STANDARDS

A. APHA (EWWW) - Standard Methods for the Examination of Water and Wastewater.

B. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

C. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).

D. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

E. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.

F. ASTM D2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.

G. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.

H. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

I. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

J. ASTM F714 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter.

K. ASTM F1055 - Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing.

L. IGSHPA (GROUT) - Grouting Procedures for GHP Systems; International Ground Source Heat Pump Association.

M. IGSHPA (SLINK) - Closed-Loop Geothermal Systems Slinky Installation Guide; International Ground Source Heat Pump Association.

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N. PPI TR-4 - PPI HSB Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene **<< one week; or _____>>** before starting work of this section. Require attendance by all installers involved with site work and HVAC work.

1.05 SUBMITTALS

A. Product Data, Polyethylene Piping: Provide manufacturer's data for piping and pipe fittings, showing compliance with specified requirements.
   1. Provide manufacturer's recommendations for fusion jointing.
   2. Include certification of long term hydrostatic basis, or test reports.

B. Product Data, Heat Exchange Fluid: Provide data showing compliance with specified requirements.
   1. Provide manufacturer's Material Data Safety Sheets.
   2. Provide results of biodegradability studies conducted in accordance with **<<APHA (EWWW)>>**:
      a. Statement of ecological behavior.
      b. Total oxygen demand, in **<< pounds>>** of oxygen per **<< pound>>** of fluid.
      c. Percent of fluid degraded in five days.

C. Product Data, Grout and Slurry: Provide information on thermal conductivity of proposed materials.

D. Shop Drawings: Show complete piping layout, water table, water level, depths of excavation, final depths of piping, backfill placement, point of entrance to building, point of connection to equipment, test point locations, and fittings used for all joints and connections.

E. Design Calculations: Submit all design calculations along with drawings.

F. Samples: Provide **<< one; or __>><< 2-inch; or __ -inch>>** length of pipe in selected size.

G. Soil**<< and Rock; _____; or None - N/A>>** Samples: Provide **<< one sample; two samples; or _____>>** from the area of proposed installation.

H. Test Reports, Soil: Indicate test methods and results for all tests performed on soil samples to determine stability, conductivity, and thermal values.

I. Test Reports, Piping: Indicate test method and results of hydrostatic pressure tests.

J. Record Documents: Record actual locations of all underground piping installed relative to **<<Owner>>**'s permanent structure on same property.

K. Operation and Maintenance Data: Provide procedures for pressurizing, charging, and isolation for equipment replacement.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: **<< Licensed Professional Engineer; IGSHPA-certified contractor; or _____>>**, regularly engaged in the design of systems of the type and capacity specified in this section, with not less than **<< three; or _____>>** years of **<< documented; _____; or None - N/A>>** experience**<< , and accredited by IGSHPA; , _____; or None - N/A>>**.

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B. Installer Qualifications: Company specializing in performing the work of this section with minimum **<< ____>>** years of**<< documented; _____; or None - N/A>>** experience**<< and accredited by IGSHPA; _____; or None - N/A>>**.

C. Heat Fusion Technician Certification: **<< IGSHPA training and certification; Qualified in accordance with 49 CFR 192.285; or _____>>**, certified within three years from **<< the date of project commencement; or _____>>**.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping and fittings to project site**<< in shipping containers; _____; or None - N/A>>** with labeling in place.

1. Comply with local and state regulations.
2. Verify that labels on piping indicate manufacturer's name, pipe or tube size, and PE cell classification.
3. Verify that piping complies with specifications and is undamaged.

B. Deliver chemicals for heat exchange fluid to project site in unopened shipping containers with labeling in place; comply with local and state regulations.

C. Protect from weather, humidity and temperature variations, dirt and dust, and other environmental contaminants.

D. Store piping capped or plugged until time of installation.

PART 2 PRODUCTS

2.01 HEAT EXCHANGER

A. The ground-coupled heat exchanger has been designed; **<<Contractor>>** is responsible for execution as required in Contract Documents.

B. Heat Exchanger Configuration: Closed system; polyethylene piping in vertical boreholes located **<< adjacent to; under; or _____>>** building**<< , as indicated on drawings; , _____; or None - N/A>>**.

C. Heat Exchanger Performance:

2.02 MATERIALS

A. Pipe: High density polyethylene pipe, type PE3408, PE3608, or PE4710, with minimum **<<ASTM D3350>>** cell classification of PE345364C.

1. Pipe Used in Vertical Bore Applications: Comply with **<<ASTM D3035>>** with minimum working pressure rating of **<< 160 psi; or ___ psi>>**.
2. **<< Other ; _____ ; or None - N/A>>**Pipe of **<< 3 Inches; or __ Inches>>** Diameter and Larger: Comply with **<<ASTM D3035>>** or **<<ASTM F714>>**, with minimum working pressure rating of **<< 100 psi; ___ psi; or __>>**.
3. **<< Other ; _____ ; or None - N/A>>**Pipe **<< 1.25 Inches; or ___ Inches>>** But Less Than **<< 3 Inches; or __ Inches>>** In Diameter (Nominal): Comply with **<<ASTM D3035>>** with minimum working pressure rating of **<< 110 psi; or ___ psi>>**.
4. **<< Other ; _____ ; or None - N/A>>**Pipe Less Than **<< 1.25 Inches; or __ Inches>>** in Diameter (Nominal): Comply with **<<ASTM D3035>>** with minimum working pressure rating of **<< 160 psi; or ___ psi>>**.
5. Long Term Hydrostatic Design Basis: **<< 1600 psi>>** at **<< 73 degrees F>>**, when tested in accordance with **<<ASTM D2837>>**; appropriate listing in current edition of **<<PPI TR-4>>** will constitute evidence of compliance with this requirement; otherwise, submit independent test results.

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6. Joints and Fittings: Polyethylene of same type as pipe, of sizes and types suitable for the pipe being used; use only heat fusion or stab-type mechanical fittings that are quality controlled to provide a leak-free union between piping ends that is stronger than the piping itself. Do not use other barbed fittings or hose clamps.
   a. Electrofusion Type Fittings: Comply with **<<ASTM F1055>>**.
   b. Butt Fusion Fittings: Comply with **<<ASTM D3261>>**.
   c. Socket Type Fittings: Comply with **<<ASTM D2683>>**.
   d. Where threaded fittings must be used for connection to equipment or dissimilar piping, use fittings and thread sealant compatible and effective with antifreeze used.
7. Manufacturers:
   a. Any manufacturer listed in **<<PPI TR-4>>** for the material to be used.
   b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Pipe, Fittings, and Jointing: Copper, see Section **<< 232300>>**, coated with polyethylene for corrosion protection.
   1. Pipe Over **<< 7/8 Inches; or ____ Inches>>** Outside Diameter: Copper tubing, refrigeration grade, **<<ASTM B280>>**, H58 hard drawn**<< or O60 soft annealed; _____; or None - N/A>>**.
   2. Pipe of **<< 7/8 Inches; or ____ Inches>>** Outside Diameter or Less: Copper tubing, refrigeration grade, **<<ASTM B88>>** (**<<ASTM B88M>>**) Type K **<< annealed; drawn; or _____>>**.

C. Heat Exchange Fluid: Potable water.

D. Pipe Insulation: Closed cell, water resistant plastic foam with thermal resistance of at least R2.

E. Detectable Underground Tape: Magnetic detectable conductor in **<< 2 inch; 4 inch; 6 inch; or ___ inch>>** wide rot-resistant plastic tape or mesh, brightly colored, imprinted with "Water Line" in large letters.

F. Backfill for Vertical Boreholes: **<< Bentonite; Fine sand; Thermally enhanced bentonite; or _____>>**.

PART 3 EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Verify location of existing structures and utilities prior to excavation.

B. Verify soil composition and rock depth, if any, before beginning excavation.

C. Protect adjacent structures from the effects of excavation.

D. Verify that layout dimensions are correct and that available land is sufficient for design.

E. Notify **<<Architect>>** of unsatisfactory conditions.

F. Do not proceed with installation until unsatisfactory conditions have been corrected.

G. Coordinate work with site grading, site backfilling, and foundation construction.

3.02 EXCAVATION

A. Excavate in accordance with requirements of authorities having jurisdiction.

B. Remove rock in accordance with Civil drawings and Division 31 sections.

C. Vertical Boreholes: Drill to depths required.

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1. Minimize over-drilling; fill over-drilled areas with backfill or excavated materials.
2. Piping: Assemble heat exchanger piping and test before installation.

D. Trenches: Excavate trenches for piping to lines and grades shown on drawings.
1. Minimize over-excavation; fill over-excavated areas with backfill or excavated materials.
2. Excavate to accommodate grade changes.
3. Excavate using the procedures specified in Section **<< 312316.13>>**.
4. Maintain trenches free of debris, material, and obstructions that may damage pipe.
5. Piping: Assemble heat exchanger piping and test before backfilling.

3.03 POLYETHYLENE PIPING

A. Join piping and fittings using heat fusion or electrofusion; do not use solvents, adhesives, or mechanical fittings.

B. Provide flanges or unions to connect heat exchanger piping to equipment or piping of different type; locate all transitions between piping of different types inside the building or otherwise accessible (i.e. above grade).

C. Keep dirt, water, and debris out of pipe assemblies; cap or plug open ends until connected to adjacent piping.

D. Do not bend piping to shorter radius than recommended by pipe manufacturer; do not kink piping; use elbow or other fittings for sharp bends.

E. Partially backfill radius bends in narrow trenches by hand to ensure that piping is properly supported and to prevent kinking.

F. Test piping to be installed in boreholes after assembly but before installation in boreholes; re-cap tested assemblies before installation.

G. Test piping to be installed in trenches after installation but before backfilling.

H. Testing: Perform hydrostatic test on all piping; portions of assembled piping may be tested separately.
1. Prior to testing, isolate piping from all connections to building systems.
2. Flush all dirt and debris using potable water flowing at twice the normal operating flow rate for a minimum of four hours or until no dirt or debris is visible, whichever is longer.
3. Plug or cap piping.
4. Pressurize piping to **<< 150 psi; or ___ psi>>** for **<< 30 minutes; 8 hours; or _____>>** and monitor.
5. If there is any pressure loss or visible leakage, identify leak and repair in accordance with manufacturer's recommendations.
6. Repeat test until there is no loss of pressure for the duration of the test.

I. Insulation: Insulate the following heat exchanger piping:
1. Above ground piping.
2. Below ground but within **<< 36 inches; or ____ inches>>** of ground surface.
3. Below ground running parallel with and within **<< 5 feet; or __ feet>>** of walls, structures, or water pipes.
4. Indoor piping that will be colder than ambient air temperature.

J. Where piping passes through foundation walls, provide sleeves sealed with non-hardening, waterproof material.

K. After connection of piping to building systems and installation of equipment served by heat exchanger, fill piping with heat exchange fluid and pressurize.

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1. Water Temperature of **<< 70 to 90 degrees F>>**: Pressurize to **<< 20 to 30 psi; or ___ psi>>**, minimum.
2. Water Temperature of **<< 40 to 50 degrees F>>**: Pressurize to **<< 40 to 50 psi; or ___ psi>>**, minimum.
3. If adequate flooding of circulating pump can be accomplished without pressurization and pump manufacturer approves, pressurization is not required.
4. After pressurization, remove charging valve handles, or plug ports, whichever is applicable, and deliver handles to **<<Owner>>**.
5. Install system label at charging valves, indicating:
   a. Heat exchange fluid, including antifreeze type and concentration.
   b. Service date.
   c. Company name.
   d. Company phone number and responsible person.

3.04 COPPER PIPING

A. Install and test piping, see Section **<< 232300>>**.

B. Join pipe and fittings by **<< brazing; soldering; or _____ >>**. Do not bend pipe, use fittings. Provide flanges or unions to connect to equipment and building piping system.

C. Keep dirt, water, and debris out of assembled piping; plug or cap open ends immediately.

D. Provide for thermal movement of components in system.

E. Insulation: Insulate the following heat exchanger piping:
   1. Above ground piping.
   2. Below ground but within **<< 36 inches; or ____ inches>>** of ground surface.
   3. Below ground running parallel with and within **<< 5 feet; or __ feet>>** of walls, structures, or water pipes.
   4. Indoor piping that will be colder than ambient air temperature.

F. Where piping passes through foundation walls, provide sleeves sealed with non-hardening, waterproof material.

G. Coordinate charging of piping with refrigerant with Section **<< 232300>>**.

3.05 BACKFILLING

A. Install in compliance with local authorities having jurisdiction.

B. Vertical Boreholes: Backfill after pipe installation in accordance with **<< IGSHPA (GROUT) - IGSHPA Grouting Procedures for GHP Systems; IGSHPA (GVERT) - IGSHPA Grouting for Vertical GHP Systems; or _____>>**.

C. Horizontal Boreholes: Fill annual space around pipe with water-bentonite slurry.

D. Trenches:
   1. Provide minimum **<< __ inch>>** cover over piping.
   2. Backfill trenches after pipe has been installed and tested, using fill free of rocks and other debris.
   3. Backfill spiral pipe installation ("Slinky") in accordance with ISGHPA Slinky Installation Guide - **<<IGSHPA (SLINK)>>**.
   4. Install detectable tape continuously **<< 6 inches>>** above top of all buried pipe.
   5. Backfill and compact using the procedures specified in Section **<< 312316.13>>**.
   6. Backfill to original grades with sufficient overfill to allow for settlement.

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E. Protect piping from displacement.

3.06 CLEANING

A. Leave adjacent paved areas broom clean.

B. Clear debris, including excess backfill and excavated dirt and rock, from heat exchanger area.

3.07 PROTECTION

A. Protect area during excavation from excess runoff and erosion.

B. Protect pipe protrusions from damage until connections to building systems are installed.

END OF SECTION 232113.33

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SECTION 232114
HYDRONIC SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Expansion tanks.
B. Air vents.
C. Air separators.
D. Strainers.
E. Suction diffusers.
F. Pressure-temperature test plugs.
G. Balancing valves.
H. Automatic flow control valves.
I. Relief valves.
J. Pressure reducing valves.

1.02 RELATED REQUIREMENTS

A. Section **<< 221119 - Domestic Water Piping Specialties>>**: Backflow preventers.
B. Section **<< 232113 - Hydronic Piping>>**.

1.03 REFERENCE STANDARDS

A. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
B. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

A. See Section **<< 013000>>** - Administrative Requirements for submittal procedures.
B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description**<< and model; , model, and dimensions; _____; or None - N/A>>**.
C. Certificates: Inspection certificates for pressure vessels from **<< _____; or authority having jurisdiction>>**.
D. Manufacturer's qualification statement.
E. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.06 QUALITY ASSURANCE

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A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum **<< three; or _____>>** years of**<< documented; _____; or None - N/A>>** experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 EXPANSION TANKS

A. Manufacturers:

1. American Wheatley, a company of Global Flow Products, LLC**<< ; _____; or None - N/A>>**: www.wheatleyhvac.com/#sle.
2. Amtrol Inc**<< ; _____; or None - N/A>>**: www.amtrol.com/#sle.
3. Bell & Gossett, a brand of Xylem, Inc**<< ; _____; or None - N/A>>**: www.bellgossett.com/#sle.
4. Taco, Inc**<< ; _____; or None - N/A>>**: www.taco-hvac.com/#sle.
5. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Maximum Rated Working Pressure: **<< 125 psi; 150 psi; 300 psi; or _____ psi>>**.

C. Maximum Allowable Service Temperature: **<< 240 degrees F; 280 degrees F; or _____ degrees F>>**.

D. Construction: Welded steel, tested and stamped in accordance with **<<ASME BPVC-VIII-1>>**; supplied with National Board Form U-1, adjustable flexible **<< butyl; EPDM; replaceable butyl; replaceable EPDM; or _____>>** diaphragm or bladder seal factory precharged to **<< 12 psi; or _____ psi>><< , and steel support stand; , _____; or None - N/A>>.<< Constructed using NSF 61 compliant materials.; _____ .; or None - N/A>>**

E. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced-pressure-principle backflow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.

1. See Section **<< 221119>>** for backflow preventer specifications.

F. Accessories: Provide **<< air-charging fitting; bulls eye sight glass; epoxy coating finish; pressure gauge; seismic-mounting clips; seismic-mounting legs; tank drain ball valve; and _____>>**.

2.02 AIR VENTS

A. Manufacturers:

1. Armstrong International, Inc**<< ; _____; or None - N/A>>**: www.armstronginternational.com/#sle.
2. Bell & Gossett, a brand of Xylem, Inc**<< ; _____; or None - N/A>>**: www.bellgossett.com/#sle.
3. Flamco**<< ; _____; or None - N/A>>**: www.flamcogroup.us/#sle.
4. Taco, Inc**<< ; _____; or None - N/A>>**: www.taco-hvac.com/#sle.

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B. Manual Air Vent: Short vertical sections of **<< 2-inch>>** diameter pipe to form air chamber, with **<< 1/8 inch>>** brass needle valve at top of chamber.

C. Float Air Vent:
   1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

D. Hygroscopic Air Vent:
   1. Brass with hygroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring-loaded ball check valve.

E. Maximum Fluid Pressure: **<< 150 psi; 200 psi; or _____ psi>>**.

F. Maximum Fluid Temperature: **<< 250 degrees F; or _____ degrees F>>**.

2.03 AIR DIRT SEPARATORS

A. Coalescing Air/Dirt Separators:
   1. Manufacturers:
      a. Spirotherm, Inc**<< ; _____; or None - N/A>>**: www.spirotherm.com/#sle.
      b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
   2. Tank: Fabricated steel tank; tested and stamped in accordance with **<<ASME BPVC-VIII-1>>** for maximum fluid service subject to application requirements and manufacturer's standard maximum operating conditions. Provide removable head.
   3. Coalescing Medium: Provide **<< structured copper; stainless steel; or _____>>** medium filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100 percent free air, 100 percent entrained air, and 99.6 percent dissolved air at the installed location. Removable heat
   4. Air Vent: Integral float actuated air vent at top fitting of tank rated at **<< 150 psi; 125 psi; or _____ psi>>**, threaded to top of separator.
   5. End Connections: Class 150 flanged for **<< 2-1/2 inch>>** and larger otherwise threaded.
   6. Blowdown Connection: Threaded.
   7. Size: **<< 2-1/2 to 12 inch; 2-1/2 inch; 3 inch; 4 inch; 5 inch; 6 inch; 8 inch; 10 inch; 12 inch; _____ inch; As indicated on drawings; or Match system flow capacity>>**.
   8. Maximum Fluid Service Pressure: **<< 145 psi; 150 psi; or _____ psi>>**.
   9. Maximum Fluid Service Temperature: **<< 250 degrees F; 270 degrees F; or _____ degrees F>>**.

2.04 STRAINERS

A. Manufacturers:
   1. American Wheatley, a company of Global Flow Products, LLC**<< ; _____; or None - N/A>>**: www.wheatleyhvac.com/#sle.
   2. Armstrong International, Inc**<< ; _____; or None - N/A>>**: www.armstronginternational.com/#sle.
   3. Flexicraft Industries**<< ; _____; or None - N/A>>**: www.flexicraft.com/#sle.
   4. Nexus Valve, Inc**<< ; _____; or None - N/A>>**: www.nexusvalve.com/#sle.
   5. The Metraflex Company**<< ; LPD Y Strainer; ; _____; or None - N/A>>**: www.metraflex.com/#sle.
   6. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

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B. Size **<< 2 inch>>** and Under:
   1. Provide **<< threaded; grooved; sweat; or _____>>** brass or iron body for up to **<< 175 psi; 600 psi; or _____ psi>>** working pressure, Y-pattern strainer **<< with; with integrated ball valve and; or _____>><< 1/32 inch>>** stainless steel perforated screen.**<< None - N/A; Include threaded ports for accesories.; or _____ .>>**
   2. Body Material by Fluid Service:
      a. Cast Iron or Brass:
         1) Steam: Up to **<< 250 psi at 450 degrees F; or ____ psi at ____ degrees F>>**.
         2) Liquids: Up to **<< 400 psi at 150 degrees F; or ____ psi at ____ degrees F>>**.
      b. Stainless Steel:
         1) Steam: Up to **<< 600 psi at 486 degrees F; or ____ psi at ____ degrees F>>**.
         2) Liquids: Up to **<< 1,440 psi at 100 degrees F; or ____ psi at ____ degrees F>>**.

C. Size **<< 2-1/2 inch>>** to **<< 4 inch; 12 inch; or _____ inch>>**:
   1. Provide **<< flanged; grooved; or _____>>** iron body for up to **<< 175 psi>>** working pressure, up to **<< 250 degrees F; or _____ degrees F>>** working temperature, Y-pattern strainer **<< with; with integrated butterfly valve and; or _____>><< 1/16 inch; 3/64 inch; or ____ inch>>** stainless steel perforated screen.**<< None - N/A; Include threaded ports for accesories.; or _____ .>>**
   2. Body Material by Fluid Service:
      a. Cast Iron:
         1) Steam: Up to **<< 125 psi at 350 degrees F; or ____ psi at ____ degrees F>>**.
         2) Liquids: Up to **<< 200 psi at 150 degrees F; or ____ psi at ____ degrees F>>**.
      b. Stainless Steel:
         1) Liquids: Up to **<< 285 psi at 100 degrees F; or ____ psi at ____ degrees F>>**.

D. Size **<< 5 inch>>** and Larger:
   1. Provide **<< flanged; grooved; or _____>>** iron body for up to **<< 175 psi>>** working pressure, basket pattern with **<< 1/8 inch>>** stainless steel perforated screen.
   2. Liquid Fluid Service: Up to **<< 285 psi at 100 degrees F; or ____ psi at ____ degrees F>>**.

E. Basket-Type, Size **<< 1 to 30 inch; or _____ inch>>** for Liquid Service:
   1. Flanged carbon steel body with **<< 1/2 inch; 1/4 inch; 1/8 inch; 1/16 inch; 3/64 inch; 5/32 inch; or ____ inch>>** stainless steel perforated basket screen, bottom drain and capped air vent.**<< Duplex-fabricated assembly with butterfly isolation valves.; _____ .; or None - N/A>>**
   2. Fluid Service: Up to **<< 285 psi at 100 degrees F; or ____ psi at ____ degrees F>>**.

2.05 SUCTION DIFFUSERS

A. Manufacturers:
   1. American Wheatley, a company of Global Flow Products, LLC**<< ; _____; or None - N/A>>**: www.wheatleyhvac.com/#sle.
   2. Anvil International**<< ; _____; or None - N/A>>**: www.anvilintl.com/#sle.

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3. Bell & Gossett, a brand of Xylem, Inc**<< ; _____; or None - N/A>>**: www.bellgossett.com/#sle.
4. Bell & Gossett, a brand of Xylem, Inc**<< ; _____; or None - N/A>>**: www.bellgossett.com/#sle.
5. Shurjoint Piping Products, Inc**<< ; _____; or None - N/A>>**: www.shurjoint.com/#sle.
6. Victaulic Company of America**<< ; _____; or None - N/A>>**: www.victaulic.com/#sle.
7. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Fitting: Angle pattern, cast-iron body, threaded for **<< 2 inch>>** and smaller, flanged for **<< 2-1/2 inch>>** and larger, rated for **<< 175 psi>>** working pressure, with inlet vanes, cylinder strainer with **<< 3/16 inch>>** diameter openings, disposable **<< 5/32 inch; 1/8 inch; or ____ inch>>** mesh strainer to fit over cylinder strainer, **<< 20 mesh; or _____>>** startup screen, and permanent magnet located in flow stream and removable for cleaning.

C. Class 125:
1. Horizontally or vertically mounted angle-pattern fitting with integral-cast vanes, fine particle mesh screen and magnetic drain plugs for particle removal without disassembly.
2. Maximum Operating Service: **<< 175 psi>>** and **<< 300 degrees F>>**.
3. Sizes, Material, and Connection:
   a. **<< 2 inch>>** and Smaller: Cast iron body, threaded.
   b. **<< 2-1/2 to 12 inch>>**: Ductile iron body, flanged.

D. Class **<< 150; 250; 300; and ____>>**, Size **<< 1-1/2 to 4 inch>>**:
1. Angle-pattern flanged **<< carbon steel; stainless steel; or _____>>** fitted with integral**<< stainless steel; _____; or None - N/A>>** vanes, removable strainer, and magnetic drain plugs for particle removal without disassembly.
2. Maximum Operating Service:
   a. Class 150: **<< 150 psi at 450 degrees F; or ____ psi at ____ degrees F>>**.

E. Accessories: Adjustable foot support, blowdown tapping in bottom, gauge tapping in side.

2.06 PUMP CONNECTORS

A. Manufacturers:
1. American Wheatley, a company of Global Flow Products, LLC**<< ; _____; or None - N/A>>**: www.wheatleyhvac.com/#sle.
2. Anvil International**<< ; AnviFlex; ; _____; or None - N/A>>**: www.anvilintl.com/#sle.
3. FNW**<< ; _____; or None - N/A>>**: www.fnw.com/#sle.
4. The Metraflex Company**<< ; Vane Flex; ; _____; or None - N/A>>**: www.metraflex.com/#sle.
5. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Flexible Connectors: **<< Flanged; Threaded; or _____>>**, **<< braided; EPDM rubber sphere; EPDM rubber double-sphere; or _____>>** type**<< with wetted components of stainless steel; with wetted components of bronze; with wetted components of _____; _____; or None - N/A>>**, sized to match piping.
1. Maximum Operating Service: **<< 300 psi; 175 psi; 150 psi; or _____ psi>>** at **<< 120 degrees F; 240 degrees F; or _____ degrees F>>**.
2. Accommodate the Following:
   a. Axial Deflection in **<< Compression; Expansion; or Compression and Expansion>>**: **<< _____inch>>**.
   b. Lateral Movement: **<< _____inch>>**.

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c. Angular Rotation: **<< 15; or _____>>** degrees.

d. Force developed by **<< 1.5; or _____>>** times specified maximum allowable operating pressure.

3. End Connections: Flanged **<< ductile iron; or _____>>**; complying with **<< ASME B16.1; or ASME B16.5>>** Class **<< 125; 150; 300; or _____>>**.

4. Provide pump connector with integral vanes to reduce turbulent flow.

5. Provide necessary accessories including, but not limited to, **<< swivel joints; limit stops; internal guides; anti-torque device; internal flow liners; control rods; control cables; and _____>>**.

2.07 PRESSURE-TEMPERATURE TEST PLUGS

A. Manufacturers:

1. FNW**<< ; _____; or None - N/A>>**: www.fnw.com/#sle.
2. Peterson Equipment Company Inc**<< ; _____; or None - N/A>>**: www.petesplug.com/#sle.
3. Sisco Manufacturing Company Inc**<< ; _____; or None - N/A>>**: www.siscomfg.com/#sle.
4. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Construction: Brass body designed to receive temperature or pressure probe with removable protective cap, and **<< Neoprene; EPDM; Nordel; or _____>>** rated for minimum **<< 200 degrees F; or ____ degrees F>>**.

C. Application: Use extended length plugs to clear insulated piping.

2.08 BALANCING VALVES

A. Manufacturers:

1. American Wheatley, a company of Global Flow Products, LLC**<< ; _____; or None - N/A>>**: www.wheatleyhvac.com/#sle.
2. Armstrong International, Inc**<< ; _____; or None - N/A>>**: www.armstronginternational.com/#sle.
3. Bell & Gossett, a brand of Xylem, Inc**<< ; _____; or None - N/A>>**: www.bellgossett.com/#sle.
4. Bell & Gossett, a brand of Xylem, Inc**<< ; _____; or None - N/A>>**: www.bellgossett.com/#sle.
5. FNW**<< ; _____; or None - N/A>>**: www.fnw.com/#sle.
6. Hays Fluid Controls**<< ; _____; or None - N/A>>**: www.haysfluidcontrols.com/#sle.
7. Nexus Valve, Inc**<< ; _____; or None - N/A>>**: www.nexusvalve.com/#sle.
8. NIBCO INC**<< ; _____; or None - N/A>>**: www.nibco.com/#sle.
9. Oventrop Corporation**<< ; Hydrocontrol F; ; Hydrocontrol G; ; Hydrocontrol R; ; Hydrocontrol MTR; ; _____; or None - N/A>>**: www.oventrop.com/#sle.
10. Taco, Inc**<< ; _____; or None - N/A>>**: www.taco-hvac.com/#sle.
11. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Size **<< 2 inch>>** and Smaller:

1. Provide **<< ball; globe; or _____>>** style with **<< flow balancing; removable flow-balancing cartridge; or _____>>**, shut-off capabilities, memory stops, and minimum of two metering ports and **<< female sweat; NPT threaded; press; soldered; or _____>>** connections.
2. Metal construction materials consist of **<< bronze; brass; or _____>>**.

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3. Non-metal construction materials consist of **<< Teflon; EPDM; engineered resin; or _____>>**.
4. Maximum Service Operation: **<< 255 psi at 240 degrees F; 300 psi at 250 degrees F; or _____ psi at _____ degrees F>>**.

C. Size **<< 2-1/2 inch>>** and Larger:
1. Provide **<< ball; globe; butterfly; or _____>>** style with **<< flow balancing; removable flow-balancing cartridge; or _____>>**, shut-off capabilities, memory stops, and minimum of two metering ports and **<< flanged; grooved; weld-end; or _____>>** connections.
2. Valve body construction materials consist of **<< cast iron; carbon steel; ductile iron; or _____>>**.
3. Internal components construction materials consist of **<< brass; aluminum bronze; bronze; Teflon; EPDM; NORYL; engineered resin; or _____>>**.
4. Maximum Service Operation: **<< 175 psi at 250 degrees F; 255 psi at 240 degrees F; 300 psi at 250 degrees F; or _____ psi at _____ degrees F>>**.

2.09 AUTOMATIC FLOW CONTROL VALVES

A. Manufacturers:
1. Armstrong International**<< ; _____; or None - N/A>>**: www.armstronginternational.com/#sle.
2. Bell & Gossett, a brand of Xylem, Inc**<< ; _____; or None - N/A>>**: www.bellgossett.com/#sle.
3. Bell & Gossett, a brand of Xylem, Inc**<< ; _____; or None - N/A>>**: www.bellgossett.com/#sle.
4. Hays Fluid Controls**<< ; Mesurflo Balancing Valve; ; _____; or None - N/A>>**: www.haysfluidcontrols.com/#sle.
5. Nexus Valve, Inc**<< ; _____; or None - N/A>>**: www.nexusvalve.com/#sle.
6. NIBCO INC**<< ; _____; or None - N/A>>**: www.nibco.com/#sle.
7. Taco Inc**<< ; _____; or None - N/A>>**: www.taco-hvac.com/#sle.
8. Griswold
9. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Construction:
1. Brass, bronze, or iron body with union on inlet**<< and outlet; _____; or None - N/A>>**, temperature and pressure test plug on inlet**<< and outlet; _____; or None - N/A>><< with blowdown/backflush drain; _____; or None - N/A>>**.
2. Built-in lug-type outlet butterfly valve with 2-position handle**<< and venturi flow-meter insert; _____; or None - N/A>>**.

C. Calibration: Control flow within **<< 5; 10; or _____>>** percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, minimum pressure **<< 2 psi; 3.5 psi; or _____ psi>>**.

D. Control Mechanism: Provide stainless steel or nickel-plated, brass piston or regulator cup, operating against stainless steel helical or wave formed spring**<< None - N/A; or or elastomeric diaphragm and polyphenylsulfone orifice plate>>**.

E. Size: **<< 2-1/2 to 12 inch; 2-1/2 inch; 3 inch; 4 inch; 5 inch; 6 inch; 8 inch; 10 inch; 12 inch; _____ inch; As indicated on drawings; or Match system flow capacity>>**.

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F. Accessories: Provide **<< air vent; blowdown vent/drain; gearbox with hand wheel; hanging tag; inlet in-line strainer; manual air vent; outlet ball valve; PT test plug extension; and _____>>**.

2.10 RELIEF VALVES

A. Manufacturers:
1. American Wheatley, a company of Global Flow Products, LLC**<< ; _____; or None - N/A>>**: www.wheatleyhvac.com/#sle.
2. Apollo Valves**<< ; _____; or None - N/A>>**: www.apollovalves.com/#sle.
3. Armstrong International, Inc**<< ; _____; or None - N/A>>**: www.armstronginternational.com/#sle.
4. Bell & Gossett, a brand of Xylem, Inc**<< ; _____; or None - N/A>>**: www.bellgossett.com/#sle.
5. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

2.11 PRESSURE REDUCING VALVES

A. Manufacturers:
1. American Wheatley, a company of Global Flow Products, LLC**<< ; _____; or None - N/A>>**: www.wheatleyhvac.com/#sle.
2. Apollo Valves**<< ; _____; or None - N/A>>**: www.apollovalves.com/#sle.
3. Armstrong International, Inc**<< ; _____; or None - N/A>>**: www.armstronginternational.com/#sle.
4. Bell & Gossett, a brand of Xylem, Inc**<< ; _____; or None - N/A>>**: www.bellgossett.com/#sle.
5. Taco, Inc**<< ; _____; or None - N/A>>**: www.taco-hvac.com/#sle.
6. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Operation: Automatically feeds make-up water to the hydronic system whenever pressure in the system drops below the pressure setting of the valve. Refer to Section **<< 232113>>**.

C. Materials of Construction:
1. Valve Body: Constructed of **<< bronze; cast iron; brass; iron; or _____>>**.
2. Internal Components: Construct of **<< stainless steel; brass; or _____>>** and **<< engineered plastics; composition material; or _____>>**.

D. Connections:
1. NPT threaded: **<< 1/2 inch; 3/4inch; or ____ inch>>**.
2. Soldered: **<< 1/2 inch; or ____ inch>>**.

E. Provide integral check valve and strainer.

F. Maximum Inlet Pressure: **<< 100 psi; 400 psi; or ____ psi>>**.

G. Maximum Fluid Temperature: **<< 180 degrees F; or ____ degrees F>>**.

H. Adjustable Pressure Range: From **<< 10 to 45 psi; or ___ psi>>**, set to **<< 25 psi; 45 psi; or ___ psi>>**.

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PART 3 EXECUTION

3.01 EXAMINATION

3.02 INSTALLATION

A. Install specialties and equipment in accordance with manufacturer's instructions.

B. Provide manual air vents at system high points and as indicated.

C. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

D. Provide air separator on suction side of system circulation pump and connect to expansion tank.

E. Provide valved drain and hose connection on strainer blowdown connection.

F. Provide pump suction fitting on suction side of base-mounted centrifugal pumps**<< where indicated; _____; or None - N/A>>**. Remove temporary strainers after cleaning systems.

G. Support pump fittings with floor-mounted pipe and flange supports.

H. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.

I. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

J. Pipe relief valve outlet to nearest floor drain.

K. Where one line vents several relief valves, make cross-sectional area equal to sum of individual vent areas.

3.03 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

3.04 CLEANING

A. See Section **<< 017000 - Execution and Closeout Requirements>>** for additional requirements.

B. Clean interior of water tanks in accordance with manufacturer's instructions.

3.05 MAINTENANCE

A. See Section **<< 017000>>** - Execution Requirements for additional requirements relating to maintenance service.

B. Provide service and maintenance of glycol system for **<< one year; or _____>>** from date of Substantial Completion at no extra charge to **<<Owner>>**.

C. Perform **<< monthly; or _____>>** visit to make glycol fluid concentration analysis on site with refractive index measurement instrument. Report findings in detail in writing, including analysis and amounts of glycol or water added.

D. Explain corrective actions to **<<Owner>>**'s maintenance personnel in person.

END OF SECTION 232114

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SECTION 232123
HYDRONIC PUMPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. In-line pumps.

B. End-suction pumps.

1.02 RELATED REQUIREMENTS

A. Section **<< 033000 - Cast-in-Place Concrete>>**.

B. Section **<< 230513 - Common Motor Requirements for HVAC Equipment>>**.

C. Section **<< 230934 - Variable-Frequency Motor Controllers>>**.

1.03 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code.

B. UL 778 - Standard for Motor-Operated Water Pumps.

1.04 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

C. Millwright's Certificate: Certify that base mounted pumps have been aligned.

D. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.

E. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

F. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.

1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
2. Extra Pump Seals: **<< One set; or _____>>** for each type and size of pump.

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PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Armstrong Fluid Technology, Inc www.armstrongfluidtechnology.com/#sle.

B. Bell & Gossett, a Xylem Inc. brand: www.bellgossett.com/#sle.

C. Taco

D. Aurora

E. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.02 GENERAL

A. Provide pumps that operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

B. Minimum Quality Standard: **<<UL 778>>**.

C. Base Mounted Pumps: Aligned by qualified millwright.

D. Electrical Requirements:

1. Listed and classified by **<< UL; testing agency acceptable to authority having jurisdiction; or _____>>** as suitable for the purpose specified and indicated.
2. Variable Frequency Drives (VFDs): Provide in accordance with Section **<< 230934; 262923; or _____>>**, except for integral-VFDs.
3. Enclosures: Provide unspecified product(s) required to fit motor:

2.03 IN-LINE PUMPS

A. Split-Coupled, Single-Stage Pump: Vertical pump with radially-**<< or horizontally-; _____; or None - N/A>>**split casing**<< and integral controls; _____; or None - N/A>>**; rated for discharge pressures up to **<< 175 psi; 250 psi; 300 psi; or ___ psi>>**.

B. Casing: **<< Cast iron; Cast steel; Stainless steel; or _____ ,>>** with**<< casing wear ring,; _____ ,; or None - N/A>>** seal flush connection, **<< threaded; flanged; or _____>>** suction, and discharge ports with gauge port and drain plug.

C. Impeller: **<< Bronze; Cast iron; Stainless steel; or _____>>**, fully enclosed, keyed directly to motor shaft or extension.

D. Shaft: **<< Carbon steel; Stainless steel; or _____>>** with stainless steel impeller cap screw or nut**<< and bronze sleeve; and stainless steel sleeve; _____; or None - N/A>>**.

E. Seal: **<< Mechanical seal; Carbon rotating against a stationary ceramic seat; Manufacturer's standard seal; or _____>>**, **<< 225 degrees F; 212 degrees F; 275 degrees F; or _____ degrees F>>** maximum continuous duty temperature.

F. Electrical:

1. Motor: 1,750 rpm**<< , total-enclosed, fan-cooled (TEFC); , open drip-proof (ODP); , mill processing duty; , chemical processing duty; , washdown duty; unless specified otherwise; or _____>>**; see Section **<< 230513>>**.
2. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to **<<NFPA 70>>**.

2.04 END-SUCTION PUMPS

A. Split-Coupled Pump: **<< Base; Frame; or _____>>**-mounted, single-stage pump with horizontal shaft**<< , integral controls,; , _____ ,; or None - N/A>>** and radially-**<< or horizontally-; _____; or None - N/A>>**split casing rated for discharge pressures up to **<< 125 psi; 175 psi; 250 psi; or ___ psi>>**.

B. Casing: Cast iron**<< or ductile iron; or _____; or None - N/A>>** with renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction, and discharge flanged connections with gauge ports.

C. Impeller: **<< Stainless steel; Bronze; or _____>>**, balanced, fully enclosed, keyed to shaft.

D. Bearings: **<< Oil; Grease; Permanently; or _____>>** lubricated roller or ball bearings.

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E. Shaft: Alloy steel with copper, bronze, or stainless steel shaft sleeve.

F. Seal: **<< Mechanical; Carbon rotating against a stationary ceramic seat; Manufacturer's standard seal; Carbon rotating against a stationary ceramic seat, viton fitted; or _____>>**, **<< 225 degrees F; 212 degrees F; 275 degrees F; or ___ degrees F>>** maximum continuous duty temperature.

G. Drive: Flexible coupling with coupling guard.

H. Baseplate: Cast iron or fabricated steel with integral drain rim.

I. Electrical:

1. Motor: 1,750 rpm**<< , total-enclosed, fan-cooled (TEFC); , open drip-proof (ODP); unless specified otherwise; or _____>>**; see Section **<< 230513>>**.
2. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to **<<NFPA 70>>**.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.

C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close-coupled or base-mounted pumps, provide supports under elbows on pump suction and discharge line sizes **<< 4 inches>>** and over.

D. Provide line sized shut-off valve and **<< strainer; pump suction fitting; or _____>>** on pump suction, and line sized **<< soft seat check valve and balancing valve; combination pump discharge valve; or check valve>>** on pump discharge.

E. Provide air cock and drain connection on horizontal pump casings.

F. Provide drains for bases and seals, piped to and discharging into floor drains.

G. Check, align, and certify alignment of base-mounted pumps prior to start-up.

H. Install**<< close-coupled and; _____; or None - N/A>>** base-mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. See Section **<< 033000>>**.

I. Lubricate pumps before start-up.

END OF SECTION 232123

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SECTION 232300
REFRIGERANT PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping.
B. Refrigerant.
C. Moisture and liquid indicators.
D. Valves.
E. Strainers.
F. Check valves.
G. Pressure regulators.
H. Pressure relief valves.
I. Filter-driers.
J. Solenoid valves.
K. Expansion valves.
L. Receivers.
M. Conduit for piping.
N. Flexible connections.
O. Engineered wall seals and insulation protection.
P. Exterior penetration accessories.

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1.02 RELATED REQUIREMENTS

A. Section **<< 078400 - Firestopping>>**.
B. Section **<< 083100 - Access Doors and Panels>>**.
C. Section **<< 099123 - Interior Painting>>**.
D. Section **<< 230716 - HVAC Equipment Insulation>>**.
E. Section **<< 230719 - HVAC Piping Insulation>>**.
F. Section **<< 260583 - Wiring Connections>>**: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. AHRI 495 - Performance Rating of Refrigerant Liquid Receivers.
B. AHRI 710 (I-P) - Performance Rating of Liquid-Line Driers.
C. AHRI 711 (SI) - Performance Rating of Liquid-Line Driers.
D. AHRI 730 (I-P) - Flow Capacity Rating of Suction Line Filters and Suction Line Filter Driers.
E. AHRI 760 (I-P) - Performance Rating of Solenoid Valves for Use with Volatile Refrigerants.
F. ASHRAE Std 15 - Safety Standard for Refrigeration Systems.
G. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants.
H. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

I. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.

J. ASME B31.5 - Refrigeration Piping and Heat Transfer Components.

K. ASME B31.9 - Building Services Piping.

L. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators.

M. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels.

N. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

O. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

P. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).

Q. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

R. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

S. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

T. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

U. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

V. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials.

W. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

X. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials.

Y. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

Z. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

AA. UL 429 - Electrically Operated Valves.

BB. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.04 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.

C. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.

D. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.

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E. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

F. Test Reports: Indicate results of leak test, acid test.

G. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.

H. Submit welders certification of compliance with **<< ASME BPVC-IX; AWS D1.1/D1.1M; or _____>>**.

I. Designer's qualification statement.

J. Installer's qualification statement.

K. Project Record Documents: Record exact locations of equipment and refrigeration accessories on record drawings.

L. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.

M. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.
   1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum **<< 5>>** years of**<< documented; _____; or None - N/A>>** experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store piping with labeling in place.

B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure integrity of system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

B. Provide pipe hangers and supports in accordance with **<< ASME B31.5; MSS SP-58; or _____>>** unless indicated otherwise.

C. Liquid Indicators:
   1. Use line size liquid indicators in main liquid line leaving condenser.
   2. If receiver is provided, install in liquid line leaving receiver.
   3. Use line size on leaving side of liquid solenoid valves.

D. Valves:
   1. Use service valves on suction and discharge of compressors.
   2. Use gauge taps at compressor inlet and outlet.
   3. Use gauge taps at hot gas bypass regulators, inlet and outlet.

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4. Use check valves on compressor discharge.
5. Use check valves on condenser liquid lines on multiple condenser systems.

E. Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.

F. Strainers:
1. Use line size strainer upstream of each automatic valve.
2. Where multiple expansion valves with integral strainers are used, use single main liquid line strainer.
3. On steel piping systems, use strainer in suction line.
4. Use shut-off valve on each side of strainer.

G. Pressure Relief Valves: Use on ASME receivers**<< and pipe to outdoors; _____; or None - N/A>>**.

H. Filter-Driers:
1. Use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.
2. Use a filter-drier on suction line just ahead of compressor.
3. Use sealed filter-driers in lines smaller than **<< 1/2 inch; 3/4 inch; or ____ inch>>** outside diameter.
4. Use sealed filter-driers in low temperature systems.
5. Use sealed filter-driers in systems utilizing hermetic compressors.
6. Use replaceable core filter-driers in lines of **<< 1/2 inch; 3/4 inch; or ____ inch>>** outside diameter or greater.
7. Use replaceable core liquid-line filter-driers in systems utilizing receivers.
8. Use filter-driers for each solenoid valve.

I. Solenoid Valves:
1. Use in liquid line of systems operating with single pump-out or pump-down compressor control.
2. Use in liquid line of single or multiple evaporator systems.
3. Use in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down.

J. Receivers:
1. Use on systems with long piping runs.

K. Flexible Connectors: Utilize at or near compressors where piping configuration does not absorb vibration.

2.02 REGULATORY REQUIREMENTS

A. Comply with **<<ASME B31.9>>** for installation of piping system.

B. Welding Materials and Procedures: Comply with **<<ASME BPVC-IX>><< and applicable state labor regulations; _____; or None - N/A>>**.

C. Welders Certification: In accordance with **<< ASME BPVC-IX; AWS D1.1/D1.1M; or _____>>**.

D. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

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2.03 PIPING

A. Copper Tube: **<<ASTM B280>>**, H58 hard drawn**<< or O60 soft annealed; _____; or None - N/A>>**.
   1. Fittings: **<<ASME B16.22>>** wrought copper.
   2. Joints: Braze, **<<AWS A5.8M/A5.8>>** BCuP silver/phosphorus/copper alloy (15% silver)

B. Preinsulated Refrigerant Piping Linesets:
   1. Copper Tube: **<<ASTM B280>>** seamless, anticorrosion pipe; **<< lineset is precoupled to include two joined pipes; line includes single, individual pipe; or _____>>**.
   2. Insulation: Polyethelene closed-cell foam; preapplied to entire length of lineset.**<< Weather- and UV-resistant for outdoor installation.; _____; or None - N/A>>** Maximum flame spread index of 25 and maximum smoke developed index of 50, when tested in accordance with **<<ASTM E84>>** or **<<UL 723>>**. White in color.
   3. Manufacturers:
      a. Inaba Denko America Inc**<< ; Paircoil; ; _____; or None - N/A>>**: www.inabadenko-america.com/#sle.
      b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

C. Pipe Supports and Anchors:
   1. Provide hangers and supports complying with **<<MSS SP-58>>**.
      a. If type of hanger or support for a particular situation is not indicated, select appropriate type using **<<MSS SP-58>>** recommendations.
      b. For pre-insulated linesets, provide Snap-A-Saddle Pro piping supports to protect all insulation or equal with zip ties sized correctly. Provide white color snap-a-saddle and black zip tie.
         1) Clevis hanger with saddle and zip tie is allowed for single refrigerant pipign runs (ie BS box to cassette).
      c. Where pipe clamps are required, provide B-line Amflex or ZSI Cush-A-Therm insulated pipe clamp or approved equal.
   2. Hangers for Pipe Sizes **<< 1/2 to 1-1/2 Inch>>**: **<< Malleable iron; Carbon steel; or _____>>** adjustable swivel, split ring.
   3. Hangers for Pipe Sizes **<< 2 Inches>>** and Over: Carbon steel, adjustable, clevis.
   4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
   5. Wall Support for Pipe Sizes to **<< 3 Inches>>**: Cast iron hook.
   6. Wall Support for Pipe Sizes **<< 4 Inches>>** and Over: Welded steel bracket and wrought steel clamp.
   7. Vertical Support: Steel riser clamp.
   8. Vertical Riser Load Reducer: Designed for installation on pipe midpoint to reduce load stress from weight and thermal expansion; directs thermal expansion both upward and downward.
      a. Clamp: **<< Corrosion-resistant steel; Stainless steel; Type 304 stainless steel; or _____>>**; attaches to piping.
      b. Base Bracket: **<< Corrosion-resistant steel; Galvanized steel; or _____>>** support; mounts **<< horizontally; vertically; or _____>>**.
      c. Load Support: Up to **<< 700 lbf; 600 lbf; 500 lbf; _____ lbf; or _____>>** or greater.
      d. Manufacturers:

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1) Inaba Denko America Inc**<< ; TKL LineBrace; ; _____; or None - N/A>>**: www.inabadenko-america.com/#sle.
2) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

9. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
10. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
11. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
12. Inserts: Malleable iron case of**<< galvanized; _____; or None - N/A>>** steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
13. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
    a. Bases: High density, UV tolerant, polypropylene or reinforced PVC.
    b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
    c. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with **<<ASTM A123/A123M>>**.
    d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
    e. Height: Provide minimum clearance of **<< 6 inches; or _____ inches>>** under pipe to top of roofing.
    f. Manufacturers:
        1) Green Link, Inc**<< ; _____; or None - N/A>>**: www.greenlinkengineering.com/#sle.
        2) PHP Systems/Design**<< ; _____; or None - N/A>>**: www.phpsd.com/#sle.
        3) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.04 REFRIGERANT

A. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of **<< zero; or _____>>** and global warming potential (GWP) **<< no greater than that allowed by federal code; of less than 50; or _____>>**.

B. Refrigerant: **<< R-454B; R-134A; or _____>>** or R-32as defined in **<<ASHRAE Std 34>>**.

2.05 MOISTURE AND LIQUID INDICATORS

A. Manufacturers:
    1. Henry Technologies**<< ; _____; or None - N/A>>**: www.henrytech.com/#sle.
    2. Mueller Refrigeration**<< ; _____; or None - N/A>>**: www.muellerrefrigeration.com/#sle.
    3. Parker Hannifin - Sporlan Division**<< ; See-All; ; _____; or None - N/A>>**: www.parker.com/#sle.
    4. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Indicators: **<< Single; Double; or _____>>** port type, UL listed, with copper or brass body, flared or soldered ends, sight glass, color coded paper moisture indicator**<< with removable element cartridge; _____; or None - N/A>>** and plastic cap; for maximum temperature of

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<< 200 degrees F>> and maximum working pressure of **<< 500 psi; 460 psi; 430 psi; or _____>>**.

2.06 VALVES

A. Manufacturers:
   1. Hansen Technologies Corporation**<< ; _____; or None - N/A>>**: www.hantech.com/#sle.
   2. Henry Technologies**<< ; _____; or None - N/A>>**: www.henrytech.com/#sle.
   3. Flomatic Valves**<< ; _____; or None - N/A>>**: www.flomatic.com/#sle.
   4. Mueller Refrigeration**<< ; _____; or None - N/A>>**: www.muellerrefrigeration.com/#sle.
   5. Parker Hannifin - Sporlan Division**<< ; _____; or None - N/A>>**: www.parker.com/#sle.
   6. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Diaphragm Packless Valves:
   1. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, soldered or flared ends, with positive backseating; for maximum working pressure of **<< 500 psi>>** and maximum temperature of **<< 275 degrees F>>**.

C. Packed Angle Valves:
   1. Forged brass**<< or nickel plated forged steel; _____; or None - N/A>>**, forged brass seal caps with copper gasket, rising stem and seat**<< with backseating; _____; or None - N/A>>**, molded stem packing, soldered or flared ends; for maximum working pressure of **<< 500 psi>>** and maximum temperature of **<< 275 degrees F>>**.

D. Ball Valves:
   1. Two piece**<< bolted; _____; or None - N/A>>** forged brass body with teflon ball seals and copper tube extensions, brass**<< bonnet and; _____; or None - N/A>>** seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of **<< 500 psi>>** and maximum temperature of **<< 300 degrees F; 325 degrees F; or _____>>**.

E. Service Valves:
   1. Forged brass body with copper stubs, brass caps, removable valve core,**<< integral ball check valve,; _____ ,; or None - N/A>>** flared or soldered ends, for maximum pressure of **<< 500 psi>>**.

2.07 STRAINERS

A. Manufacturers:
   1. Hansen Technologies Corporation**<< ; _____; or None - N/A>>**: www.hantech.com/#sle.
   2. Mueller Refrigeration**<< ; _____; or None - N/A>>**: www.muellerrefrigeration.com/#sle.
   3. Parker Hannifin - Sporlan Division**<< ; _____; or None - N/A>>**: www.parker.com/#sle.
   4. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Straight Line or Angle Line Type:
   1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of **<< 430 psi>>**.

C. Straight Line, Noncleanable Type:

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1. Steel shell, copper plated fittings, stainless steel wire screen, for maximum working pressure of **<< _____ psi>>**.

2.08 CHECK VALVES

A. Manufacturers:
   1. Hansen Technologies Corporation**<< ; _____; or None - N/A>>**: www.hantech.com/#sle.
   2. Mueller Refrigeration**<< ; _____; or None - N/A>>**: www.muellerrefrigeration.com/#sle.
   3. Parker Hannifin**<< ; _____; or None - N/A>>**: www.parker.com/#sle.
   4. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Globe Type:
   1. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum temperature of **<< 300 degrees F>>** and maximum working pressure of **<< 425 psi; 450 psi; 500 psi; or _____>>**.

C. Straight Through Type:
   1. Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of **<< 500 psi>>** and maximum temperature of **<< 200 degrees F; 250 degrees F; or _____>>**.

2.09 PRESSURE REGULATORS

A. Manufacturers:
   1. Hansen Technologies Corporation**<< ; _____; or None - N/A>>**: www.hantech.com/#sle.
   2. Parker Hannifin**<< ; _____; or None - N/A>>**: www.parker.com/#sle.
   3. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Brass body, stainless steel diaphragm, **<< direct acting; pilot operated with remote pressure pilot; or _____>>**, adjustable over **<< 0 to 80 psi>>** range, for maximum working pressure of **<< 450 psi>>**.

2.10 PRESSURE RELIEF VALVES

A. Manufacturers:
   1. Hansen Technologies Corporation**<< ; _____; or None - N/A>>**: www.hantech.com/#sle.
   2. Henry Technologies**<< ; _____; or None - N/A>>**: www.henrytech.com/#sle.
   3. Mueller Refrigeration**<< ; _____; or None - N/A>>**: www.muellerrefrigeration.com/#sle.
   4. Sherwood Valve/Harsco Corporation**<< ; _____; or None - N/A>>**: www.sherwoodvalve.com/#sle.
   5. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB, selected to **<<ASHRAE Std 15>>**, with standard setting of **<< 235 psi; 300 psi; 350 psi; 400 psi; 425 psi; 450 psi; or _____>>**.

2.11 FILTER-DRIERS

A. Manufacturers:

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1. Flow Controls Division of Emerson Electric**<< ; _____; or None - N/A>>**: www.emersonflowcontrols.com/#sle.
2. Mueller Refrigeration**<< ; _____; or None - N/A>>**: www.muellerrefrigeration.com/#sle.
3. Parker Hannifin - Sporlan Division**<< ; Catch-All; ; _____; or None - N/A>><< ; _____; or None - N/A>>**: www.parker.com/#sle.
4. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Performance:
1. Flow Capacity - Liquid Line: **<< ____ ton; As indicated in schedule; or _____>>**, minimum, rated in accordance with **<<AHRI 710 (I-P)>>** (**<<AHRI 711 (SI)>>**).
2. Flow Capacity - Suction Line: **<< ____ ton; As indicated in schedule; or _____>>**, minimum, rated in accordance with **<<AHRI 730 (I-P)>>**.
3. Pressure Drop: **<< 2 psi; ___ psi; As indicated in schedule; or _____>>**, maximum, when operating at full connected evaporator capacity.
4. Design Working Pressure: **<< 350 psi; 500 psi; ____ psi; As indicated in schedule; or _____>>**, minimum.

C. Cores: **<< Molded or loose-fill; Molded; Loose-fill; or _____>>** molecular sieve desiccant compatible with refrigerant, activated alumina,**<< activated charcoal,; _____ ,; or None - N/A>>** and filtration to 40 microns**<< , with secondary filtration to 20 microns; , _____; or None - N/A>>**; of construction that will not pass into refrigerant lines.

D. Construction: UL listed.
1. Replaceable Core Type: Steel shell with removable cap.
2. Sealed Type: **<< Copper; Steel; or _____>>** shell.
3. Connections: As specified for applicable pipe type.

2.12 SOLENOID VALVES

A. Manufacturers:
1. Flow Controls Division of Emerson Electric**<< ; _____; or None - N/A>>**: www.emersonflowcontrols.com/#sle.
2. Parker Hannifin - Sporlan Division**<< ; _____; or None - N/A>>**: www.parker.com/#sle.
3. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Valve: **<<AHRI 760 (I-P)>>**, pilot operated, copper, **<< or brass; brass or steel; or _____>>** body and internal parts, synthetic seat, stainless steel stem and plunger assembly (permitting manual operation in case of coil failure),**<< integral strainer,; _____ ,; or None - N/A>>** with flared, soldered, or threaded ends; for maximum working pressure of **<< 500 psi; 450 psi; 300 psi; or _____>>**.

C. Coil Assembly: **<< UL 429 ; _____ ; or None - N/A>>**UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box**<< with pilot light; _____; or None - N/A>>**.

2.13 EXPANSION VALVES

A. Manufacturers:
1. Flow Controls Division of Emerson Electric**<< ; _____; or None - N/A>>**: www.emersonflowcontrols.com/#sle.
2. Parker Hannifin - Sporlan Division**<< ; _____; or None - N/A>>**: www.parker.com/#sle.
3. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

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B. Angle or Straight Through Type: **<<AHRI 760 (I-P)>>**; design suitable for refrigerant, brass body, internal or external equalizer, **<< bleed hole; mechanical pressure limit (maximum operating pressure MOP feature); or _____>>**, **<< adjustable; nonadjustable; or _____>>** superheat setting, replaceable inlet strainer, with **<< nonreplaceable; replaceable; or _____>>** capillary tube and remote sensing bulb**<< and remote bulb well; _____; or None - N/A>>**.

C. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum **<< 10 degrees F>>** superheat. Select to avoid being undersized at full load and excessively oversized at part load.

2.14 ELECTRONIC EXPANSION VALVES

A. Manufacturers:
   1. Flomatic Valves**<< ; _____; or None - N/A>>**: www.flomatic.com/#sle.
   2. Parker Hannifin - Sporlan Division**<< ; _____; or None - N/A>>**: www.parker.com/#sle.
   3. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Valve:
   1. Brass body with flared or soldered connection, needle valve with floating needle and machined seat, stepper motor drive.

C. Evaporation Control System:
   1. Electronic microprocessor based unit in enclosed case, proportional integral control with adaptive superheat, maximum operating pressure function, preselection allowance for electrical defrost and hot gas bypass.

D. Refrigeration System Control: Electronic microprocessor based unit in enclosed case, with proportional integral control of valve, on/off thermostat, air temperature alarm (high and low), solenoid valve control, liquid injection adaptive superheat control, maximum operating pressure function, night setback thermostat, timer for defrost control.

2.15 RECEIVERS

A. Manufacturers:
   1. Henry Technologies**<< ; _____; or None - N/A>>**: www.henrytech.com/#sle.
   2. Parker Hannifin**<< ; _____; or None - N/A>>**: www.parker.com/#sle.
   3. Sherwood Valve/Harsco Corporation**<< ; _____; or None - N/A>>**: www.sherwoodvalve.com/#sle.
   4. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Internal Diameter **<< 6 inch>>** and Smaller:
   1. **<<AHRI 495>>**, UL listed, steel, brazed; **<< 400 psi>>** maximum pressure rating, with tappings for inlet, outlet, and pressure relief valve.

C. Internal Diameter Over **<< 6 inch>>**:
   1. **<<AHRI 495>>**, welded steel, tested and stamped in accordance with **<<ASME BPVC-VIII-1>>**; **<< 400 psi>>** with tappings for liquid inlet and outlet valves, pressure relief valve**<< , and magnetic liquid level indicator; , _____; or None - N/A>>**.

2.16 CONDUIT FOR PIPING

A. Heavy-Duty, Protective Multi-Lineset Enclosure:
   1. Manufacturers:

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a. Inaba Denko America Inc**<< ; Slimduct RD Metal Lineset Cover; ; _____; or None - N/A>>**: www.inabadenko-america.com/#sle.

b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2. Description: Rigid encasement to cover and enclose multiple linesets; suitable for outdoor and rooftop applications; provides protection agains impact force and weather; installs on both horizontal and vertical piping.

3. Construction: **<< Metal; Steel; Stainless steel; or _____>>** exterior; **<< weather-; corrosion-; salt-; and _____>>**resistant.

a. Coating: Layer of **<< zinc chemical mixture; chemical mixture; or _____>>** applied to exterior for corrosion resistance.

4. Tensile Strength: **<< 30 lbf/sq in; _____ lbf/sq in; or _____>>** or greater.

5. Load Rating: Cover provides resistance to loads up to **<< 100 lbf/sq ft; 1000 lbf/sq ft; _____ lbf/sq ft; or _____>>** or greater.

2.17 FLEXIBLE CONNECTORS

A. Manufacturers:

1. Circuit Hydraulics, Ltd**<< ; _____; or None - N/A>>**: www.circuit-hydraulics.co.uk/#sle.
2. Flexicraft Industries**<< ; _____; or None - N/A>>**: www.flexicraft.com/#sle.
3. Penflex**<< ; _____; or None - N/A>>**: www.penflex.com/#sle.
4. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Corrugated **<< stainless steel; bronze; or _____>>** hose with single layer of**<< stainless steel; _____; or None - N/A>>** exterior braiding, minimum **<< 9 inches>>** long with copper tube ends; for maximum working pressure of **<< 500 psi; 400 psi; 350 psi; 300 psi; or _____>>**.

2.18 ENGINEERED WALL SEALS AND INSULATION PROTECTION

A. Manufacturers:

1. Airex Manufacturing, Inc**<< ; ____; or None - N/A>>**: www.airexmfg.com/#sle.
2. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Basis of Design: Airex Manufacturing, Inc; www.airexmfg.com/#sle.

1. Pipe Penetration Wall Seal**<< : Airex Titan Outlet; : ____; or None - N/A>>**.
2. Refrigeration Pipe Insulation Protection System**<< : Airex E-Flex Guard; : ____; or None - N/A>>**.
3. Pipe Penetration Wall Seal and Insulation Protection System**<< : Airex Pro-System Kit; : ____; or None - N/A>>**.

C. Pipe Penetration Wall Seal: Seals HVAC piping wall penetrations with compression gasket wall mounted rigid plastic outlet cover.

1. Wall Outlet Size, Stucco and Masonry Applications: **<< 7-1/2 inch wide by 10 inch high>>**.

a. Elastomeric Sleeve Diameter: **<< 1-11/16 inch; 2-3/8 inch; 3-3/16 inch; or ___ inch>>**.

2. Wall Outlet Size, Siding and Compact Applications: **<< 6-7/8 inch wide by 3-7/8 inch high>>**.

a. Elastomeric Sleeve Diameter: **<< 1-11/16 inch; 2-3/8 inch; or ___ inch>>**.

3. Outlet Cover Color: **<< Gray; White; or _____>>**.
4. Water Penetration: Comply with **<<ASTM E331>>**.

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5. Air Leakage: Comply with **<<ASTM E283/E283M>>**.
6. Air Permeance: Comply with **<<ASTM E2178>>**.

D. Insulation Protection System: Mechanical line insulation and PVC cover.
1. PVC Insulation Cover Color: **<< Black; White; or _____>>** with full-length velcro fastener.
2. Weatherization and Ultraviolet Exposure Protection: Comply with **<<ASTM G153>>**.
3. Water/Vapor Permeability: Comply with **<<ASTM E96/E96M>>**.
4. Anti-Fungal and Anti-Microbial Resistance: Comply with **<<ASTM G21>>**.
5. Flame Spread and Smoke Development Rating of 25/450: Comply with **<<ASTM E84>>**.
6. Adhesive free.

2.19 EXTERIOR PENETRATION ACCESSORIES

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.
1. Products:
a. Quickflash Weatherproofing Products, Inc**<< ; _____; or None - N/A>>**: www.quickflashproducts.com/#sle.
b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.
1. Products:
a. Alta Products, LLC; Sigrist Pipe Chase Housing, Curbs, and Exit Seals: www.altaproductsllc.com/#sle.
b. Menzies Metal Products**<< ; _____; or None - N/A>>**: www.menzies-metal.com/#sle.
c. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

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PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs.**<< Bevel plain end ferrous pipe.; _____ .; or None - N/A>>**

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A. Install refrigeration specialties in accordance with manufacturer's instructions.

B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

C. Install piping to conserve building space and avoid interference with use of space.

D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over **<< 4 inches>>**.
   4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut **<< above; flush with top of; recessed into and grouted flush with; or _____>>** slab.

G. Pipe Hangers and Supports:
   1. Install in accordance with **<< ASME B31.5; ASTM F708; MSS SP-58; and _____>>**.
   2. Support horizontal piping as indicated.
   3. Install hangers to provide minimum **<< 1/2 inch>>** space between finished covering and adjacent work.
   4. Place hangers within **<< 12 inches>>** of each horizontal elbow.
   5. Support vertical piping at every**<< other; _____; or None - N/A>>** floor. Support riser piping independently of connected horizontal piping.
   6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers. Only use trapeze hangers to support all refrigerant piping 3 feet apart.
   7. Provide **<< copper plated hangers and supports for copper piping; sheet lead packing between hanger or support and piping; or _____>>**.

H. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.

I. Provide clearance for installation of insulation and access to valves and fittings.

J. Provide access to concealed valves and fittings. **<< Coordinate size and location of access doors with Section 083100.; _____ .; or None - N/A>>**

K. Flood piping system with nitrogen when brazing.

L. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.

M. Prepare unfinished pipe, fittings, supports, and accessories ready for finish painting. See Section **<< 099123>>**.

N. Insulate piping**<< and equipment; _____; or None - N/A>>**.

O. Follow **<<ASHRAE Std 15>>** procedures for charging and purging of systems and for disposal of refrigerant.

P. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.

Q. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

R. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

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S. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

T. Fully charge completed system with refrigerant after testing.

U. Provide electrical connection to solenoid valves. See Section **<< 260583>>**.

3.03 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Test refrigeration system in accordance with **<<ASME B31.5>>**.

C. Pressure test system with dry nitrogen to **<< 200 psi>>**. Perform final tests at 500 microns vacuum and **<< 500 psi>>** using **<< halide torch; electronic leak detector; or _____>>**. Test to no leakage. Test per manufacturers recommendations.

3.04 SCHEDULES

A. Hanger Spacing for Copper Tubing.

1. **<< 1/2 inch>>**, **<< 5/8 inch>>**, and **<< 7/8 inch>>** OD: Maximum span, **<< 3 feet>>**; minimum rod size, **<< 1/4 inch>>**.
2. **<< 1-1/8 inch>>** OD: Maximum span, **<< 3 feet>>**; minimum rod size, **<< 1/4 inch>>**.
3. **<< 1-3/8 inch>>** OD: Maximum span, **<< 3 feet>>**; minimum rod size, **<< 3/8 inch>>**.
4. **<< 1-5/8 inch>>** OD: Maximum span, **<< 3 feet>>**; minimum rod size, **<< 3/8 inch>>**.
5. **<< 2-1/8 inch>>** OD: Maximum span, **<< 3 feet>>**; minimum rod size, **<< 3/8 inch>>**.
6. **<< 2-5/8 inch>>** OD: Maximum span, **<< 3 feet>>**; minimum rod size, **<< 3/8 inch>>**.
7. **<< 3-1/8 inch>>** OD: Maximum span, **<< 3 feet>>**; minimum rod size, **<< 3/8 inch>>**.
8. **<< 3-5/8 inch>>** OD: Maximum span, **<< 3 feet>>**; minimum rod size, **<< 1/2 inch>>**.
9. **<< 4-1/8 inch>>** OD: Maximum span, **<< 3 feet>>**; minimum rod size, **<< 1/2 inch>>**.

END OF SECTION 232300

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SECTION 232500
HVAC WATER TREATMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Materials.
   1. System cleaner.
   2. Closed system treatment (water).
   3. Condenser water system treatment (cooling towers).

B. By-pass (pot) feeder.

C. Solution metering pump.

D. Solution tanks.

E. Agitator.

F. Liquid level switch.

G. Conductivity controller.

H. Water meter.

I. Solenoid valves.

J. Timers.

K. Glycol.

L. Test equipment.

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1.02 RELATED REQUIREMENTS

A. Section **<< 016000 - Product Requirements>>**: **<<Owner>>** furnished **<< treatment equipment; chemicals; and _____>>**.

1.03 REFERENCE STANDARDS

A. FM (AG) - FM Approval Guide.

B. ITS (DIR) - Directory of Listed Products.

C. UL (DIR) - Online Certifications Directory.

1.04 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>**, for submittal procedures.

B. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.

C. Shop Drawings: Indicate system schematic, equipment locations, and controls schematics, electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Indicate placement of equipment in systems, piping configuration, and connection requirements.

E. Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.

F. Certificate: Submit certificate of compliance from **<< Authority Having Jurisdiction; or _____>>** indicating approval of chemicals and their proposed disposal.

G. Project Record Documents: Record actual locations of equipment and piping, including sampling points and location of chemical injectors.

H. Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

I. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.
   1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
   2. Sufficient chemicals for treatment and testing during required maintenance period.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum **<< three; ten; or _____>>** years of**<< documented; _____; or None - N/A>>** experience. Company shall have local representatives with water analysis laboratories and full time service personnel.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section,**<< with minimum _____ years of experience; with minimum 5 years of documented experience; _____; or None - N/A>>** and approved by manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. AmSolv-Amrep, Inc**<< ; _____; or None - N/A>>**: www.amsolv.com/#sle.

B. GE Water & Process Technologies**<< ; _____; or None - N/A>>**: www.gewater.com/#sle.

C. Nalco, an Ecolab Company**<< ; _____; or None - N/A>>**: www.nalco.com/#sle.

D. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.02 REGULATORY REQUIREMENTS

A. Comply with applicable codes for addition of non-potable chemicals to building mechanical systems and to public sewage systems.

B. Comply with **<< UL (DIR); FM (AG); ITS (DIR) or Warnock Hersey; or ___>>** requirements.

C. Perform work in accordance with **<< local health department; or _____>>** regulations.

D. Provide certificate of compliance from **<< Authority Having Jurisdiction; or _____>>** indicating approval of installation.

2.03 MATERIALS

A. System Cleaner:
   1. Manufacturers:
      a. AmSolv-Amrep, Inc**<< ; _____; or None - N/A>>**: www.amsolv.com/#sle.
      b. GE Water & Process Technologies**<< ; _____; or None - N/A>>**: www.gewater.com/#sle.
      c. Nalco, an Ecolab Company**<< ; _____; or None - N/A>>**: www.nalco.com/#sle.
      d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

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2. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products**<< ; sodiumtripoly phosphate and sodium molybdate; ; _____; or None - N/A>>**.
3. Biocide **<< chlorine release agents such as sodium hypochlorite or calcium hypochlorite; microbiocides such as quarternary ammonia compounds, tributyltin oxide, methylene bis (thiocyanate); isothiazolones; or _____>>**.

B. Closed System Treatment (Water):
1. Manufacturers:
   a. AmSolv-Amrep, Inc**<< ; _____; or None - N/A>>**: www.amsolv.com/#sle.
   b. GE Water & Process Technologies**<< ; _____; or None - N/A>>**: www.gewater.com/#sle.
   c. Nalco, an Ecolab Company**<< ; _____; or None - N/A>>**: www.nalco.com/#sle.
   d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
2. Sequestering agent to reduce deposits and adjust pH**<< ; polyphosphate; ; _____; or None - N/A>>**.
3. Corrosion inhibitors**<< ; boron-nitrite, sodium nitrite and borax, sodium totyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites; ; liquid boron-nitrite, sodium nitrite and borax, sodium totyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites; ; _____; or None - N/A>>**.
4. Conductivity enhancers**<< ; phosphates or phosphonates; or ; _____>>**.

C. Condenser Water System Treatment (Cooling Towers):
1. Manufacturers:
   a. AmSolv-Amrep, Inc**<< ; _____; or None - N/A>>**: www.amsolv.com/#sle.
   b. GE Water & Process Technologies**<< ; _____; or None - N/A>>**: www.gewater.com/#sle.
   c. Nalco, an Ecolab Company**<< ; _____; or None - N/A>>**: www.nalco.com/#sle.
   d. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
2. Sequestering agent to inhibit scaling**<< ; phosphonates, sodium polyphosphates, lignin derivatives, synthetic polymer polyelectrolytes, or organic phosphates; ; _____; or None - N/A>>**.
3. Acid to reduce alkalinity and pH**<< ; sulphuric acid; ; _____; or None - N/A>>**.
4. Corrosion inhibitor**<< ; zinc-phosphate, phosphonate-phosphate, phosphonate-molybdate and phosphonate-silicate, sodium tolyltriazole, or low molecular weight polymers; ; _____; or None - N/A>>**.
5. Biocide **<< chlorine release agents such as sodium hypochlorite or calcium hypochlorite; microbiocides such as quaternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate); isothiazolones; or _____>>**.

2.04 BY-PASS (POT) FEEDER

A. Manufacturers:
1. Griswold Controls**<< ; _____; or None - N/A>>**: www.griswoldcontrols.com/#sle.
2. J. L. Wingert Company**<< ; _____; or None - N/A>>**: www.jlwingert.com/#sle.
3. Neptune, a brand of the Dover Company**<< ; _____; or None - N/A>>**: www.neptune1.com/#sle.

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4. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. **<< 2 quart; 1.8 gal; 6.0 gal; or __ gal>>** quick opening cap for working pressure of **<< 175 psi; or ___ psi>>**.

2.05 SOLUTION METERING PUMP

A. Manufacturers:
1. J. L. Wingert Company**<< ; _____; or None - N/A>>**: www.jlwingert.com/#sle.
2. Dover Corporation**<< ; _____; or None - N/A>>**: www.neptune1.com/#sle.
3. Pulsafeeder Engineered Products**<< ; _____; or None - N/A>>**: www.pulsa.com/#sle.
4. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Positive displacement, diaphragm pump with adjustable flow rate, thermoplastic construction, continuous-duty fully enclosed electric motor and drive, and**<< built-in; _____; or None - N/A>>** relief valve.

C. Electrical Characteristics:
1. Cord and Plug: Provide unit with **<< 6 foot; or __ foot>>** cord and plug for connection to electric wiring system**<< including grounding connector; _____; or None - N/A>>**.

2.06 SOLUTION TANKS

A. **<< 30 gallon; 50 gallon; or __ gallon>>** capacity, polyethylene, self-supporting, **<< 1 gallon; 5 gallon; or __ gallon>>** graduated markings; molded fiberglass cover with recess for mounting pump, agitator, and liquid level switch.

2.07 AGITATOR

A. **<< Totally enclosed; Explosion-proof; or _____>>** electric motor, **<< cast iron; stainless steel; or _____>>** clamp and motor mount, **<< 1/2 inch; 5/8 inch; or __ inch>>** diameter **<< coated ; _____; or None - N/A>>**Type 316 stainless steel propeller.

B. Electrical Characteristics:
1. Cord and Plug: Provide unit with **<< 6 foot; or ____ foot>>** cord and plug for connection to electric wiring system**<< including grounding connector; _____; or None - N/A>>**.

2.08 LIQUID LEVEL SWITCH

A. Polypropylene housing with integrally mounted PVC air trap, receptacles for connection to metering pump, and low level alarm.

2.09 CONDUCTIVITY CONTROLLER

A. Manufacturers:
1. Envirocare International**<< ; _____; or None - N/A>>**: www.envirocare.com/#sle.
2. JENCO Instruments Incorporated**<< ; _____; or None - N/A>>**: www.jencoi.com/#sle.
3. Omega Engineering, Inc**<< ; _____; or None - N/A>>**: www.omega.com/#sle.
4. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Packaged monitor controller with solid state circuiting, five percent accuracy, linear dial adjustment, built-in calibration switch, on-off switch and light, control function light, output to control circuit**<< and recorder; _____; or None - N/A>>**.

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2.10 WATER METER

A. Displacement type cold water meter with sealed, tamper-proof magnetic drive, impulse contact register**<< , single pole, double throw dry contact switch; , _____; or None - N/A>>**.

2.11 SOLENOID VALVES

A. Forged brass body globe pattern, normally open or closed as required, **<< general purpose; or explosion-proof and watertight>>** solenoid enclosure, and continuous duty coil.

2.12 TIMERS

A. Electronic timers, infinitely adjustable over full range, 150 second and five minute range, mounted together in cabinet with hands-off-automatic switches and status lights.

2.13 GLYCOL

A. Manufacturers:
   1. CORECHEM, Inc**<< ; _____; or None - N/A>>**: www.corecheminc.com/#sle.
   2. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Description: Glycol-based anti-freeze protection for heat-transfer fluid in hydronic systems; corrosion inhibitors added for prevention of metal piping deterioration.

C. Application: For **<< hydronic heating and cooling; geothermal; or _____>>** system.

D. Composition: Use **<< ethylene; nontoxic propylene; or _____>>** glycol.

E. Operating Temperature: Rated for operating range of hydronic system.
   1. Minimum Mixture Operating Temperature: **<< 0 degrees F; _____ degrees F; or _____>>**.
   2. Maximum Mixture Operating Temperature: **<< 215 degrees F; _____ degrees F; or _____>>**.

F. pH: **<< 9.0 to 11.0; 8.5 to 10.5; 7.0 to 9.0; or _____>>**.

G. Food Safe: NSF-certified nonfood compound, Category HT-1 heat transfer fluid for incidental food contact.

2.14 TEST EQUIPMENT

A. Provide white enamel test cabinet with local and fluorescent light, capable of accommodating 4 - 10 ml zeroing titrating burettes and associated reagents.

B. Provide the following test kits:
   1. Alkalinity titration test kit.
   2. Chloride titration test kit.
   3. Sulfite titration test kit.
   4. Total hardness titration test kit.
   5. Low phosphate test kit.
   6. Conductivity bridge, range 0 - 10,000 micro-ohms.
   7. Creosol red pH slide complete with reagent.
   8. Portable electronic conductivity meter.
   9. High nitrite test kit.

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PART 3 EXECUTION

3.01 PREPARATION

A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.

B. Place terminal control valves in open position during cleaning.

C. Verify that electric power is available and of the correct characteristics.

3.02 CLEANING SEQUENCE

A. Concentration:
   1. As recommended by manufacturer.

B. Hot Water Heating Systems:
   1. Apply heat while circulating, slowly raising temperature to **<< 160 degrees F>>** and maintain for 12 hours minimum.
   2. Remove heat and circulate to **<< 100 degrees F>>** or less; drain systems as quickly as possible and refill with clean water.
   3. Circulate for 6 hours at design temperatures, then drain.
   4. Refill with clean water and repeat until system cleaner is removed.

C. Chilled Water Systems:
   1. Circulate for 48 hours, then drain systems as quickly as possible.
   2. Refill with clean water, circulate for 24 hours, then drain.
   3. Refill with clean water and repeat until system cleaner is removed.

D. Use neutralizer agents on recommendation of system cleaner supplier and approval of **<<Architect>>**.

E. Flush open systems **<< and glycol filled closed systems; or None - N/A>>** with clean water for one hour minimum. Drain completely and refill.

F. Remove, clean, and replace strainer screens.

G. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.04 CLOSED SYSTEM TREATMENT

A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.

B. Introduce closed system treatment through bypass feeder when required or indicated by test.

C. Provide **<< 3/4 inch>>** water coupon rack around circulating pumps with space for **<< 4; 12; or _____>>** test specimens.

3.05 CONDENSER WATER SYSTEMS (COOLING TOWERS)

A. Provide automatic condenser water control systems for inhibitor feed, blowdown and biocide feeds. Inhibitor application shall be meter activated, blowdown shall be conductivity activated, and biocide shall be meter fed with blowdown locked out to ensure biocide retention time.

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B. Control system shall incorporate solid state integrated circuits and digital LED displays, in NEMA-12 steel enclosure. Provide gasketed and lockable door.

C. Base dissolved solids control on conductivity and include:
   1. LED digital readout display (micro-ohm/cm).
   2. Temperature compensated sensor probe adaptable to sample stream manifold.
   3. High, low, normal conductance indicator lights (LED).
   4. High or low conductance alarm light (flash or steady switch), trip points field adjustable. Flash or steady switch shall have silence position.
   5. Illuminated legend shall indicate "ALARM" whenever alarm condition exists.
   6. Hand-off-automatic switch for solenoid bleed valve.
   7. Illuminated legend shall indicate "BLEED" when valve is operated.
   8. Adjustable hysteresis or dead-band (internal).

D. Base inhibitor feed control on make-up volume and include:
   1. Solid state counter (1-15 field selectable).
   2. Solid state timer (adjustable 1/4 to 5 minutes).
   3. Test switch.
   4. Hand-off-automatic switch for chemical pump.
   5. Illuminated legend shall indicate "FEED" when pump is activated.
   6. Solid state lock-out timer (adjustable 1/4 to 3 hours) and indicator light. Lock-out timer shall deactivate the pump and activate alarm circuits.
   7. Panel totalizer (amount of makeup), electro-mechanical type.

E. Biocide programmer to include:
   1. 24 hour timer with 14 day skip feature to permit activation any hour of the day.
   2. Precision solid state bleed lock-out timer (0-9 hours) and biocide pump timer (0 - 2-1/4 hours), clock controlled.
   3. Solid state alternator to enable the use of two different formulations.
   4. Digital display of the time of day (24 hours).
   5. LED display of day of week (14 days).
   6. Fast and slow clock set controls (internal).
   7. Battery back-up so clock is not disturbed by power outages, quartz timekeeping accuracy.
   8. Hand-off-automatic switches for biocide pumps.
   9. Illuminated legend shall indicate "BIOCIDE A" or "BIOCIDE B" when pump is activated.

F. Provide water meter on system make-up**<< , wired to control system; , _____; or None - N/A>>**.

G. Provide solution pumps to feed sequestering agent and corrosion inhibitor from solution tank into condenser water supply to tower. Provide agitator as required.

H. Provide conductivity controller to sample condenser water and operate **<< 1 inch; or _ inch>>** solenoid bleed valve and piping to blowdown controller sampler wired to open when condensing water pump is operating.

I. Introduce biocide to tower by **<< intermittent slug feed; continuous feed with solution pump or solenoid valve on tank (chlorine); or _____>>**.

J. Provide liquid level switch in each solution tank to deactivate solution pump and agitator and **<< sound local alarm bell; signal mechanical alarm system; refer to Section 230913; or _____>>**.

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K. Provide **<< 3/4 inch>>** water coupon rack around circulating pumps with space for **<< 4; 12; or _____>>** test specimens.

3.06 CLOSEOUT ACTIVITIES

A. Training: Train **<<Owner>>**'s personnel on operation and maintenance of chemical treatment system.
   1. Provide minimum of **<< two hours; or _____>>** of instruction for **<< two people; or _____>>**.
   2. Have operation and maintenance data prepared and available for review during training.
   3. Conduct training using actual equipment after treated system has been put into full operation.

3.07 MAINTENANCE

A. See Section **<< 017000>>** - Execution Requirements, for additional requirements relating to maintenance service.

B. Provide a separate maintenance contract for specified maintenance service.

C. Perform maintenance work using competent and qualified personnel **<< under the supervision; in the direct employ; and _____>>** of the equipment manufacturer or original installer.

D. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of **<<Owner>>**.

E. Provide service and maintenance of treatment systems for **<< one year; ___ years; or _____>>** from Date of Substantial Completion.

F. Provide **<< monthly; or _____>>** technical service visits to perform field inspections and make water analysis on-site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit.

G. Provide laboratory and technical assistance services during this maintenance period.

H. Provide on-site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.

END OF SECTION 232500

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SECTION 233100
HVAC DUCTS AND CASINGS

<<<< UPDATE NOTES

PART 1 GENERAL

2.01 SECTION INCLUDES

A. Metal ducts.

B. Flexible ducts.

C. Air plenums and casings.

D. Ducts for kitchen exhaust applications.

2.02 RELATED REQUIREMENTS

A. Section **<< 078400 - Firestopping>>**.

B. Section **<< 099113 - Exterior Painting>>**: Weld priming, weather resistant, paint or coating.

C. Section **<< 099123 - Interior Painting>>**: Weld priming, paint or coating.

D. Section **<< 114000 - Foodservice Equipment>>**: Kitchen range hoods.

E. Section **<< 230130.51 - HVAC Air-Distribution System Cleaning>>**: Post install duct cleaning.

F. Section **<< 230713 - Duct Insulation>>**: External insulation and duct liner.

G. Section **<< 233319 - Duct Silencers>>**.

H. Section **<< 233700 - Air Outlets and Inlets>>**: Fabric air distribution devices.

2.03 REFERENCE STANDARDS

A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

D. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

E. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

F. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

I. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

J. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.

K. ASTM E2336 - Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.

L. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements.

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M. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry.

N. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements.

O. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

P. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.

Q. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

R. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

S. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.

T. SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines.

U. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual.

V. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.

W. UL 1479 - Standard for Fire Tests of Penetration Firestops.

X. UL 1978 - Grease Ducts.

Y. UL 2221 - Tests of Fire Resistive Grease Duct Enclosure Assemblies.

2.04 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Product Data: Provide data for **<< duct materials; duct liner; duct connections; and _____>>**.

1. Sealants and gaskets where applicable.

C. Shop Drawings: Indicate duct fitting types, gauges, sizes, welds, and configuration**<< for _____ pressure class and higher systems; for kitchen hood exhaust systems; for glass fiber duct systems; for _____ systems; or None - N/A>>**.

D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate per appropriate seal class, following **<<SMACNA (LEAK)>>**.

E. Manufacturer's Installation Instructions: Indicate special procedures for glass fiber ducts.

F. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

2.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum **<< three; or _____>>** years of**<< documented; _____; or None - N/A>>** experience**<< , and approved by manufacturer; , _____; or None - N/A>>**.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum **<< three; five; or ____>>** years of**<< documented; _____; or None - N/A>>** experience.

2.06 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

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PART 2 PRODUCTS

3.01 GENERAL REQUIREMENTS

A. Provide**<< UL Class 0; UL Class 1; _____; or None - N/A>> << None - N/A; or reinforced >>**ductwork, fittings, hangers, supports, and appurtenances in accordance with **<< NFPA 90A; NFPA 90B; SMACNA (DCS); and _____>>** guidelines unless stated otherwise**<< . Apply illustrated design guides and specifics for underground construction; _____; or None - N/A>>**.

B. Provide metal duct unless otherwise indicated.

C. Acoustical Treatment: Provide sound-absorbing liner where indicated.

D. Duct Shape and Material in accordance with Allowed Static Pressure Range:

1. Round: Plus or minus **<< 2 in-wc; 4 in-wc; 10 in-wc; or ___ in-wc>>** of **<< G60-coated galvanized steel; galvanized steel; stainless steel; or _____>>**.
2. Rectangular: Plus or minus **<< 1/2 in-wc; 1 in-wc; 2 in-wc; 3 in-wc; 4 in-wc; 6 in-wc; 10 in-wc; or ___ in-wc>>** of **<< G60-coated galvanized steel; galvanized steel; stainless steel; or _____>>**.
3. Flat Oval: Plus **<< 1 in-wc; 2 in-wc; 3 in-wc; 4 in-wc; 6 in-wc; 10 in-wc; or _____ in-wc>>** of **<< galvanized steel; stainless steel; or _____>>**.
4. Flexible Duct (Fabric and wire): Plus or minus **<< 1/2 in-wc; 1 in-wc; 2 in-wc; 3 in-wc; 4 in-wc; 6 in-wc; 10 in-wc; or ___ in-wc>>**; see Section **<< 233700>>**.

E. Duct Sealing and Leakage in accordance with Static Pressure Class:

1. Duct Pressure Class and Material for Common Mechanical Ventilation Applications:
   a. Supply Air: **<< 1/2 in-wc; 1 in-wc; or ___ in-wc>>** pressure class**<< , galvanized steel; , _____; or None - N/A>>**.
   b. Outside Air Intake: **<< 1/2 in-wc; 1 in-wc; or ___ in-wc>>** pressure class**<< , galvanized steel; , _____; or None - N/A>>**.
   c. Return and Relief Air: **<< 1/2 in-wc; 1 in-wc; or ___ in-wc>>** pressure class**<< , galvanized steel; , _____; or None - N/A>>**.
   d. General Exhaust Air: **<< 1/2 in-wc; 1 in-wc; or ___ in-wc>>** pressure class**<< , galvanized steel; , _____; or None - N/A>>**.
   e. Transfer-air and Sound Booths: **<< 1/2 in-wc; 1 in-wc; 2 in-wc; or ___ in-wc>>** pressure class**<< , fibrous glass; , _____; or None - N/A>>**.
2. Low Pressure Service: Up to 2 in wc:
   a. Seal: Class A, apply to seal off transverse joints.
   b. Leakage:
      1) Rectangular: Class 6 or **<< 6 cfm/100 sq ft>>**.
      2) Round: Class 12 or **<< 3 cfm/100 sq ft>>**.
3. Medium Pressure Service: From 2 in wc to 6 in wc:
   a. Seal: Class A, apply sealing of transverse joints and longitudinal seams.
   b. Leakage:
      1) Rectangular: Class 12 or **<< 6 cfm/100 sq ft>>**.
      2) Round: Class 6 or **<< 3 cfm/100 sq ft>>**.

F. Duct Fabrication Requirements:

1. Duct and Fitting Fabrication and Support: **<<SMACNA (DCS)>>** including specifics for continuously welded round and oval duct fittings.

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2. No variation of duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts in accordance with **<<ASHRAE (FUND)>>** Handbook - Fundamentals.
3. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.
4. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide **<< airfoil; or _____>>** turning vanes of perforated metal with glass fiber insulation.
5. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
6. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
7. Provide turning vanes of perforated metal with glass fiber insulation when an acoustical lining is required.
8. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

3.02 METAL DUCTS

A. Material Requirements:
   1. Galvanized Steel: Hot-dipped galvanized steel sheet, **<<ASTM A653/A653M>>** FS Type B, with **<< G60/Z180; G90/Z275; or _____>>** coating.
   2. Aluminum: **<<ASTM B209/B209M>>**, aluminum sheet, alloy 3003-H14.
   3. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength.
   4. Stainless Steel: **<< ASTM A240/A240M; ASTM A276/A276M; ASTM A480/A480M; ASTM A666; or _____>>**, Type **<< 304; 316; 302; or _____>>**.

B. Flat-Oval Metal Ducts:
   1. Flat-Oval Single Wall Duct: Machine made from a round spiral lock seam duct.
      a. Fittings: Manufacture at least two gauges heavier metal than the duct.
      b. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
   2. Flat-Oval Double Wall Insulated Duct: Machine made from round spiral lock seam duct.
      a. Fittings: Manufacture with solid inner wall.
      b. Inner Wall: Perforated galvanized steel.
      c. Insulation:
         1) Thickness: **<< 1 inch; or ___ inch>>** fiberglass.

C. Round Metal Ducts:
   1. Round Single Wall Duct: Round lock seam duct with galvanized steel outer wall.
   2. Round Double Wall Insulated Duct: Round spiral lock seam duct with galvanized steel outer wall,**<< perforated; _____; or None - N/A>>** galvanized steel inner wall; fitting with the solid inner wall.
      a. Insulation:
         1) Thickness: **<< 1 inch; or ___ inch>>**.
         2) Material: **<< Air; Fiberglass; or _____>>**.
   3. Round Connection System: Interlocking duct connection system in accordance with **<<SMACNA (DCS)>>**.

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D. Round Spiral Duct:
   1. Round spiral lock seam duct with galvanized steel outer wall.

E. Connectors, Fittings, Sealants, and Miscellaneous:
   1. Fittings: Manufacture with solid inner wall of perforated galvanized steel.
   2. Transverse Duct Connection System: **<< SMACNA "E" rated; SMACNA "J" rated; SMACNA "F" rated; or _____>>** rigid class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with **<<SMACNA (DCS)>>**.
   3. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
      a. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts. No tape only sealing permitted.
      b. VOC Content: Not more than 250 g/L, excluding water.
      c. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with **<<ASTM E84>>**.
      d. For Use with Flexible Ducts: UL labeled.
      e. Manufacturers:
         1) Carlisle HVAC Products**<< ; Hardcast Versa-Grip 181 Water Based Fiber Reinforced Duct Sealant; ; Hardcast Duct-Seal 321 Indoor/Outdoor Water Based Duct Sealant; ; Hardcast Flex-Grip 550 Flexible Water Based Duct Sealant; ; Hardcast Iron-Grip 601 Water Based Duct Sealant; ; Hardcast Foil-Grip 1404 UL 181 True Zero VOC Rolled Sealant; ; Hardcast Foil-Grip 1402 UL 723 Classified True Zero VOC Rolled Sealant; ; Hardcast Spray-Seal Water Based Duct Sealant; ; Hardcast Aluma-Grip 701 Heavy Duty, Zero VOC Rolled Sealant; ; Hardcast Sure-Grip 404 Solvent Based Fiber Free Duct Sealant; ; Model _____; or None - N/A>>**: www.carlislehvac.com/#sle.
         2) Design Polymerics**<< ; DP 1010 Water Based Smooth Duct Sealant, Premium Quality; ; DP 1020 Water Based, Premium Quality, Fiber Reinforced Duct Sealant; ; DP 1030 Water Based, Fiber Reinforced Duct Sealant; ; DP 1090 Solvent Based, Low VOC, Duct Sealant; ; _____; or None - N/A>>**: www.designpoly.com/#sle.
         3) Ductmate Industries, Inc, a DMI Company**<< ; _____; or None - N/A>>**: www.ductmate.com/#sle.
         4) Elgen Manufacturing Company, Inc**<< ; Duct Sealer; ; _____; or None - N/A>>**: www.elgenmfg.com/#sle.
         5) H.B. Fuller Construction Products, Inc**<< ; _____; or None - N/A>>**: www.fosterproducts.com//#sle.
         6) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
   4. Gasket Tape:
      a. Provide butyl rubber gasket tape for a flexible seal between transfer duct connector (TDC), transverse duct flange (TDF), applied flange connections, and angle ring connections.
      b. Manufacturers:
         1) Design Polymerics**<< ; DP 1040 100 Percent Solids, High Pressure/High-Velocity Butyl Gasket Tape; ; _____; or None - N/A>>**: www.designpoly.com/#sle.

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2) Elgen Manufacturing Company, Inc**<< ; 440 Butyl Gasket Tape; ; _____; or None - N/A>>**: www.elgenmfg.com/#sle.

3) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

5. Hanger Rod: **<<ASTM A36/A36M>>**; steel**<< , galvanized; , _____; or None - N/A>>**; threaded both ends, threaded one end, or continuously threaded.
6. Duct Straps: Use a minimum of three #10 screws on hanger straps, two in side and one on the bottom on each side of ductwork.
7. Hanger Fasteners: Attach hangers to structure using appropriate fasteners. Use beam clamps wherever possible.

3.03 FLEXIBLE DUCTS

A. Flexible Ducts: **<<UL 181>>**, Class 1, polyethylene film, mechanically fastened and rolled using galvanized steel to form spiral helix.
1. Insulation: **<< R6; Fiberglass; or _____>>** insulation with **<< polyethylene; aluminized; or _____>>** vapor barrier film.
2. Pressure Rating: **<< 10 in-wc; or ___ in-wc>>** positive and **<< 1 in-wc; 5 in-wc; or ___ in-wc>>** negative.
3. Maximum Velocity: **<< 4000 fpm; 5500 fpm; or ___ fpm>>**.
4. Temperature Range: **<< Minus 20 degrees F to 250 degrees F; or _____ degrees F>>**.
5. Manufacturers:
a. Flexmaster USA, a brand of Masterduct, Inc**<< ; Type 1; ; Type 1M; or None - N/A>>**: www.flexmasterusa.com/#sle.
b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Medium Pressure Flexible Ducts: **<<UL 181>>**, Class 1, aluminized laminate, mechanically fastened and rolled using galvanized steel to form spiral helix.
1. Insulation: **<< Fiberglass insulation with metallic vapor barrier; Fiberglass insulation with flame-retardant vapor barrier; None; or _____>>**.
2. Inner Core: **<< Tri-laminate of polyester, fiberglass, and aluminum foil; _____; or None - N/A>>**.
3. Pressure Rating: **<< 10 in-wc; 15 in-wc; or ___ in-wc>>** positive and **<< 1 in-wc; 5 in-wc; 10 in-wc; or ___ in-wc>>** negative.
4. Maximum Velocity: **<< 4000 fpm; 5500 fpm; or ___ fpm>>**.
5. Temperature Range: **<< Minus 20 degrees F to 250 degrees F; or _____ degrees F>>**.
6. Manufacturers:
a. Flexmaster USA, a brand of Masterduct, Inc**<< ; Type 5; ; ____; or None - N/A>>**: www.flexmasterusa.com/#sle.

3.04 AIR PLENUMS AND CASINGS

A. Fabricate in accordance with **<<SMACNA (DCS)>>** for indicated operating pressures indicated.

B. Minimum Fabrication Requirements:
1. Fabricate acoustic plenum or casing with reinforcing turned inward.

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2. Provide **<< 16-gauge, 0.059-inch>>** sheet steel back facing and **<< 22-gauge, 0.029-inch>>** perforated sheet steel front facing with **<< 3/32 inch>>** diameter holes on **<< 5/32 inch>>** centers.
3. Construct panels **<< 3 inches>>** thick, packed with **<< 4.5 pcf>>** minimum glass fiber insulation media, on inverted channel of **<< 16-gauge, 0.059-inch>>** sheet steel.
4. Mount floor-mounted plenum or casings on **<< 4-inch; 6-inch; or _____-inch>>** high concrete curbs. At floor, rivet panels on **<< 8-inch; or ___-inch>>** centers to angles. Where floors are acoustically insulated, provide liner of galvanized **<< 18-gauge, 0.052-inch; or __-gauge, __-inch>>** expanded metal mesh supported at **<< 12-inch; or ___-inch>>** centers, turned up **<< 12 inches; or ___ inches>>** at sides with sheet metal shields.

C. Access Doors:
1. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.
2. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles.
3. Provide clear wire glass observation ports, minimum **<< 6 by 6 inch>>** size.

D. Thermal Panels:
1. Material: Steel-faced composite panel with noncombustible structural high density mineral fiber core for plenum fabrication.
   a. Facing: Galvanized steel (G90), **<< 24 gauge, 0.0275 inch; 26 gauge, 0.0217 inch; or _____ gauge, _____ inch>>**.
   b. Finish: **<< Unpainted; or _____>>**.
   c. Core: Mineral wool board.
   d. Structural: Nonload bearing.
2. Panel Thickness: **<< 2.5 inches; 3 inches; 4 inches; 5 inches; or _____ inches>>**.
3. R-Value: **<< 12; 14; 18; 22; or _____>>** when tested in accordance with **<<ASTM C177>>**.
4. Manufacturers:
   a. DuraSystems Barriers Inc**<< ; _____; or None - N/A>>**: www.durasystems.com/#sle.
   b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

E. Fire-Rated Metal Panels:
1. Fire Rating: **<< 60 minutes; 120 minutes; or _____ minutes>>** when tested in accordance with **<<ASTM E119>>**.
2. Material: Steel-faced composite panel with noncombustible structural high density mineral fiber core, UL or ETL labeled, nonload bearing fire separations.
   a. Facing: Galvanized steel (G90), **<< 24 gauge (0.0275 inch); 26 gauge (0.0217 inch); or _____ gauge (_____ inch)>>**.
   b. Finish: **<< Unpainted; or _____>>**.
   c. Core: Mineral wool board.
   d. Structural: Nonload bearing.
3. Panel Thickness: **<< 4 inches; 6 inches; or _____ inches>>**.
4. Sound Transmission Class: **<< 30; 32; or _____>>** when tested in accordance with **<<ASTM E90>>**.
5. Manufacturers:

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a. DuraSystems Barriers Inc**<< ; _____; or None - N/A>>**: www.durasystems.com/#sle.

b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

3.05 DUCTS FOR KITCHEN EXHAUST APPLICATIONS

A. Provide ductwork, fittings, and appurtenances in accordance with **<<NFPA 96>>**, **<<SMACNA (KVS)>>**, **<<UL 1978>>**, and **<<UL 2221>>** requirements and guidelines.

B. Class 1 duct for air with gas and grease particle exhaust at an air velocity of **<< 1,500 to 2,500 fpm>>**.

C. Where ducts are not self-draining back to equipment, provide low-point drain pocket with the copper drain pipe to a sanitary sewer.

D. Design, fabricate, and install liquidtight preventing exhaust leakage into building.

E. Dishwasher Exhaust Duct:

1. Duct Size: **<< 1/2 in-wc; 1 in-wc; 2 in-wc; or ___ in-wc>>** pressure class**<< stainless steel; galvanized steel; ungalvanized steel; _____; or None - N/A>>**.
2. Fabricate using single wall, **<< 21-gauge, 0.034-inch; 20-gauge, 0.035-inch; 18-gauge, 0.050-inch; or ___-gauge, ___-inch>><< Type 304; Type 306; _____; or None - N/A>>** stainless steel with external welded joints.
3. Seal joints during installation with factory-supplied overlapping V-bands and sealant.

F. Kitchen Hood and Grease Exhaust Duct:

1. Fabricate in accordance with**<< ductwork manufacturer's instructions,; _____ ,; or None - N/A>> <<SMACNA (DCS)>>**, **<<SMACNA (KVS)>>**, and **<<NFPA 96>>**.
2. Round, Single-Wall, Premanufactured Grease Exhaust Duct:
   a. UL Listed and labeled to **<<UL 1978>>**.
   b. Construct of **<< 20-gauge, 0.035-inch; or 18-gauge, 0.050-inch>>** Type 304 stainless steel.
   c. Seal joints during installation with factory-supplied overlapping V-bands and sealant.
   d. Minimum horizontal slope of **<< 1/16 inch per foot>>** per manufacturers listing to **<<UL 1978>>**.
   e. Manufacturers:
      1) AMPCO by Hart & Cooley, Inc**<< ; Model N; ; _____; or None - N/A>>**: www.ampcostacks.com/#sle.
      2) Selkirk Corporation**<< ; Model G; ; _____; or None - N/A>>**: www.selkirkcommercial.com/#sle.
      3) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
3. Rectangular, Single-Wall, Premanufactured Grease Exhaust Duct:
   a. UL Listed and labeled to **<<UL 1978>>**.
   b. Construct of **<< 16-gauge, 0.059-inch; or __-gauge, __-inch>>** sheet steel using continuous external welded joints in rectangular sections.
   c. Construct of **<< 18-gauge, 0.050-inch; or ___-gauge, ___-inch>>** stainless steel using continuous external welded joints in rectangular sections.
4. Zero Clearance,**<< 2-Hour ; _____ ; or None - N/A>>**Fire-Rated, Round, Double-Wall, Premanufactured Grease Duct:

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a. UL Listed and labeled to **<<UL 1978>>** and **<<UL 2221>>**.
b. Nominal **<< 3 inches; or __ inches>>** thick, high density body soluble fiber insulation between **<< 20-gauge, 0.035-inch; or __-gauge, __-inch>>** Type 304 stainless steel liner, and **<< 24-gauge, 0.0239-inch; or __-gauge, __-inch>>** aluminized steel sheet outer jacket.
c. Seal joints during installation with factory-supplied overlapping V-bands and sealant.
d. Through-penetration firestop listed to **<<UL 1479>>** or **<<ASTM E814>>**.
e. Minimum horizontal slope of **<< 1/16 inch per foot>>** per manufacturers listing to **<<UL 1978>>**.

5. Zero Clearance, 2-Hour Fire-Rated, Rectangular, Double-Wall, Premanufactured Grease Duct:
   a. Listed when tested in accordance with **<<UL 1978>>** and **<<ASTM E2336>>**.
   b. Construct of **<< 16-gauge, 0.059-inch; or __-gauge, __-inch>>** sheet steel using continuous external welded joints in rectangular sections.
   c. Construct of **<< 18-gauge, 0.050-inch; or ___-gauge, ___-inch>>** stainless steel using continuous external welded joints in rectangular sections.
   d. Liquidtight with continuous external weld for seams and joints.
   e. Where ducts are not self-draining back to equipment, provide low-point drain pocket with copper drain pipe to sanitary sewer.
   f. Through-penetration firestop listed to **<<UL 1479>>** or **<<ASTM E814>>**.
   g. Manufacturers:
      1) DuraSystems Barriers Inc**<< ; _____; or None - N/A>>**: www.durasystems.com/#sle.
      2) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
6. Grease Exhaust Duct Access Doors:
   a. Listed when tested in accordance with **<<UL 1978>>**.
   b. Provide with preinsulated door to comply with **<<ASTM E2336>>**.
   c. Install hinged access doors where indicated or required for access for cleaning and inspection of duct.
   d. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles.
   e. Size: **<< 6 by 6 inches; 6 by 10 inches; 8 by 12 inches; 12 by 12 inches; 12 by 16 inches; 14 by 18 inches; 20 by 20 inches; or _____ by _____ inches>>**.
   f. Manufacturers:
      1) Fire Shield, LLC**<< ; Easy Access Grease Duct Door; ; _____; or None - N/A>>**: www.fireshieldlv.com/#sle.
      2) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

PART 3 EXECUTION

4.01 INSTALLATION

A. Install, support, and seal ducts in accordance with **<<SMACNA (DCS)>>**.

B. Duct air leak test all ductwork to pressure classes indicated per **<<SMACNA (LEAK)>>**. Engage Owner and TAB agent to witness all leakage testing.

C. Install products following the manufacturer's instructions.

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D. Comply with safety standards **<<NFPA 90A>>** and **<<NFPA 90B>>**.

E. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering the ductwork system.

F. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

G. Flexible Ducts: Connect to metal ducts with **<< adhesive; adhesive plus sheet metal screws; draw bands; liquid adhesive plus tape; mechanical fastener; or _____>>**. Length of flexible duct shall be no longer than **<< 4 feet; 5 feet; and _____>>** .

H. Kitchen Range Hoods: Install when provided by Section **<< 114000>>** then fit-out with respective ductwork and accessories to interconnect exhaust system.

I. Kitchen Hood Exhaust: Provide residue traps at the base of vertical risers with provisions for the cleanout.

J. Duct sizes indicated are precise inside dimensions. For lined ducts, maintain sizes inside lining.

K. Provide openings in ductwork as indicated to accommodate thermometers and controllers. Provide pilot tube openings as indicated for testing of systems, complete with metal can with spring device or screw to insure against air leakage. For openings, insulate ductwork and install insulation material inside a metal ring.

L. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

M. Use crimp joints with or without bead for joining round duct sizes **<< 8 inch; or ____ inch>>** and smaller with a crimp in the direction of airflow.

N. Use double nuts and lock washers on threaded rod supports.

O. Connect terminal units to supply ducts**<< directly or; _____; or None - N/A>>** with **<< one foot>>** maximum length of flexible duct. Do not use flexible duct to change direction.

P. Connect diffusers or light troffer boots to low-pressure ducts**<< directly or; _____; or None - N/A>>** with **<< 5 feet>>** maximum length of flexible duct held in place with strap or clamp.

Q. Set plenum doors at **<< 6 to 12 inches>>** above floor. Arrange door swings so that fan static pressure holds door in closed position.

R. At exterior wall louvers, seal duct to louver frame**<< and install blank-out panels; and install blank-out panels supplied in Section 089100; and install blank-out panels supplied in Section _____; _____; or None - N/A>>**.

S. Louver Fit-out:
   1. Provide blank-out panels sealing available area of wall-mounted exterior-faced louver when connected ductwork is smaller than actual louver free area, and duct outlet is smaller than the louver frame.
   2. Use the same duct material painted black on the exterior side, then seal louver frame and duct.

T. Plenums and Casings:
   1. Mount floor-mounted casings on **<< 4 inch; 6 inch; or __ inch>>** high concrete curbs.
   2. At floor, rivet panels on **<< 8 inch; or ___ inch>>** centers to angles.
   3. Where floors are acoustically insulated, provide liner of galvanized **<< 18-gauge, 0.052-inch; or __-gauge, __-inch>>** expanded metal mesh supported at **<< 12-inch; or ___-**

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inch>> centers, turned up **<< 12 inches; or ___ inches>>** at sides with sheet metal shields.

U. Fire Partitions: Provide firestopping sealing. See Section **<< 078400>>**.

V. Duct Insulation: Provide duct insulation. See Section **<< 230713>>**.

W. Painting: Provide surface finish as indicated on drawings. See Sections **<< 099113>>** and **<< 099123>>**. Where ductwork is visbile through return and exhaust grilles, paint black to reduce visibilty through the grilles.

4.02 CLEANING

A. See Section **<< 017419 - Construction Waste Management and Disposal>>** for additional requirements.

B. Clean thoroughly each duct system. See Section **<< 230130.51>>**.

END OF SECTION 233100

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SECTION 233300
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air turning devices/extractors.
B. Backdraft dampers - metal.
C. Backdraft dampers - fabric.
D. Combination fire and smoke dampers.
E. Duct access doors.
F. Duct test holes.
G. Fire dampers.
H. Flexible duct connectors.
I. Smoke dampers.
J. Smoke and fire-smoke damper test module.
K. Volume control dampers.
L. Low leakage (Class 1A) control dampers.
M. Miscellaneous Products:
    1. Fire-rated enclosures.
    2. Internal strut end plugs.
    3. Duct opening closure film.
    4. Airflow meters, thermal-dispersion type.

1.02 RELATED REQUIREMENTS

A. Section **<< 230548 - Vibration and Seismic Controls for HVAC>>**.
B. Section **<< 233100 - HVAC Ducts and Casings>>**.
C. Section **<< 253513 - Integrated Automation Actuators and Operators>>**: Damper operators.
D. Section **<< 253516 - Integrated Automation Sensors and Transmitters>>**: Damper position switch.

1.03 REFERENCE STANDARDS

A. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks.
B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
C. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
E. NFPA 92 - Standard for Smoke Control Systems.
F. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

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G. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives.

H. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.

I. UL 33 - Safety Heat Responsive Links for Fire-Protection Service.

J. UL 555 - Standard for Fire Dampers.

K. UL 555C - Standard for Safety Ceiling Dampers.

L. UL 555S - Standard for Smoke Dampers.

M. UL 1978 - Grease Ducts.

1.04 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Product Data: Provide for shop-fabricated assemblies including **<< volume control dampers; duct access doors; duct test holes; hardware used; and _____>>**. Include electrical characteristics and connection requirements.

C. Shop Drawings: Indicate for shop fabricated assemblies including **<< volume control dampers; duct access doors; duct test holes; and _____>>**.

D. Manufacturer's Installation Instructions: Provide instructions for **<< fire dampers; combination fire and smoke dampers; and _____>>**.

E. Project Record Drawings: Record actual locations of **<< access doors; test holes; and _____>>**.

F. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.

1. See Section **<< 016000 - Product Requirements>>** for additional provisions.
2. Extra Fusible Links: **<< One; Two; or ____>>** of each type and size.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum **<< three; or _____>>** years of**<< documented; _____; or None - N/A>>** experience.

B. Products Requiring Electrical Connection: Listed and classified by **<< Underwriters Laboratories Inc.; testing firm acceptable to the Authority Having Jurisdiction; or _____>>** as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.01 AIR TURNING DEVICES/EXTRACTORS

A. Manufacturers:

1. Carlisle HVAC Products**<< ; Dynair Hollow Vane and Rail (Double Wall Vane); ; Model _____; or None - N/A>>**: www.carlislehvac.com/#sle.
2. Elgen Manufacturing Company, Inc**<< ; _____; or None - N/A>>**: www.elgenmfg.com/#sle.
3. Krueger-HVAC, Division of Air System Components**<< ; _____; or None - N/A>>**: www.krueger-hvac.com/#sle.
4. Ruskin Company**<< ; _____; or None - N/A>>**: www.ruskin.com/#sle.

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5. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Multi-blade device with blades aligned in short dimension; **<< steel; aluminum; or _____>>** construction; with individually adjustable blades, mounting straps.

2.02 BACKDRAFT DAMPERS - METAL

A. Manufacturers:
1. Louvers & Dampers, Inc, a brand of Mestek, Inc**<< ; _____; or None - N/A>>**: www.louvers-dampers.com/#sle.
2. Nailor Industries, Inc**<< ; _____; or None - N/A>>**: www.nailor.com/#sle.
3. Pottorff**<< ; _____; or None - N/A>>**: www.pottorff.com/#sle.
4. Ruskin Company**<< ; _____; or None - N/A>>**: www.ruskin.com/#sle.
5. United Enertech**<< ; _____; or None - N/A>>**: www.unitedenertech.com/#sle.
6. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: **<< Galvanized steel; Extruded aluminum; or _____>>**, with**<< center pivoted; _____; or None - N/A>>** blades of maximum **<< 6 inch; or ___ inch>>** width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with **<< 90 degree; or _____>>** stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.03 BACKDRAFT DAMPERS - FABRIC

A. Fabric Backdraft Dampers: Factory-fabricated.
1. Blades: Neoprene coated **<< fabric; fiberglass; or _____>>** material.
2. Birdscreen: **<< 1/2 inch; or ____ inch>>** nominal mesh of **<< galvanized steel; aluminum; or _____>>**.
3. Maximum Velocity: 1000 fpm (5 mps) face velocity.

2.04 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers:
1. AireTechnologies, Inc, a DMI Company**<< ; _____; or None - N/A>>**: www.airetechnologies.com/#sle.
2. Lloyd Industries, Inc**<< ; _____; or None - N/A>>**: www.firedamper.com/#sle.
3. Louvers & Dampers, Inc, a brand of Mestek, Inc**<< ; _____; or None - N/A>>**: www.louvers-dampers.com/#sle.
4. Nailor Industries, Inc**<< ; _____; or None - N/A>>**: www.nailor.com/#sle.
5. NCA, a brand of Metal Industries Inc**<< ; _____; or None - N/A>>**: www.ncamfg.com/#sle.
6. Pottorff**<< ; _____; or None - N/A>>**: www.pottorff.com/#sle.
7. Ruskin Company**<< ; _____; or None - N/A>>**: www.ruskin.com/#sle.
8. United Enertech**<< ; _____; or None - N/A>>**: www.unitedenertech.com/#sle.
9. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Fabricate in accordance with **<<NFPA 90A>>**, **<<UL 555>>**, **<<UL 555S>>**, and as indicated.

C. Provide factory sleeve and collar for each damper.

D. Multiple Blade Dampers: Fabricate with **<< 16 gauge, 0.0598 inch; or ___ gauge, _____ inch>>** galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, **<< 1/8 by 1/2 inch; or ___ by ___**

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inch>> plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and **<< 1/2 inch; or ___ inch>>** actuator shaft.

E. Operators: UL listed and labeled; spring-return, electric-type suitable for 120 volts, single phase, 60 Hz.**<< Provide end switches to indicate damper position.; _____ .; or None - N/A>>** Locate damper operator on **<< interior; exterior; or _____>>** of duct and link to damper operating shaft.

F. Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure.

G. Electro Thermal Link: Fusible link melting at **<< 165 degrees F; or ____ degrees F>>**; 120 volts, single phase, 60 Hz; UL listed and labeled.

2.05 DUCT ACCESS DOORS

A. Manufacturers:
1. Acudor Products Inc, a Division of Nelson Industrial Inc**<< ; _____; or None - N/A>>**: www.acudor.com/#sle.
2. Ductmate Industries, Inc, a DMI Company**<< ; _____; or None - N/A>>**: www.ductmate.com/#sle.
3. Elgen Manufacturing Company, Inc**<< ; _____; or None - N/A>>**: www.elgenmfg.com/#sle.
4. Lloyd Industries, Inc**<< ; _____; or None - N/A>>**: www.firedamper.com/#sle.
5. Nailor Industries, Inc**<< ; _____; or None - N/A>>**: www.nailor.com/#sle.
6. Ruskin Company**<< ; _____; or None - N/A>>**: www.ruskin.com/#sle.
7. SEMCO LLC**<< ; _____; or None - N/A>>**: www.semcohvac.com/#sle.
8. The Williams Brothers Corporation of America**<< ; _____; or None - N/A>>**: www.wbdoors.com/#sle.
9. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Fabricate in accordance with **<<SMACNA (DCS)>>** and as indicated.

C. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick-fastening locking devices. For insulated ducts, install minimum **<< 1-inch>>** thick insulation with sheet metal cover.
1. Less Than **<< 12 inches; or ___ inches>>** Square: Secure with sash locks.
2. Up to **<< 18 inches; or ___ inches>>** Square: Provide two hinges and two sash locks.
3. Up to **<< 24 by 48 inches; or ___ by ___ inches>>**: Three hinges and two compression latches**<< with outside and inside handles; _____; or None - N/A>>**.
4. Larger Sizes: Provide an additional hinge.
5. High Temperature Duct Access Doors:
   a. Comply with **<<NFPA 96>>**.
   b. Comply with **<<UL 1978>>**.
   c. Manufacturers:
      1) Ductmate Industries, Inc, a DMI Company**<< ; _____; or None - N/A>>**: www.ductmate.com/#sle.
      2) Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

D. Access doors with sheet metal screw fasteners are not acceptable.

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2.06 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

1. Manufacturers:
   a. Carlisle HVAC Products**<< ; Dynair Test Port with Red Cap with O-Ring Seal; ; Model _____; or None - N/A>>**: www.carlislehvac.com/#sle.
   b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.07 FIRE DAMPERS

A. Manufacturers:

1. AireTechnologies, Inc, a DMI Company**<< ; _____; or None - N/A>>**: www.airetechnologies.com/#sle.
2. Lloyd Industries, Inc**<< ; _____; or None - N/A>>**: www.firedamper.com/#sle.
3. Louvers & Dampers, Inc, a brand of Mestek, Inc**<< ; _____; or None - N/A>>**: www.louvers-dampers.com/#sle.
4. Nailor Industries, Inc**<< ; _____; or None - N/A>>**: www.nailor.com/#sle.
5. NCA, a brand of Metal Industries Inc**<< ; _____; or None - N/A>>**: www.ncamfg.com/#sle.
6. Panasonic Corporation of North America**<< ; Flex Damper; ; _____; or None - N/A>>**: www.panasonic.com/#sle.
7. Pottorff**<< ; _____; or None - N/A>>**: www.pottorff.com/#sle.
8. Ruskin Company**<< ; _____; or None - N/A>>**: www.ruskin.com/#sle.
9. United Enertech**<< ; _____; or None - N/A>>**: www.unitedenertech.com/#sle.
10. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Fabricate in accordance with **<<NFPA 90A>>** and **<<UL 555>>**, and as indicated.

C. Ceiling (Radiation) Dampers: Galvanized steel, **<< 22-gauge, 0.0299-inch; or ___-gauge, _____-inch>>** frame and **<< 16-gauge, 0.0598-inch; or ___-gauge, _____-inch>>** flap, two layers of **<< 0.125-inch; or ___-inch>>** thick ceramic fiber on top side**<< and one layer on bottom side for round flaps,; _____ ,; or None - N/A>>** with locking clip.

1. Boot Fitting: Factory-provided **<< as indicated on drawings; el type (90 degree); end type; straight type; or _____>>**. Include **<< field-provided collar; flanged recess; ceramic thermal blanket; and _____>>**.
2. Box Fitting: Factory-provided **<< 26 gauge, 0.0179 inch; or ___ gauge, _____ inch>>** with **<< field-provided collar; flanged recess; ceramic thermal blanket; and _____>><< None - N/A; or , and tagged as compliant with {\rs\#1} when used in floor or ceiling wood truss assemblies rated for one hour or less>>**.
3. Rated for **<< one; three; or ____>>** hour service in compliance with **<<UL 555C>>**.
4. Manufacturers:
   a. Pottorff**<< ; _____; or None - N/A>>**: www.pottorff.com/#sle.
   b. Ruskin Company**<< ; _____; or None - N/A>>**: www.ruskin.com/#sle.
   c. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

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D. Horizontal Dampers: Galvanized steel, **<< 22-gauge, 0.0299-inch; or ___-gauge, ____-inch>>** frame, stainless steel closure spring, and lightweight, heat-retardant, non-asbestos fabric blanket.

E. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for **<< horizontal installations; closure under air flow conditions; or _____>>**. Configure with blades out of air stream except for **<< 1-inch; or __-inch>>** pressure-class ducts up to **<< 12 inches; or ___ inches>>** in height.

F. Multiple Blade Dampers: **<< 16-gauge, 0.0598-inch; or ___-gauge, _____-inch>>** galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, **<< 1/8 by 1/2 inch; or ___ by ___ inch>>** plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

G. Fusible Links: **<<UL 33>>**, separate at **<< 160 degrees F; 165 degrees F; 212 degrees F; or ___ degrees F>>** with adjustable link straps for combination fire/balancing dampers.

2.08 FLEXIBLE DUCT CONNECTORS

A. Manufacturers:

1. Carlisle HVAC Products**<< ; Dynair Connector Plus G90 Steel Offset Seam Neoprene Fabric; ; Dynair Connector Plus G90 Steel Offset Seam Hypalon Fabric (Extended Outdoor UV Stable); ; Model _____; or None - N/A>>**: www.carlislehvac.com/#sle.
2. Ductmate Industries, Inc, a DMI Company**<< ; _____; or None - N/A>>**: www.ductmate.com/#sle.
3. Elgen Manufacturing Company, Inc**<< ; _____; or None - N/A>>**: www.elgenmfg.com/#sle.
4. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Fabricate in accordance with **<<SMACNA (DCS)>>** and as indicated.

C. Flexible Duct Connections: Fabric crimped into metal edging strip.

1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to **<<NFPA 90A>>**, minimum density **<< 30 oz/sq yd; or __ oz/sq yd>>**.
   a. Net Fabric Width: Approximately **<< 2 inches; 3 inches; 6 inches; or __ inch>>** wide.
2. Metal: **<< 3 inches; or __ inches>>** wide, **<< 24 gauge, 0.0239 inch; or ___ gauge, ___ inch>>** thick **<< galvanized steel; or _____>>**.

D. Leaded Vinyl Sheet: Minimum **<< 0.55 inch; or ___ inch>>** thick, **<< 0.87 lbs per sq ft; or ___ lbs per sq ft>>**, 10 dB attenuation in 10 to 10,000 Hz range.

E. Maximum Installed Length: **<< 14 inch; or ___ inch>>**.

2.09 SMOKE DAMPERS

A. Manufacturers:

1. AireTechnologies, Inc, a DMI Company**<< ; _____; or None - N/A>>**: www.airetechnologies.com/#sle.
2. Louvers & Dampers, Inc, a brand of Mestek, Inc**<< ; _____; or None - N/A>>**: www.louvers-dampers.com/#sle.
3. Nailor Industries, Inc**<< ; _____; or None - N/A>>**: www.nailor.com/#sle.
4. Pottorff**<< ; _____; or None - N/A>>**: www.pottorff.com/#sle.
5. Ruskin Company**<< ; _____; or None - N/A>>**: www.ruskin.com/#sle.
6. United Enertech**<< ; _____; or None - N/A>>**: www.unitedenertech.com/#sle.

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7. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Fabricate in accordance with **<<NFPA 90A>>** and **<<UL 555S>>**, and as indicated.

C. Dampers: UL Class 1 **<< airfoil blade; v-groove blade; true round; or _____>>** type smoke damper, normally **<< open; closed; or _____>>** automatically operated by **<< pneumatic; electric; or _____>>** actuator.

D. Electro Thermal Link: Fusible link melting at **<< 165 degrees F; or __ degrees F>>**; 120 volts, single phase, 60 Hz; UL listed and labeled.

2.10 SMOKE AND FIRE-SMOKE DAMPER TEST MODULE

A. Addressable fire alarm system proprietary controller module preconfigured for remote testing of dedicated smoke damper or combination fire-smoke damper.

B. Provide module, accessories, and connectivity to meet **<<NFPA 80>>** and **<<NFPA 105>>** requirements.

2.11 VOLUME CONTROL DAMPERS

A. Manufacturers:

1. AireTechnologies, Inc, a DMI Company**<< ; _____; or None - N/A>>**: www.airetechnologies.com/#sle.
2. Louvers & Dampers, Inc, a brand of Mestek, Inc**<< ; _____; or None - N/A>>**: www.louvers-dampers.com/#sle.
3. Elgen Manufacturing Company, Inc**<< ; _____; or None - N/A>>**: www.elgenmfg.com/#sle.
4. MKT Metal Manufacturing**<< ; _____; or None - N/A>>**: www.mktduct.com/#sle.
5. Nailor Industries, Inc**<< ; _____; or None - N/A>>**: www.nailor.com/#sle.
6. NCA, a brand of Metal Industries Inc**<< ; _____; or None - N/A>>**: www.ncamfg.com/#sle.
7. Pottorff**<< ; _____; or None - N/A>>**: www.pottorff.com/#sle.
8. Ruskin Company**<< ; _____; or None - N/A>>**: www.ruskin.com/#sle.
9. United Enertech**<< ; _____; or None - N/A>>**: www.unitedenertech.com/#sle.
10. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Fabricate in accordance with **<<SMACNA (DCS)>>** and as indicated.

C. Splitter Dampers:

1. Material: Same gauge as duct to **<< 24 inches; or ___ inches>>** size in either direction, and two gauges heavier for sizes over **<< 24 inches; or ___ inches>>**.
2. Blade: Fabricate of **<< single; double; or _____>>** thickness sheet metal to streamline shape, secured with continuous hinge or rod.
3. Operator: Minimum **<< 1/4 inch; or ___ inch>>** diameter rod in self aligning, universal joint action, flanged bushing with set screw.

D. Single Blade Dampers:

1. Fabricate for duct sizes up to **<< 6 by 30 inch; 12 by 48 inch; or ___ by ___ inch>>**.
2. Blade: **<< 24 gauge, 0.0239 inch; or ___ gauge, _____ inch>>**, minimum.

E. Multi-Blade Damper: Fabricate consisting of opposed blades with maximum blade sizes **<< 8 by 72 inches; or ___ by ___ inches>>**. Assemble center- and edge-crimped blades in prime-coated or galvanized-channel frame with suitable hardware.

1. Blade: **<< 18 gauge, 0.0478 inch; or ___ gauge, _____ inch>>**, minimum.

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F. End Bearings: Except in round ducts **<< 12 inches; or __ inches>>** and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.

G. Quadrants:
1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
3. Where rod lengths exceed **<< 30 inches; or ___ inches>>** provide regulator at both ends.

2.12 LOW LEAKAGE (CLASS 1A) CONTROL DAMPERS

A. Manufacturers:
1. Ruskin Company**<< ; CD50; ; _____; or None - N/A>>**: www.ruskin.com/#sle.
2. United Enertech**<< ; _____; or None - N/A>>**: www.unitedenertech.com/#sle.
3. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Maximum Leakage Allowed: **<< 3 cfm/sq ft at 1 in-wc>>**.

C. Frame:
1. Material: **<< 12-gauge; 16-gauge; 18-gauge; 20-gauge; or _____>><< aluminum; aluminum, perforated; carbon steel; galvanized steel; 304 stainless steel; 316 stainless steel; or _____>>**.
2. Free-area: **<< As indicated on drawings; Array cross section; Custom _____ cross section; Horizontal-face and by-pass; Vertical-face and by-pass; Single cross section; or _____ >>**.
3. Blanked-off: Split frame into two free-area sections to allow a smaller free-area to be used for a minimum airflow intake or exhaust application and secondary free-area fully blanked-off.

D. Blade:
1. Type: **<< Multi-blade airfoil for high pressure; Multi-blade extruded airfoil for high pressure; Multi-blade such as V or 3V for low to medium pressure; Single-blade square shape; Single-blade rectangle shape; Single-blade round or butterfly shape; As indicated on drawings; or _____>>**.
2. Operation: **<< As indicated on drawings; Diffuser type; Inlet vane type; Opposed type; Parallel type; or _____>>**.
3. Maximum Individual Blade Height: **<< 8 inches>>**.
4. Material: **<< 12-gauge; 16-gauge; 18-gauge; 20-gauge; or _____>><< aluminum; aluminum, perforated; carbon steel; galvanized steel; 304 stainless steel; 316 stainless steel; or _____>>**.
5. Authority: **<< As indicated on drawings; Opposed type, 5 to 50 percent (typically 10 percent); Parallel type, 10 to 100 percent (typically 50 percent); Specialty, _____; or _____>>**.

E. Insulation: **<< Water-resistant sound absorbing material; Thermally-broken blade and frame for _____ degree __ range; or _____>>**.

F. Temperature Service Range: **<< Minus 25 to 185 degrees F; or _____ to _____ degrees F>>**.

G. Other Requirements:
1. Paint Finish: **<< Standard; or _____>>**.

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2. Rust Inhibitor Coating: **<< Moisture and salt water-resistant; or _____>>**.
3. Sleeve or Flange: **<< Factory-mounted standard; Factory-mounted custom; or _____>>**.
4. Duct Transition Fitting: **<< Round; Oval; Square; or _____>>**.
5. Custom: Include **<< bird screen; filter rack of the _____ type; insect screen; security bars; and _____>>**.

2.13 MISCELLANEOUS PRODUCTS

A. Damper Operators: Provide **<< manual; electric; pneumatic; and _____>>** operators; see Section **<< 253513>>**.

B. Damper position switch; see Section **<< 253516>>**.

C. Fire-Rated Enclosures:
1. Provide as required to preserve fire resistance rating of building elements.

D. Internal Strut End Plugs: Combination end-mounting and sealing plugs for metal conduit used as internal reinforcement struts for metal ducts; plug crimped inside conduit with outside gasketed washer seal.

E. Duct Opening Closure Film: Mold-resistant, self-adhesive film to keep debris out of ducts during construction.
1. Thickness: **<< 2 mils; or __ mils>>**.
2. High tack water based adhesive.
3. UV stable light blue color.
4. Elongation Before Break: 325 percent, minimum.

F. Residential Dryer Exhaust Receptacle: Formed aluminized-steel in-wall receptacle to house flexible transition duct; seamless interior, rounded corners; integral nailing flanges. Match depth of box to depth of stud cavity.
1. Manufacturers:
a. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

G. Airflow Meters, Thermal-Dispersion Type:
1. Manufacturers:
a. Ebtron**<< ; _____; or None - N/A>>**: www.ebtron.com/#sle.
b. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
2. Configuration: Duct or plenum inserted assembly using up to eight water-resistant thermal dispersion sensors per metal probe wired into external access box holding self-diagnosing sensor interface electronics with respective field wire and cable landing terminals.
3. Monitoring Range:
a. Air Velocity: **<< As indicated on drawings; 0 to 5,000 fpm; _____ to _____ fpm; or _____>>** converted to airflow using section area.
b. Temperature: **<< Minus 20 to 120 degrees F; or _____ to _____ degrees F>>**.
4. Accuracy: Plus or minus **<< 1 percent, NIST; 2 percent, NIST; 2 percent; 3 percent; 5 percent; or _____>>** with a plus or minus **<< 0.25 percent; or _____>>** repeatability over listed range. Includes means to zero, adjust, and calibrate outputs.
5. Access Box: **<<NEMA EN 10250>>**, **<< Type 1; Type 2; Type 4; Type 4x; or _____>>** with hinged cover housing and cable access ports.

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6. Interface: **<< Fitted; External linked device; or _____>>** with 16 character, 2-line, backlit, alphanumeric display and labeled pad-type surface membrane buttons.
7. Controller: Fitted with factory-installed module to handle up to 16 external ancillary probes to form an extended measuring probe array for custom duct or plenum sizes.
8. Outputs: **<< Two-wire; Three-wire; Four-wire; or _____>>**, **<< 0 to 10 VDC; 0 to 5 VDC; 2 to 10 VDC; 0 to 20 mA; 4 to 20 mA; _____ to _____ VDC; or _____ to _____ mA>>**, for airflow and temperature signals, configurable.
9. BAS, SCADA, or other Integrated Automation Link: **<< ASHRAE Std 135 BACnet IP; ASHRAE Std 135 BACnet MS/TP; ASHRAE Std 135 BACnet SC; Modbus (PS) Modbus IP; Modbus (PS) Modbus RTU; LonMark Interoperability Guide LonWorks; Bluetooth CS wireless using Bluetooth ; IEEE 802.11 wireless using Wi-Fi ; IEEE 802.15.4 wireless using Zig-bee; or _____>>**.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, **<<NFPA 90A>>**, and follow **<<SMACNA (DCS)>>**. See Section **<< 233100>>** for duct construction and pressure class.

B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated.**<< Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96; _____; or None - N/A>>** Provide minimum **<< 8 by 8 inch; or ___ by ___ inch>>** size access door for hand and shoulder access, or as indicated on drawings. Provide minimum **<< 4 by 4 inch; or ___ by ___ inch>>** size access door for balancing dampers only. Review locations prior to fabrication.

D. Provide duct test holes where indicated and required for testing and balancing purposes.

E. Provide **<< fire dampers; combination fire and smoke dampers; smoke dampers; and _____>>** at locations indicated, where ducts and outlets pass through fire-rated components**<< , and where required by authorities having jurisdiction; , _____; or None - N/A>>**. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

F. Install smoke dampers and combination smoke and fire dampers in accordance with **<<NFPA 92>>**.

G. Demonstrate re-setting of fire dampers to **<<Owner>>**'s representative.

H. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

I. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
   1. See Section **<< 230548>>**.

J. For fans developing static pressures of **<< 5.0 inches; or ___ inches>>** and over, cover flexible connections with leaded vinyl sheet, held in place with metal straps.

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K. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum two duct widths from duct take-off.

L. Use splitter dampers only where indicated.

M. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION 233300

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SECTION 233319
DUCT SILENCERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Duct silencers.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>**, for submittal procedures.

B. Product Data: Provide catalog information indicating, materials, dimensional data, pressure losses, and acoustical performance.

C. Shop Drawings: Indicate assembly, materials, thicknesses, dimensional data, pressure losses, acoustical performance, layout, and connection details.

D. Design Data: Provide engineering calculations, referenced to specifications and **<< AHRI 270; AMCA 301; AMCA 302; AMCA 303; ANSI S12.1; and _____>>** standards indicating that maximum room sound levels are not exceeded.

E. Test Reports: Indicate **<< dynamic insertion loss and noise generation values of silencers; acoustic housings meet or exceed specified sound transmission loss values; and _____>>**.

F. Manufacturer's Installation Instructions: Indicate installation procedures necessary to maintain integrity of sound isolation.

G. Manufacturer's Field Reports: Indicate installation is complete and in accordance with instructions.

H. Project Record Documents: Record actual locations of **<< cross-talk silencers; acoustic housings; ductwork lagging; air transfer silencers; and _____>>**.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum **<< three; or _____>>** years of**<< documented; _____; or None - N/A>>** experience.

B. Perform Work in accordance with **<< AHRI 575; AMCA 300; ANSI S1.13; or _____>>** standards and recommendations of **<< ASHRAE Std 68; NEBB (STDS); or _____>>**.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Comply with **<< applicable; sound transmission class (STC) rating; or _____>>** codes for sound levels **<< at the property line; between wall partitions; at the property line and between wall partitions; or _____>>**.

2.02 DUCT SILENCERS

A. Manufacturers:

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1. Price Industries, Inc**<< ; _____; or None - N/A>>**: www.priceindustries.com/#sle.
2. Ruskin Company**<< ; _____; or None - N/A>>**: www.ruskin.com/#sle.
3. SEMCO LLC, Flakt Woods Group**<< ; _____; or None - N/A>>**: www.semcohvac.com/#sle.
4. Spiral Pipe of Texas, Inc**<< ; _____; or None - N/A>>**: www.spotusa.com/#sle.
5. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Basis of Design: Price Industries, Inc.

1. Absorptive Silencers:
   a. Axial Fan Silencers - **<< AFS; or _____>>**.
   b. Circular Silencers - **<< CM (Medium Velocity); CMP (Medium Velocity Pod); CH (High Velocity); or _____>>**.
   c. Circular, Extended Casing Silencers - **<< CMX (Medium Velocity); CHX (High Velocity); or _____>>**.
   d. Rectangular Silencers - **<< RL (Low Velocity); RH (High Velocity); or _____>>**.
   e. Rectangular, Extended Casing Silencers - **<< RLX (Low Velocity); RHX (High Velocity); or _____>>**.
   f. Rectangular, Legacy Silencers - **<< L (Low Pressure); LF (Low Pressure); M (Medium Pressure); MF (Medium Pressure); H (High Pressure); HF (High Pressure); LL (Low-Frequency Pressure); LLF (Low-Frequency Pressure); LM (Low-Frequency Medium Pressure); LMF (Low-Frequency Medium Pressure); LH (Low-Frequency High Pressure); LHF (Low-Frequency High Pressure); or _____>>**.
2. Absorptive Elbow Silencers:
   a. Elbow Silencers - **<< ERM; or _____>>**.
   b. Extended Casing, Elbow Silencers - **<< ERMX; or _____>>**.
3. Film-Lined Silencers:
   a. Circular Silencers - **<< CMT (Medium Velocity); CHT (High Velocity); or _____>>**.
   b. Circular, Extended Casing - **<< CMX (Medium Velocity); CHX (High Velocity); or _____>>**.
   c. Rectangular Silencers - **<< RLT (Low Velocity); RHT (Hight Velocity); or _____>>**.
4. Film-Lined Elbow Silencers:
   a. Elbow Silencers - **<< ERMT (Medium Velocity); or _____>>**.
   b. Extended Casing, Elbow Silencer - **<< ERMTX (Medium Velocity); or _____>>**.
5. Packless Silencers:
   a. Circular Silencers - **<< PCLS (Low Velocity - 20 Inch x 20 Inch Casing); PCLB (Low Velocity - 30 Inch x 30 Inch Casing); PCMS (Medium Velocity - 20 Inch x 20 Inch Casing); PCMB (Medium Velocity - 30 Inch x 30 Inch Casing); PCHS (High Velocity - 20 Inch x 20 Inch Casing); PCHB (High Velocity - 30 Inch x 30 Inch Casing); or _____>>**.
   b. Rectangular Silencers - **<< PRM (Medium Velocity); or _____>>**.
6. Packless Elbow Silencers:
   a. Circular Elbow Silencers - **<< PECLS (Low Velocity - 20 Inch x 20 Inch Casing); PECLB (Low Velocity - 30 Inch x 30 Inch Casing); PECMS (Medium Velocity - 20 Inch x 20 Inch Casing); PECMB (Medium Velocity - 30 Inch x 30 Inch**

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Casing); PECHS (High Velocity - 20 Inch x 20 Inch Casing); PECHB (High Velocity - 30 Inch x 30 Inch Casing); or _____>>.

b. Elbow Silencers - **<< PERM (Medium Velocity); or _____>>**.

C. Description: Duct section with sheet metal outer casing, sound absorbing fill material, and inner casing of perforated sheet metal; incorporating interior baffles of similar construction. Fabricate in accordance with **<<SMACNA (DCS)>>** HVAC Duct Construction Standards.

D. General Requirements:

1. Casing, sealants, adhesives, accessory materials, and packing materials to comply with **<<ASTM E84>>**.
2. Airstream surfaces installed in a return air plenum to comply with requirements in **<<ASHRAE Std 62.1>>**.
3. Factory-fabricated, field-installed products.

2.03 AIR TRANSFER SILENCERS

A. Manufacturers:

1. Price Industries, Inc**<< ; _____; or None - N/A>>**: www.priceindustries.com/#sle.
2. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Basis of Design: Price Industries, Inc.

1. Rectangular Sounds Transmission Class - **<< R-STC; or _____>>**.
2. Return Air Canopy - **<< RAC; or _____>>**.
3. Thin Line Return - **<< TLRD; or _____>>**.

C. Description: Duct sections with sheet metal outer casing, sound absorbing fill material**<< , and inner casing of perforated sheet metal; , _____; or None - N/A>>**; incorporating interior baffles of similar construction. Fabricate in accordance with **<<SMACNA (DCS)>>** HVAC Duct Construction Standards.

D. Materials:

1. Outer Casing: Minimum **<< 22 gauge, 0.0299 inch>>** thick galvanized steel with **<< mastic filled lock formed; welded; or _____>>** seams, **<< 3 inch>>** long, **<< 11 gauge, 0.1196 inch>>** slip joint on both ends.
2. Inner Casing and Splitters: Minimum **<< 24 gauge, 0.0239 inch>>** thick perforated galvanized steel.
3. Fill: Glass fiber or mineral wool of minimum **<< 4 lb/cu ft; 3 lb/cu ft; or _____ lb/cu ft>>** density.
4. Fill Liner: **<< Bonded glass fiber matting; Mylar film; or _____>>**.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Support duct silencers **<< independent of; rigidly to; or _____>>** ducts**<< with flexible duct connections, lagged with leaded vinyl sheet on inlet and outlet; _____; or None - N/A>>**. Refer to Section **<< 233100>>** and Section **<< 233300>>**.

C. Where indicated, lag ductwork by wrapping with insulation and covering. Apply covering to be air tight. Do not attach covering rigidly to ductwork.

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D. Attach ductwork to acoustic louvers with flexible duct connections. Refer to Section **<< 233300>>**.

E. Provide Return Air Canopy - RAC option on all return grilles open to plenum.

END OF SECTION 233319

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SECTION 233423
HVAC POWER VENTILATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof exhausters.

B. Wall exhausters.

C. Cabinet exhaust fans.

D. Upblast roof exhausters.

E. Inline centrifugal fans and blowers.

F. Kitchen hood upblast roof exhausters.

G. Utility vent blowers.

1.02 REFERENCE STANDARDS

A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program.

B. AMCA 99 - Standards Handbook.

C. AMCA 204 - Balance Quality and Vibration Levels for Fans.

D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.

E. AMCA 300 - Reverberation Room Methods of Sound Testing of Fans.

F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

G. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

H. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

I. UL 705 - Power Ventilators.

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1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate fan roof curbs and service utilities installation according to fan size.

B. Sequencing: Ensure that utility connections are completed in an orderly and expeditious manner.

1.04 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Product Data: Provide data on fans and accessories, including fan curves with specified operating point plotted, power, rpm, sound power levels at rated capacity, and electrical characteristics and connection requirements.

C. Manufacturer's Instructions: Indicate installation instructions.

D. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

E. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.

1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.

2. Extra Fan Belts: **<< One set; Two sets; or ____ sets>>** for each individual fan.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum **<< three; or _____>>** years of**<< documented; _____; or None - N/A>>** experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Greenheck Fan Corporation**<< ; _____; or None - N/A>>**: www.greenheck.com/#sle.

B. Loren Cook Company**<< ; _____; or None - N/A>>**: www.lorencook.com/#sle.

C. PennBarry, Division of Air System Components**<< ; _____; or None - N/A>>**: www.pennbarry.com/#sle.

D. Twin City Fan & Blower**<< ; _____; or None - N/A>>**: www.tcf.com/#sle.

E. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.02 POWER VENTILATORS - GENERAL

A. Static and Dynamically Balanced: Comply with **<<AMCA 204>>**.

B. Performance Ratings: Comply with **<<AMCA 210>><< , bearing certified rating seal; , _____; or None - N/A>>**.

C. Sound Ratings: Comply with **<<AMCA 301>>**, tested to **<<AMCA 300>><< , bearing certified sound ratings seal; , _____; or None - N/A>>**.

D. Fabrication: Comply with **<<AMCA 99>>**.

E. UL Compliance: **<<UL 705>>**, listed, labeled, designed, manufactured, and tested.

F. Electrical Components: Listed and classified by **<< Underwriters Laboratories Inc.; testing firm acceptable to the Authority Having Jurisdiction; or _____>>** as suitable for the purpose specified and indicated.

2.03 ROOF << EXHAUSTERS; VENTILATORS; OR _____>>

A. Fan Unit: V-belt or direct driven as indicated, with **<< spun aluminum; galvanized steel with baked-on enamel; fiberglass reinforced plastic; upblast spun aluminum; or _____>>** housing; resilient mounted motor; **<< 1/2 inch>>** mesh, **<< 0.62 inch>>** thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.

B. Roof Curb: **<< 8 inch; 12 inch; 16 inch; 20 inch; 24 inch; or ___ inch>>** high**<< self-flashing; _____; or None - N/A>>** of **<< galvanized steel; aluminum; or _____>>** with continuously welded seams, **<< built-in cant strips; insulation and curb bottom; interior baffle with acoustic insulation, curb bottom; ventilated double wall; hinged curb adapter; factory installed nailer strip; and _____>>**.

C. Disconnect Switch: Factory wired, nonfusible, in housing for thermal overload protected motor**<< and wall mounted multiple speed switch; and wall mounted multiple speed switch or solid-state speed controller; and wall mounted solid-state speed controller; _____; or None - N/A>>**.

D. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked**<< , and line voltage motor drive, power open, spring return; , _____; or None - N/A>>**.

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E. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm gets attained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.04 WALL EXHAUSTERS

A. Fan Unit: V-belt or direct driven with spun aluminum housing; resiliently mounted motor; **<< 1/2 inch>>** mesh, **<< 0.062 inch>>** thick aluminum wire bird screen.

B. Disconnect Switch: Factory wired, nonfusible, in housing for thermal overload protected motor**<< , and wall mounted multiple speed switch; , and wall mounted multiple speed switch or solid-state speed controller; , and wall mounted solid-state speed controller; , _____; or None - N/A>>**.

C. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked**<< , and line voltage motor drive, power open, spring return; , _____; or None - N/A>>**.

D. Sheaves: For V-belt drives, provide cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm can be reached with sheaves set at mid-position; fan shaft with self-aligning prelubricated ball bearings.

2.05 << CABINET; CEILING; OR _____>> EXHAUST FANS

A. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing**<< lined with acoustic insulation; _____; or None - N/A>>**, resiliently mounted motor, gravity backdraft damper in discharge.

B. Disconnect Switch: Cord and plug-in housing for thermal overload protected motor**<< and wall mounted switch; and wall mounted multiple speed switch; and wall mounted solid state speed controller; _____; or None - N/A>>**.

C. Grille: **<< Molded white plastic; Aluminum; Aluminum with baked white enamel finish; or _____>>**.

D. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is reached with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.06 UPBLAST ROOF EXHAUSTERS

A. **<< Direct; Belt; or _____>>** Drive Fan:

1. Fan Wheel:
   a. Type: Non-overloading, backward inclined centrifugal.
   b. Material: **<< Aluminum; Aluminum with non-stick coating; or _____>>**, statically and dynamically balanced.
2. Housing:
   a. Construct of heavy gauge aluminum including curb cap, windband, and motor compartment.
   b. Rigid internal support structure.
   c. One-piece fabricated or fully welded curb-cap base to windband for leak proof construction.
   d. Construct drive frame assembly of heavy gauge steel, mounted on vibration isolators.
   e. Provide breather tube for fresh air motor cooling and wiring.

B. Shafts and Bearings:

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1. Fan Shaft:
   a. Ground and polished steel with anti-corrosive coating.
   b. First critical speed at least **<< 25 percent; or _____>>** over maximum cataloged operating speed.
2. Bearings:
   a. Permanently sealed or pillow block type.
   b. Minimum **<< L10; or __>>** life in excess of **<< 100,000 hours (equivalent to L50 average life of 500,000 hours); or _____>>**, at maximum cataloged operating speed.
   c. **<< 100 percent; or _____>>** factory tested.

C. Drive Assembly:
1. Belts, pulleys, and keys oversized for a minimum of **<< 150 percent; or _____>>** of driven horsepower.
2. Belts: Static free and oil resistant.
3. Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
4. Motor pulley adjustable for final system balancing.
5. Readily accessible for maintenance.

D. Disconnect Switches:
1. **<< Factory mounted and wired; Shipped loose for field mounting; or _____>>**.
2. Environment Type per **<<NEMA EN 10250>>**: **<< Unless otherwise indicated, as specified for the following installation locations:; As indicated on the drawings.; _____ .; or _____ :>>**
   a. Indoor Clean, Dry Locations: **<< Type 1; or _____>>**.
   b. Outdoor Locations: **<< Type 3R; Type 4X, stainless steel; or _____>>**.
3. Finish for Painted Steel Enclosures: Provide **<< manufacturer's standard; factory-applied gray; or _____>>** unless otherwise indicated.
4. Positive electrical shutoff.
5. Wired from fan motor to junction box installed within motor compartment.

E. Roof Curb: **<< 8 inch; 12 inch; 16 inch; 20 inch; 24 inch; or ___ inch>>** high**<< self-flashing; _____; or None - N/A>>** of **<< galvanized steel; aluminum; or _____>>** with continuously welded seams, **<< built-in cant strips; insulation and curb bottom; curb bottom; ventilated double wall; factory installed nailer strip; and _____>>**.

F. Drain Trough: Allows for single-point drainage of water, grease, and other residues.

G. Options/Accessories:
1. Birdscreen:
   a. Provide **<< galvanized steel; aluminum; or _____>>** construction.
   b. Protects fan discharge.
2. Dampers: Provide **<< motorized; gravity; or _____>>** type.
3. Finishes: **<< Factory primed; Standard factory finish; or _____>>**.

2.07 INLINE CENTRIFUGAL FANS AND BLOWERS

A. Centrifugal Fan Unit: V-belt or direct driven, with galvanized steel housing**<< lined with acoustic insulation; _____; or None - N/A>>**, resiliently-mounted motor, gravity backdraft damper in discharge.

B. **<< Low Profile ; _____; or None - N/A>>**Forward Curved Blower:

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1. **<< Adjustable belt; Direct; Adjustable belt- or direct; or _____>>**-driven, resiliently mounted**<< , electrically commutated; , induction; , _____; or None - N/A>>** motor, heavy-duty ball bearings, **<< galvanized steel; powder-coated steel; or _____>>** housing for **<< indoor or outdoor; indoor; outdoor; or _____>>** service**<< lined with acoustic insulation; _____; or None - N/A>>**, and removable service panels.
2. Service Temperature: **<< Minus 65 to 250 degrees F; or _____ degrees F>>**.
3. Accessories: Provide **<< backdraft damper; external vibration isolator spring; filter section; intake hood with bird screen; MERV- __ filters; motor out of airstream; and _____>>**.

C. Disconnect Switch: Cord and plug-in housing for thermal overload protected motor**<< and wall mounted switch; and wall mounted multiple speed switch; and wall mounted solid state speed controller; _____; or None - N/A>>**.

D. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm gets reached with sheaves set at mid-position; fan shaft with self-aligning prelubricated ball bearings.

2.08 KITCHEN HOOD UPBLAST ROOF EXHAUSTERS

A. **<< Direct; Belt; or _____>>** Drive Fan:
1. Fan Wheel:
a. Type: Non-overloading, backward inclined centrifugal.
b. Material: **<< Aluminum; Aluminum with non-stick coating; or _____>>**, statically and dynamically balanced.
2. Housing:
a. Construct of heavy gauge aluminum including curb cap, windband, and motor compartment.
b. Rigid internal support structure.
c. One-piece fabricated or fully welded curb-cap base to windband for leak proof construction.
d. Construct drive frame assembly of heavy gauge steel, mounted on vibration isolators.
e. Provide breather tube for fresh air motor cooling and wiring.

B. Shafts and Bearings:
1. Fan Shaft:
a. Ground and polished steel with anti-corrosive coating.
b. First critical speed at least **<< 25 percent; or _____>>** over maximum cataloged operating speed.
2. Bearings:
a. Permanently sealed or pillow block type.
b. Minimum **<< L10; or ___>>** life in excess of **<< 100,000 hours (equivalent to L50 average life of 500,000 hours); or _____>>**, at maximum cataloged operating speed.
c. **<< 100 percent; or _____>>** factory tested.

C. Drive Assembly:
1. Belts, pulleys, and keys oversized for a minimum of **<< 150 percent; or _____>>** of driven horsepower.
2. Belts: Static free and oil resistant.

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3. Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
4. Motor pulley adjustable for final system balancing.
5. Readily accessible for maintenance.

D. Disconnect Switches:
1. **<< Factory mounted and wired; Shipped loose for field mounting; or _____>>**.
2. Environment Type per **<<NEMA EN 10250>>**: **<< Unless otherwise indicated, as specified for the following installation locations:; As indicated on the drawings.; _____ .; or _____ :>>**
a. Outdoor Locations: **<< Type 3R; Type 4X, stainless steel; or _____>>**.
3. Finish for Painted Steel Enclosures: Provide **<< manufacturer's standard; factory-applied gray; or _____>>** unless otherwise indicated.
4. Positive electrical shutoff.
5. Wired from fan motor to junction box installed within motor compartment.

E. Roof Curb: **<< 8 inch; 12 inch; 16 inch; 20 inch; 24 inch; or ___ inch>>** high**<< self-flashing; _____; or None - N/A>>** of **<< galvanized steel; aluminum; or _____>>** with continuously welded seams, **<< built-in cant strips; insulation and curb bottom; curb bottom; ventilated double wall; factory installed nailer strip; and _____>>**.

F. Drain Trough: Allows for single-point drainage of water, grease, and other residues.

G. Options/Accessories:
1. Automatic Belt Tensioner: Automatic device that adjusts for correct belt tension for single drives.
2. Clean Out Port: Removable grease repellent compression rubber plug allows access for cleaning wheel through windband.
3. Roof Curb Extension: Vented curb extension where required for compliance with minimum clearances required by **<<NFPA 96>>**.
4. Drain Connection:
a. Aluminum construction.
b. Container allows single-point drainage of grease, water, or other residues.
5. Finishes: **<< Factory primed; Standard factory finish; or _____>>**.
6. Grease Trap:
a. Aluminum.
b. Built-in drain connection.
c. Container system to collect grease residue.
7. Hinge Kit:
a. Aluminum hinges.
b. Hinges and restraint cables mounted to base sleeve.
c. Allows fan to tilt away for access to wheel and ductwork for inspection and cleaning.
8. Heat Baffle: Prevents heat from radiating into motor compartment.

2.09 UTILITY VENT << BLOWERS; BLOWER SETS; OR _____>>

A. **<< Direct; Belt; or _____>>** Drive Fan:
1. Fan Wheel:
a. Type: Non-overloading, backward inclined centrifugal.
b. Material: **<< Aluminum; Aluminum with non-stick coating; or _____>>**, statically and dynamically balanced.

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2. Housing:
   a. Construct of heavy gauge aluminum including curb cap, windband, and motor compartment.
   b. Rigid internal support structure.
   c. One-piece fabricated or fully welded curb-cap base to windband for leak proof construction.
   d. Construct drive frame assembly of heavy gauge steel, mounted on vibration isolators.
   e. Provide breather tube for fresh air motor cooling and wiring.

B. Shafts and Bearings:
   1. Fan Shaft:
      a. Ground and polished steel with anti-corrosive coating.
      b. First critical speed at least **<< 25 percent; or _____>>** over maximum cataloged operating speed.
   2. Bearings:
      a. Permanently sealed or pillow block type.
      b. Minimum **<< L10; or __>>** life in excess of **<< 100,000 hours (equivalent to L50 average life of 500,000 hours); or _____>>**, at maximum cataloged operating speed.
      c. **<< 100 percent; or _____>>** factory tested.

C. Drive Assembly:
   1. Belts, pulleys, and keys oversized for a minimum of **<< 150 percent; or _____>>** of driven horsepower.
   2. Belts: Static free and oil resistant.
   3. Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
   4. Motor pulley adjustable for final system balancing.
   5. Readily accessible for maintenance.

D. Drain Trough: Allows for single-point drainage of water, grease, and other residues.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with **<< manufacturer's instructions; or _____>>**.

B. Secure **<< roof; wall; or _____>>** exhausters with **<< cadmium plated steel; aluminum; stainless steel; or _____>>** lag screws to **<< roof curb; structure; or _____>>**.

C. Extend ducts to **<< roof; wall; or _____>>** exhausters into **<< roof curb; structure; or _____>>**. Counterflash duct to **<< roof; wall; or _____>>** opening.

D. Provide sheaves required for final air balance.

E. Install backdraft dampers on inlet to roof and wall exhausters.

F. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.

END OF SECTION 233423

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SECTION 233513
DUST COLLECTION SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Industrial centrifugal exhaust fans.

B. Ductwork and duct fittings.

C. Inlet fittings.

D. Centrifugal separator.

E. Accessories.

1.02 RELATED REQUIREMENTS

A. Section **<< 230548 - Vibration and Seismic Controls for HVAC>>**: Vibration isolators.

1.03 REFERENCE STANDARDS

A. ACGIH (IV) - Industrial Ventilation: A Manual of Recommended Practice for Design, 31st Edition.

B. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program.

C. AMCA 99 - Standards Handbook.

D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.

E. AMCA 300 - Reverberation Room Methods of Sound Testing of Fans.

F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

H. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

J. AWS D9.1/D9.1M - Sheet Metal Welding Code.

K. NFPA 91 - Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids.

L. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.

M. SMACNA (RIDC) - Rectangular Industrial Duct Construction Standards.

N. SMACNA (ROUND) - Round Industrial Duct Construction Standards.

O. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.

1.04 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

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B. Shop Drawings: Indicate dimensions, sizes, weights and point loadings, material thickness, and locations and sizes of field connections.**<< Submit construction layout and details for inlet fittings.; _____ .; or None - N/A>>**

C. Product Data: Provide manufacturers literature and data indicating rated capacities, dimensions, weights and point loadings, accessories, electrical characteristics and connection requirements, wiring diagrams, and location and sizes of field connections.

D. Provide fan curves with specified operating point clearly plotted.

E. Submit sound power levels for both fan inlet and outlet at rated capacity.

F. Manufacturer's Installation Instructions: Indicate assembly and installation instructions.

G. Operation and Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

H. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.
   1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
   2. Extra Filter Separator Filters: **<< One; Two; or ____>>**.
   3. Extra Filter Bags: **<< One; Two; or ____>>**.

1.05 QUALITY ASSURANCE

A. Fans:
   1. Performance Ratings: Comply with **<<AMCA 210>><< and bear the AMCA Certified Rating Seal; _____; or None - N/A>>**.
   2. Sound Ratings: **<<AMCA 301>>**, tested to **<<AMCA 300>><< , and bear AMCA Certified Sound Rating Seal; , _____; or None - N/A>>**.
   3. Fabrication: Comply with **<<AMCA 99>>**.

B. Products Requiring Electrical Connection: Listed and classified by **<< Underwriters Laboratories Inc.,; testing firm acceptable to the Authority Having Jurisdiction; or _____>>** as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 INDUSTRIAL CENTRIFUGAL EXHAUST FANS

2.02 DUCTWORK AND DUCT ACCESSORIES

A. Manufacturers:
   1. Dust Duct Systems (a Hranec Corporation Company)**<< ; Welded Pipe One Seam; ; _____; or None - N/A>>**: www.dustductsystems.com/#sle.
   2. EHG, a DMI Company**<< ; _____; or None - N/A>>**: www.ehgduct.com/#sle.
   3. Linx Industries, Inc, a DMI Company**<< ; _____; or None - N/A>>**: www.li-hvac.com/#sle.
   4. Nordfab Ducting**<< ; _____; or None - N/A>>**: www.nordfab.com/#sle.
   5. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Materials:
   1. Galvanized Steel Ducts: Hot-dipped galvanized steel sheet, **<<ASTM A653/A653M>>**, FS Type B, with **<< G60/Z180; G90/Z275; or ____>>** coating.
      a. Thickness: Base sheet steel, **<< 24 gauge, 0.0239 inch; or ___ gauge, ___ inch>>** minimum.

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b. Thickness: As indicated on drawings.

2. Steel Ducts: **<<ASTM A1011/A1011M>>**, Designation CS, Type **<< B; A; C; or __>>** carbon steel, **<< 24 gauge, 0.0239 inch; or ___ gauge, ___ inch>>** minimum thickness.
3. Stainless Steel Ducts: **<<ASTM A666/A666M>>**, Type **<< 304; or ____>>**, **<< 26 gauge, 0.0187 inch; 24 gauge, 0.0250 inch; or ___ gauge, ___ inch>>** minimum thickness.

C. Ductwork:

1. Fabricate and Support**<< to UL 181; _____; or None - N/A>>** in Accordance With:
   a. **<<SMACNA (DCS)>>**, **<< 2 inch; or _____ inch>>** pressure class.
   b. **<<SMACNA (ROUND)>>** and **<<SMACNA (RIDC)>>**.
   c. **<<ACGIH (IV)>>** Industrial Ventilation Manual.
2. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline.
3. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
4. Fabricate continuously welded round and oval duct fittings two gauges heavier than duct gauges indicated in **<<SMACNA (ROUND)>>**. Prime coat welded joints.
5. Use crimp joints with or without bead for joining round duct sizes **<< 8 inch; or ____ inch>>** and smaller with crimp in direction of air flow, with liquid adhesive plus sheet metal screws.
6. Joints: Minimum **<< 4 inch>>** cemented slip type, brazed, or electric welded to comply with **<<AWS D9.1/D9.1M>>**.
7. Provide standard 45-degree lateral wye branch fittings unless otherwise indicated.
8. Use double nuts and lock washers on threaded rod supports.

D. Flexible Connectors: UL listed, fire-retardant chloroprene or chlorosulfonated polyethylene impregnated fabric, minimum density **<< 20 oz per sq yd; 36 oz per sq yd; or __ oz per sq yd>>**, approximately **<< 2 inches; 3 inches; 6 inches; or __ inches>>** wide, crimped into metal edging strip.

E. Angle Rings: Carbon steel, unpainted, leg out, drilled with bolt holes.

F. Blast Gates: **<< Half; Full; or ___>>** collar of **<< cast aluminum; steel; or _____>>**, with galvanized steel slide, set screw.

G. Flat Back Elbows: Long radius rectangular elbow at duct material with heavy gauge, removable, **<< stainless steel; rubber lined; or _____>>** back strip.

H. Ball Joints: **<< Cast iron; Spun galvanized steel; or _____>>** with tubular studs for connecting ducts, allowing 25 degree angle off center.

2.03 INLET FITTINGS

2.04 CENTRIFUGAL SEPARATOR

A. Manufacturers:

1. Kraemer Tool & Manufacturing Company Inc**<< ; _____; or None - N/A>>**: www.kraemertool.com/#sle.
2. Spencer Turbine Company**<< ; _____; or None - N/A>>**: www.spencerturbine.com/#sle.
3. Donaldson Company, Inc**<< ; _____; or None - N/A>>**: www.donaldson.com/#sle.
4. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

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B. Cyclone dust collector consisting of cyclone with integral fan and structural stand incorporating dust storage.

C. Frame and Casing: Steel frame with enameled finish, **<< 16 gauge, 0.0598 inch; or _____ gauge, _____ inch>>** structure with **<< 18 gauge, 0.0478 inch; or _____ gauge, _____ inch>>** panels and **<< 20 gauge, 0.0359 inch; or _____ gauge, _____ inch>>** cyclone minimum base metal thicknesses, and **<< _____ cubic feet>>** dust storage capacity.

D. Cyclone Efficiency: **<< 99; 84; or _____>>** percent of **<< steel grindings; sawdust; baking flour; corn starch; or _____>>**.

E. Fan: Welded construction centrifugal fan with material handling wheel, direct drive.

F. Accessories: **<< Discharge silencer; Push Button control panel with motor starter; Polyester bag filter; and _____>>**.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as **<< indicated; indicated on shop drawings; instructed by the manufacturer; or _____>>**.

3.02 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions.

B. Install in accordance with **<< NFPA 91; SMACNA (DCS); SMACNA (ROUND); SMACNA (RIDC); ACGIH (IV); and _____>>** except as indicated.

C. Do not operate fans for any purpose until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

D. Install fans with resilient mountings and flexible electrical leads. See Section **<< 230548>>**.

E. Install flexible connections at **<< fan; separator; or _____>>** inlet and discharge. Ensure metal bands of connectors are parallel with minimum **<< 1-inch>>** flex between ductwork and fan while running.

F. Provide pitot tube openings where required for testing of systems, complete with metal cap with spring device or screw to ensure against air leakage.

G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

END OF SECTION 233513

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SECTION 233600
AIR TERMINAL UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single-duct terminal units.
   1. Variable-volume units.
B. Fan-powered units.

1.02 REFERENCE STANDARDS

A. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
B. AHRI 880 (I-P) - Performance Rating of Air Terminals.
C. AHRI 885 - Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.
D. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality.
E. ASHRAE Std 130 - Laboratory Methods of Testing Air Terminal Units.
F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
G. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements.
H. NFPA 70 - National Electrical Code.
I. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
J. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.

1.03 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.
B. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate airflow, static pressure, and NC designation. Include electrical characteristics and connection requirements.
C. Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.
   1. Include schedules listing discharge and radiated sound power level for each of the second through sixth-octave bands at inlet static pressures of **<< 1 to 4 in-wc>>**.
D. Certificates: Certify that **<< air coil capacities, pressure drops, and selection procedures meet or exceed specified requirements; coils are tested and rated in accordance with AHRI 410; or _____>>**.
E. Manufacturer's Installation Instructions: Indicate support and hanging details, installation instructions, recommendations, and service clearances required.
F. Project Record Documents: Record actual locations of **<< units; controls components; and _____>>** and locations of access doors required for access of valving.
G. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.
H. Warranty: Submit manufacturer warranty and ensure forms have been completed in **<<Owner>>**'s name and registered with manufacturer.

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I. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.
   1. See Section **<< 016000 - Product Requirements>>** for additional provisions.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum **<< three; eight; or _____>>** years of**<< documented; _____; or None - N/A>>** experience.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.05 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Provide **<< five; or ____>>** year manufacturer warranty for **<< air terminal units; integral sound attenuators; integral heating coils; and integral controls>>**.

PART 2 PRODUCTS

2.01 SINGLE-DUCT, << VARIABLE-VOLUME; AND CONSTANT-VOLUME>> UNITS

A. Manufacturers:
   1. Carrier, a part of UTC Building and Industrial Systems, a unit of United Technologies Corp.**<< ; _____; or None - N/A>>**: www.commercial.carrier.com/#sle.
   2. Johnson Controls, Inc**<< ; _____; or None - N/A>>**: www.johnsoncontrols.com/#sle.
   3. Krueger-HVAC**<< ; _____; or None - N/A>>**: www.krueger-hvac.com/#sle.
   4. Metalaire, a brand of Metal Industries Inc**<< ; _____; or None - N/A>>**: www.metalaire.com/#sle.
   5. Price Industries, Inc**<< ; _____; or None - N/A>>**: www.priceindustries.com/#sle.
   6. Trane, a brand of Ingersoll Rand**<< ; _____; or None - N/A>>**: www.trane.com/#sle.
   7. Tuttle and Bailey**<< ; _____; or None - N/A>>**: www.tuttleandbailey.com/#sle.
   8. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Acoustic Performance Requirements:
   1. Use attenuation values found in appendix E of **<<AHRI 885>>**.

C. General:
   1. Factory-assembled, **<<AHRI 880 (I-P)>>** rated**<< and bearing the AHRI seal; or None - N/A>>**, air volume control terminal with damper assembly, flow sensor, externally mounted volume controller, duct collars, and all required features.
   2. Control box bearing identification, including but not necessarily limited to nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil (right or left hand) connection, where applicable.

D. Unit Casing:
   1. Minimum **<< 22 gauge, 0.0299 inch; or _____ gauge, _____ inch>>** galvanized steel.
      a. Assembled with longitudinal lock seam construction.
      b. Casing leakage to meet **<<ASHRAE Std 130>>**.
   2. Air Inlet Collar: Provide **<< round; rectangular; or _____>>**, suitable for standard flexible duct sizes.
   3. Unit Discharge: Rectangular, with slip-and-drive connections.

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4. Acceptable Liners:
   a. **<< 1/2 inch; 3/4 inch; 1 inch; or _____ inch>>** thick, coated, fibrous-glass complying with **<<ASTM C1071>>**.
      1) Secure with adhesive.
      2) Coat edges exposed to airstream with **<<NFPA 90A>>** approved sealant.
      3) Cover liner with **<< non-porous foil; perforated metal; and _____>>**.
   b. Liner not to contain pentabrominated diphenyl ether (CAS #32534-81-9) or octabrominated diphenyl ether.

E. Sound Attenuator:
1. Provide if required to meet scheduled acoustical performance requirements.
2. Construction to consist of a continuous extension of the casing and liner as required to achieve required attenuation.

F. Damper Assembly:
1. Heavy-gauge, galvanized steel, or extruded aluminum construction with solid steel, nickel-plated shaft pivoting on HDPE, self-lubricating bearings.
2. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees.

G. Hot Water Heating Coil:
1. Coil Casing: Minimum **<< 22 gauge, 0.0299 inch; or _____ gauge, _____ inch>>** galvanized steel, factory-installed on terminal discharge with rectangular outlet, duct connection type.
   a. Access Door: Gasketed and insulated located **<< on bottom; on top; downstream of coils; and _____>>**.
   b. Right or left coil inlets.
2. Coil Fins: Aluminum or aluminum plated**<< None - N/A; 0.0045 inch; or _____ inch>>** fins, mechanically-bonded to seamless**<< None - N/A; 0.50 by 0.016 inch; or _____ inch>>** copper tubes.
   a. Fins to be formed in a high heat transfer sine wave configuration.
3. Coil leak tested to minimum **<< 350 psig; 300 psig; or _____ psig>>**.
4. Base performance data on tests run in accordance with **<<AHRI 410>><< and units to bear AHRI 410 label; or None - N/A>>**.

H. Electric Heating Coil:
1. Listed and provided by the terminal unit manufacturer.
2. Coil Casing: **<< 20 gauge, 0.0359 inch; or _____ gauge, _____ inch>>** galvanized steel.
3. Heating Elements: Nickel chrome, supported by ceramic insulators.
4. Integral Control Panel: **<<NEMA EN 10250>>**, Type **<< 2; 12; or __>>** enclosure with hinged access door for access to all controls and safety devices.
5. Furnish a primary automatic reset thermal cutout and differential pressure airflow switch for proof of airflow.
6. Provide the following additional components, mounted and/or wired within the control enclosure:
   a. Fused or non-fused door interlocking disconnect switch.

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7. Factory wired, including all limit switches and steps of control as **<< indicated; indicated on the equipment schedule; or _____>>**, with the SSR (solid-state relay) proportional heat control.
8. Provide SCR (Silicon Controlled Rectifier) controller.

I. Electrical Requirements:
1. Single-point power connection.
2. Equipment wiring to comply with requirements of **<<NFPA 70>>**.

J. Control Transformers: Factory supplied and mounted for electric and electronic control applications.

K. Controls:
1. Airflow Sensor: Differential pressure airflow device measuring total, static, and wake pressures.
a. Basis of Design: Price Industries, Inc; SP300 Air Flow Sensor: www.priceindustries.com/#sle.
1) Plastic parts are fire-resistant, complying with **<<UL 94>>**.
2) Provides accuracy within 5 percent with a 90 degree sheet metal elbow directly at the inlet of the assembly.
3) Control tubing is protected by grommets at the wall of the air flow sensor's housing.
4) Furnished with twelve total pressure sensing ports and a center averaging chamber that amplifies the sensed air flow signal.
5) Provide sensor with a pressure transducer to interface with **<< a DDC system; the building management system; and _____>>**.
6) Provide velocity pressure sensor with a removable access section for maintenance.
b. Signal accuracy: Plus/minus five percent throughout terminal operating range.

2.02 FAN-POWERED<< NONE - N/A; PARALLEL; OR SERIES>> UNITS

A. Manufacturers:
1. Carrier, a part of UTC Building and Industrial Systems, a unit of United Technologies Corp.**<< ; _____; or None - N/A>>**: www.commercial.carrier.com/#sle.
2. Johnson Controls, Inc**<< ; _____; or None - N/A>>**: www.johnsoncontrols.com/#sle.
3. Krueger-HVAC**<< ; _____; or None - N/A>>**: www.krueger-hvac.com/#sle.
4. Metalaire, a brand of Metal Industries Inc**<< ; _____; or None - N/A>>**: www.metalaire.com/#sle.
5. Price Industries, Inc**<< ; _____; or None - N/A>>**: www.priceindustries.com/#sle.
6. Trane, a brand of Ingersoll Rand**<< ; _____; or None - N/A>>**: www.trane.com/#sle.
7. Tuttle and Bailey**<< ; _____; or None - N/A>>**: www.tuttleandbailey.com/#sle.
8. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. General:
1. Factory-assembled and wired, **<<AHRI 880 (I-P)>>** rated, horizontal fan-powered terminal unit with blower, blower motor, mixing plenum, and primary air damper contained in a single unit housing.

C. Unit Casing:
1. Minimum **<< 22 gauge, 0.0299 inch; 20 gauge, 0.0359 inch; or _____ gauge, _____ inch>>** galvanized steel.

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2. Primary Air Inlet Collar: Suitable for standard flexible duct sizes.
3. Unit Discharge: Rectangular, suitable for flanged duct connection.
4. Plenum Inlet: Filter rack with disposable filters.
   a. **<< 1 inch>>** thick disposable fiberglass filters.
   b. Minimum Efficiency Reporting Value (MERV): **<< 8>>**, when tested in accordance with **<<ASHRAE Std 52.2>>**.
5. Acceptable Liners:
   a. **<< 1/2 inch; or _____ inch>>** thick, coated, fibrous-glass complying with **<<ASTM C1071>>**.
      1) Secure with adhesive.
      2) Coat edges exposed to airstream with **<<NFPA 90A>>** approved sealant.
      3) Cover liner with **<< non-porous foil; perforated metal; and _____>>**.

D. Sound Attenuator:
   1. Provide if required to meet scheduled acoustical performance requirements.
   2. Construction to consist of a continuous extension of the casing and liner as required to achieve required attenuation.

E. Primary Air Damper Assembly:
   1. Heavy-gauge, galvanized steel, or extruded aluminum construction with solid shaft rotating in bearings.
   2. Provide indicator on damper shaft or alternative method for indicating damper position over full range of 90 degrees.
   3. Fan(s): Forward curved, centrifugal type.
   4. Fan Motor:
      a. ECM (Electrically Commutated Motor):
         1) Brushless DC controlled by an integrated controller/inverter that operates the wound stator and senses rotor position to electrically commutate the stator.
         2) Permanent magnet type motor with near-zero rotor losses designed for synchronous rotation.
         3) Designed to maintain 70 percent efficiency over the entire operating range.
      b. Fan motor shaft directly connected to fan and isolated from unit casing to prevent transmission of vibration.

F. Electric Heating Coil:
   1. Listed and provided by the terminal unit manufacturer.
   2. Coil Casing: Minimum **<< 20 gauge, 0.0359 inch; or _____ gauge, _____ inch>>** galvanized steel.
   3. Heating Elements: Open wire, nickel chrome, supported by ceramic insulators.
   4. Integral Control Panel: **<<NEMA EN 10250>>**, Type **<< 2; 12; or __>>** enclosure, with hinged access door for access to all controls and safety devices.
   5. Provide a primary automatic reset thermal cutout and differential pressure airflow switch for proof of airflow or electrical interlock to prevent heater operation when fan is not running.
   6. Provide the following additional components, mounted and/or wired within the control enclosure:
      a. Fused or non-fused door interlocking disconnect switch.
   7. Provide SCR (Silicon Controlled Rectifier) controller.

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G. Hot Water Heating Coil:
   1. Coil Casing: Minimum **<< 22 gauge, 0.0299 inch; or _____ gauge, _____ inch>>** galvanized steel, factory-installed on terminal unit with flanged discharge for attachment to downstream ductwork.
   2. Heavy-gauge aluminum fins, mechanically bonded to tubes.
   3. Copper Tubes: **<< 0.016 inch; or _____ inch>>** minimum wall thickness with male solder header connections.
   4. Coil leak tested to minimum **<< 305 psig; or _____ psig>>**.
   5. Base performance data on tests run in accordance with **<<AHRI 410>>**.

H. Electrical Requirements:
   1. Single-point power connection.
   2. Equipment wiring to comply with requirements of **<<NFPA 70>>**.

I. Controls:
   1. Airflow Sensor: Differential pressure airflow device measuring total, static, and wake pressures.
      a. Basis of Design: Price Industries, Inc; SP300 Air Flow Sensor: www.priceindustries.com/#sle.
         1) Plastic parts are fire-resistant, complying with **<<UL 94>>**.
         2) Provides accuracy within 5 percent with a 90 degree sheet metal elbow directly at the inlet of the assembly.
         3) Control tubing is protected by grommets at the wall of the air flow sensor's housing.
         4) Furnished with twelve total pressure sensing ports and a center averaging chamber that amplifies the sensed air flow signal.
         5) Provide sensor with a pressure transducer to interface with **<< a DDC system; the building management system; and _____>>**.
         6) Provide velocity pressure sensor with a removable access section for maintenance.
      b. Signal accuracy: Plus/minus five percent throughout terminal operating range.

2.03 HOSE KITS AND VALVES

A. Manufacturers:
   1. Griswold Controls**<< ; _____; or None - N/A>>**: www.griswoldcontrols.com/#sle.
   2. Hays Fluid Controls**<< ; _____; or None - N/A>>**: www.haysfluidcontrols.com/#sle.
   3. IMI Flow Design, a brand of IMI Hydronic Engineering Division of IMI plc**<< ; _____; or None - N/A>>**: www.flowdesign.com/#sle.
   4. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Hoses:
   1. Provide hoses for all units for connection to main water supply and return headers.
   2. Length: **<< 2 feet; or __ feet>>**.
   3. Material: Braided stainless steel rated to minimum **<< 400 psi; or ___ psi>>** at **<< 265 degrees F; or ___ degrees F>>**.

C. **<< Automatic ; Manual ; or None - N/A>>**Balancing Valves:
   1. Brass body for shutoff and hydronic balancing.

D. Ball Valves:

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1. Brass body for shutoff and hydronic balancing.
2. Provide pressure/temperature ports.
3. Provide balancing valves.

E. Y Strainers:
1. Bronze body.
2. "Y" type configuration with brass cap.
3. Maximum Operating Pressure: Minimum **<< 450 psi; or ___ psi>>**.
4. Screen: Stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are suitable for installation.

B. Verify that field measurements are as indicated on drawings.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install the inlets of air terminal units and air flow sensors a minimum of four duct diameters from elbows, transitions, and duct takeoffs.

C. See drawings for the size(s) and duct location(s) of the air terminal units.

D. Provide ceiling access doors or locate units above easily removable ceiling components.

E. Support units individually from structure**<< with wire rope complying with ASTM A492 and ASTM A603; _____; or None - N/A>>** in accordance with **<<SMACNA (SRM)>>**. **<< See Section 23 0548.; _____ .; or None - N/A>>**

F. Embed anchors in concrete in accordance with **<<ASTM E488/E488M>>**.

G. Do not support from ductwork.

H. Connect to ductwork in accordance with Section **<< 233100>>**.

I. Install heating coils in accordance with Section **<< 238200>>**.

J. Verify that electric power is available and of the correct characteristics.

K. Insulate hot water coil ends, minimum R-6.

3.03 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

B. Provide manufacturer's field representative to **<< test; inspect; instruct; observe; and _____>>** field-assembled components and equipment installation, including connections**<< and to assist in field testing; _____; or None - N/A>>**. Report results in writing.
1. Operational Test:
a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
b. Test and adjust controls and safeties.
c. Replace damaged and malfunctioning controls and other equipment.
d. Remove and replace malfunctioning units and retest as specified above.

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3.04 CLEANING

A. See Section **<< 017419 - Construction Waste Management and Disposal>>** for additional requirements.

B. Vacuum clean coils and inside of units.

C. Install new filters.

3.05 CLOSEOUT ACTIVITIES

A. See Section **<< 017800 - Closeout Submittals>>** for closeout submittals.

B. See Section **<< 017900 - Demonstration and Training>>** for additional requirements.

END OF SECTION 233600

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SECTION 233700
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Diffusers

B. Kiln exhaust hoods.

C. Roof hoods.

D. Goosenecks.

E. Gravity ventilators.

1.02 REFERENCE STANDARDS

A. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices.

B. AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers.

C. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Air Inlets.

D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

F. SMACNA (ASMM) - Architectural Sheet Metal Manual.

G. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.

1.03 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.04 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with **<<ASHRAE Std 70>>**.

B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum **<< three; or _____>>** years of**<< documented; _____; or None - N/A>>** experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Anemostat, Inc.

B. Krueger.

C. Metalaire.

D. Nailor Industries, Inc.

E. Price Industries.

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F. Titus.

G. Tuttle and Bailey.

H. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

2.02 GENERAL

A. All trim pieces shall be mechanically fastened. Friction fit trim rings/frames shall not be provided or shall be mechanically fastened in the field. Fasteners shall not be visible.

B. Finish: Powder-coated or baked enamel, white unless noted otherwise.
   1. For inlets or outlets in metal or wood ceilings, provide finish suitable for field painting where indicated (color shall be selected by Architect) or provide anodized clear finish where indicated.
   2. For sidewall-mounted inlets and outlets, provide finish suitable for field painting where indicated (color shall be selected by Architect) or provide anodized clear finish where indicated.
   3. Finish for Exposed Ductwork: Where ductwork is exposed, inlets and outlets mounted in exposed ductwork shall be factory primed for field painting.

C. Filter Grille Inlets: Grille shall accommodate a 2" deep, MERV 8 pleated filter. Refer to Section 234000.

D. Mounting: As indicated in schedule or match condition indicated.

2.03 LINEAR SLOT DIFFUSER PLENUMS

A. Linear slot diffuser plenums shall be fully insulated. Provide one of the following:
   1. Factory-installed, internal fiberglass insulation on sides and end caps.
   2. Factory-installed, external aluminum foil-backed insulation.

2.04 CEILING DIFFUSERS

A. Ceiling diffuser backpans shall be externally insulated.
   1. Factory-installed with foil/scrim vapor barrier insulation with a minimum R-value of 6.

B. For diffusers connected to flexible duct, provide the following:
   1. Field-provided 12” long duct collar with diameter matching diffuser inlet. Attach to diffuser inlet with a minimum of four sheet metal screws evenly distributed around collar.

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2.05 KILN EXHAUST HOODS

A. Provide Greenheck Model GO Type II hood or equal over each kiln.

B. General: Air inlet device configured to exhaust suspended gases, vapors, fumes and fine dust particles under 20 microns in diameter**<< sourced from cold processes; sourced from hot processes; _____; or None - N/A>>**.

2.06 ROOF HOODS

A. Fabricate air inlet or exhaust hoods in accordance with **<<SMACNA (DCS)>>**.

B. Fabricate of galvanized steel, minimum **<< 16 gauge, 0.0598 inch>>** base and **<< 20 gauge, 0.0359 inch>>** hood, or aluminum, minimum **<< 16 gauge, 0.0598 inch>>** base and **<< 18 gauge, 0.0598 inch>>** hood; suitably reinforced; with removable hood; birdscreen with **<< 1/2 inch>>** square mesh for exhaust and **<< 3/4 inch>>** for intake, and factory **<< prime coat; baked enamel; or _____>>** finish.

C. Mount unit on minimum **<< 12 inch>>** high curb base with insulation between duct and curb.

D. Make hood outlet area minimum of twice throat area.

2.07 GOOSENECKS

A. Fabricate in accordance with of minimum **<< 18 gauge, 0.0598 inch>>** galvanized steel.

B. Mount on minimum **<< 12 inch>>** high curb base where size exceeds **<< 9 by 9 inch; or _____ inch>>**.

2.08 GRAVITY VENTILATORS

A. Hood **<< Intake; Relief; and _____>>** Gravity Ventilator:

1. Manufacturers:
   a. Greenheck Fan Corporation**<< ; _____; or None - N/A>>**: www.greenheck.com/#sle.
   b. Loren Cook Company**<< ; _____; or None - N/A>>**: www.lorencook.com/#sle.
   c. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
2. General:
   a. Low silhouette for **<< intake; relief; and _____>>** applications with natural gravity or negative pressure system(s).
   b. Performance ratings and factory testing in accordance with **<<AMCA 511>>** and **<<AMCA 550>>**.
   c. Suitable for non-ducted applications.
   d. Equipment to bear permanently affixed manufacturer's nameplate listing model and serial number.
3. Hood and Base:
   a. Material: **<< Aluminum; Galvanized steel; or _____>>**.
   b. Hood Construction: Precision formed, arched panels with interlocking seams.
   c. Vertical End Panels: Fully locked into hood end panels.
   d. Curb Cap: Pre-punched mounting holes for installation.
4. Birdscreen:
   a. Fabricate in accordance with **<<ASTM B221>>** (**<<ASTM B221M>>**).
   b. Construction: **<< 1/2 inch; or __ inch>><< Galvanized; Aluminum; or _____>>** mesh.

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c. Horizontally mounted across hood intake area.

5. Hood Support: Galvanized steel construction and fastened so hood can be removed completely from base or hinged open.
6. Options/Accessories:
   a. Roof Curbs:
      1) Flat Roofs:
         (a) Welded, straight side curb with flashing flange**<< and wood nailer; _____; or None - N/A>>**.
      2) Pitched Roofs: Welded, straight side curb with flashing flange**<< and wood nailer; _____; or None - N/A>>**.
      3) Mounted on roof with fan.
      4) Material: **<< Aluminum; Galvanized; or _____>>**.
      5) Insulation Thickness: **<< 1 inch; 1-1/2 inches; 2 inches; or __ inches>>**.
   b. Provide extended base minimum **<< 7 inch; or __ inches>>** extension to base height making overall base **<< 12 inches; or __ inches>>** in height to prevent snow or moisture intake.
   c. Curb Seal: Rubber seal between fan and roof curb.
   d. Dampers:
      1) Type: **<< Gravity; Motorized; or _____>>**.
      2) Factory designed to prevents outside air from entering back into building when fan is off.
      3) Galvanized frames with pre-punched mounting holes.
   e. Factory Finish: **<< Thermo-setting polyester urethane; Polyester meeting or exceeding the chemical resistance properties of air dry phenolic (heresite); Factory primed for field application of final finish; Baked enamel matching or complementing building colors; None; or _____>>**.

B. Spun Aluminum **<< Intake; Relief; and _____>>** Gravity Ventilator:
   1. Manufacturers:
      a. Greenheck Fan Corporation**<< ; _____; or None - N/A>>**: www.greenheck.com/#sle.
      b. Loren Cook Company**<< ; _____; or None - N/A>>**: www.lorencook.com/#sle.
      c. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
   2. General:
      a. Provide **<< low silhouette; tiered; or ____>>** configuration for **<< intake; relief; and _____>>** applications with natural gravity or negative pressure system.
      b. Performance ratings and factory testing in accordance with **<<AMCA 511>>** and **<<AMCA 550>>**.
      c. Suitable for non-ducted applications.
      d. Equipment to bear permanently affixed manufacturer's nameplate listing model and serial number.
   3. Hood:
      a. Material: Aluminum.
      b. Internal structure constructed of galvanized steel.
   4. Birdscreen:
      a. Fabricate in accordance with **<<ASTM B221>>** (**<<ASTM B221M>>**).

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b. Construction: **<< 1/2 inch; or __ inch>><< galvanized; aluminum; or _____>>** mesh.
c. Horizontally mounted across hood intake area.

5. Housing:
   a. Curb Cap:
      1) Type: **<< Hinged; No Hinged; or _____>>**.
      2) Construction: **<< Aluminum; or _____>>**.
      3) Integral deep spun inlet venturi with pre-punched mounting holes to ensure correct attachment to roof.
   b. Windband:
      1) One piece spun aluminum construction with uniform, original material thickness throughout housing.
      2) Include integral rolled bead for strength.
6. Options/Accessories:
   a. Roof Curbs:
      1) Flat Roofs:
         (a) Welded, straight side curb with flashing flange**<< and wood nailer; _____; or None - N/A>>**.
      2) Pitched Roofs: Welded, straight side curb with flashing flange**<< and wood nailer; _____; or None - N/A>>**.
      3) Mounted upon roof with fan.
      4) Material: **<< Aluminum; Galvanized steel; or _____>>**.
      5) Insulation Thickness: **<< 1 inch; 1-1/2 inches; 2 inches; or __ inches>>**.
   b. Curb Seal: Rubber seal between fan and roof curb.
   c. Dampers:
      1) Type: **<< Gravity; Motorized; or _____>>**.
      2) Factory designed to prevent outside air from entering back into building when fan is off.
   d. Factory Finish: **<< Thermo-setting polyester urethane; Polyester meeting or exceeding the chemical resistance properties of air dry phenolic; Factory primed for field application of final finish; Baked enamel matching or complementing building colors; None; or _____>>**.

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PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install air inlets and outlets level and flush with ceiling unless noted otherwise.

C. For linear slot diffusers, unless noted otherwise, adjust diffuser so half the slots throw horizontally in each direction. For linear slot diffusers at an exterior wall, adjust half the slots vertically downward at the exterior wall and half horizontally toward the interior.

D. Ceiling-mounted inlets and outlets shall be supported independently from the ceiling system to structure and shall not be supported from conduit, piping, or ductwork.

E. Comply with **<<SMACNA (ASMM)>>** for flashing/counter-flashing of roof penetrations and supports for roof curbs and roof mounted equipment.

F. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, other ceiling-mounted devices, and lighting.

G. Install diffusers to ductwork with air tight connection.

H. Provide balancing dampers on duct take-off to diffusers and grilles and registers, despite whether dampers are specified as part of diffuser, or grille and register assembly.

I. Paint ductwork visible behind air outlets and inlets matte black, see Section **<< 099123>>**.

J. Provide Price return air canopy (RAC) option for all open to plenum return grilles.

K. Install all ceiling return air filter grilles to open into the wall for easier access.

3.02 CLOSEOUT ACTIVITIES

A. Demonstrate operational system to Owner's representative.

B. Instruct Owner's representative to maintain system and use occupant controls or interfaces, as required.

3.03 PROTECTION

A. Protect installed products until completion of project.

B. Replace, repair, or touch-up damaged products before Substantial Completion.

END OF SECTION 233700

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SECTION 234000
HVAC AIR CLEANING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Disposable, extended area panel filters.

B. Disposable panel filters.

C. Extended surface high efficiency media filters.

D. Extended surface non-supported media filters.

E. Washable permanent panel filters.

F. Filter frames and housings.

G. Filter gauges.

1.02 REFERENCE STANDARDS

A. AHRI 851 (SI) - Performance Rating of Commercial and Industrial Air Filter Equipment.

B. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

C. UL 900 - Standard for Air Filter Units.

1.03 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Product Data: Provide data on filter media, filter performance data, filter assembly and filter frames, dimensions, motor locations and electrical characteristics and connection requirements.

C. Shop Drawings: Indicate filter assembly and filter frames, dimensions, motor locations, and electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Indicate assembly and change-out procedures.

E. Operation and Maintenance Data: Include instructions for operation, changing, and periodic cleaning.

F. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.

1. See Section **<< 016000 - Product Requirements>>** for additional provisions.
2. Extra Filters: **<< One set; 9 sets; or Two sets>>** of each type and size.

1.04 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by **<< Underwriters Laboratories Inc.; testing firm acceptable to the Authority Having Jurisdiction; or _____>>** as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 FILTER MANUFACTURERS

A. American Air Filter Company, Inc

B. Camfil, a company of the The Camfil Group

C. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

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2.02 PERFORMANCE REQUIREMENTS

A. Comply with the rating requirements in **<< AHRI 851 (SI); or AHRI 850 (I-P)>>**.

2.03 DISPOSABLE, EXTENDED AREA PANEL FILTERS

2.04 DISPOSABLE PANEL FILTERS

A. Media: **<<UL 900>>** Class 2, fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive.
   1. Nominal Size: **<< 12 by 24 inches; 16 by 25 inches; 24 by 24 inches; or ____ by ____ inches>>**.
   2. Thickness: **<< 1 inch; 2 inch; or ___ inch>>**.
   3. Minimum Efficiency Reporting Value (MERV): **<< 8; 13; 15; or ____>>**, when tested in accordance with **<<ASHRAE Std 52.2>>**.

B. Performance Rating:
   1. Face Velocity: **<< 500 fpm>>**.
   2. Initial Resistance: **<< 0.15 in-wc; 0.10 in-wc; or ____ in-wc>>**.
   3. Recommended Final Resistance: **<< 0.50 in-wc>>**.

C. Casing: Cardboard frame.

2.05 EXTENDED SURFACE HIGH EFFICIENCY MEDIA FILTERS

2.06 EXTENDED SURFACE NON-SUPPORTED MEDIA FILTERS

2.07 WASHABLE PERMANENT PANEL FILTERS

2.08 FILTER FRAMES AND HOUSINGS

A. General: Fabricate filter frames and supporting structures of **<< 16 gauge, 0.0598 inch>>** galvanized steel or extruded aluminum T-section construction with necessary gasketing between frames and walls.

B. Standard Sizes: Provide for interchangeability of filter media of other manufacturers; for panel filters, size for **<< 24 by 24 inches; or ___ by ____ inches>>** filter media, minimum **<< 2 inches>>** thick, for extended surface and high efficiency particulate air filters, provide for upstream mounting of panel filters.

C. Side Servicing Housings: Flanged for insertion into ductwork, of reinforced **<< 16 gauge, 0.0598 inch>>** galvanized steel; access doors with continuous gasketing and positive locking devices on both sides; extruded aluminum tracks or channels for primary **<< secondary; tertiary; and _____>>** filters with positive sealing gaskets.

2.09 FILTER GAUGES

PART 3 EXECUTION

3.01 INSTALLATION

A. Install air cleaning devices in accordance with manufacturer's instructions.

B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.

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C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with clean set.

END OF SECTION 234000

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SECTION 235100
BREECHINGS, CHIMNEYS, AND STACKS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured breechings.

B. Type B double wall gas vents.

C. Double wall metal stacks.

D. Special gas venting.

1.02 RELATED REQUIREMENTS

A. Section **<< 078400 - Firestopping>>**.

1.03 REFERENCE STANDARDS

A. ANSI Z21.66 - Automatic Damper Devices for Use with Gas-Fired Appliances.

B. NFPA 31 - Standard for the Installation of Oil-Burning Equipment.

C. NFPA 54 - National Fuel Gas Code.

D. NFPA 82 - Standard on Incinerators and Waste and Linen Handling Systems and Equipment.

E. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances.

F. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.

G. UL 103 - Factory-Built Chimneys for Residential Type and Building Heating Appliances.

H. UL 441 - Standard for Gas Vents.

I. UL 1738 - Standard for Venting Systems for Gas-Burning Appliances, Categories II, III, and IV.

J. UL 1777 - Chimney Liners.

K. ULC CAN-S635 - Standard for Lining Systems for Existing Masonry or Factory-Built Chimneys and Vents.

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1.04 DEFINITIONS

A. Breeching: Vent connector.

B. Vent: That portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.

C. Vent Connector: That part of a venting system that conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

1.05 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Product Data: Provide data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics and connection requirements.

C. Shop Drawings: Indicate general construction, dimensions, weights, support and layout of breechings. Submit layout drawings indicating plan view and elevations**<< where factory-built units are used; _____; or None - N/A>>**.

D. Manufacturer's Instructions: Include installation instructions, and indicate assembly, support details, and connection requirements.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum **<< three; or _____>>** years of**<< documented; _____; or None - N/A>>** experience.

B. Obtain listed system components through one source from a single manufacturer.

1.07 COORDINATION

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations including work specified in Division 07.

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of venting system that fail in material or workmanship within the warranty period. Failures include, but are not limited to, structural failure caused by expansion and contraction.

B. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 BREECHINGS, CHIMNEYS, AND STACKS - GENERAL REQUIREMENTS

A. Regulatory Requirements:

1. Comply with **<< applicable codes; NFPA 54; or _____>>** for installation of **<< natural gas; propane; or _____>>** burning appliances and equipment.
2. Comply with **<< applicable code; NFPA 31; or _____>>** for installation of oil burning appliances and equipment.
3. Factory-built vents and chimneys used for venting natural draft appliances to comply with **<<NFPA 211>>** and UL listed and labeled.

2.02 MANUFACTURED BREECHINGS

A. Manufacturers:

1. AMPCO**<< ; _____; or None - N/A>>**: www.ampcostacks.com/#sle.
2. Selkirk Corporation**<< ; _____; or None - N/A>>**: www.selkirkcommercial.com/#sle.

B. Provide factory-built, modular connector and manifold system, tested to **<<UL 103>>** with positive pressure rating.

C. Assembly to be UL listed for use with building equipment in accordance with **<<NFPA 211>>**.

D. Fabricate with **<< 1-inch; or ___-inch>>** minimum **<< body soluble fiber insulation; ceramic fiber insulation; air space; or _____>>** between walls, and construct inner liner of **<< 20-gauge, 0.0375-inch>><< 304 stainless steel; 316 stainless steel; or _____>>** and outer jacket of **<< 24-gauge, 0.0239-inch>><< 304 stainless steel; 316 stainless steel; aluminized steel; or _____>>**.

1. Protect aluminized steel surfaces exposed to elements with a minimum of one base coat of primer and one finish coat of corrosion-resistant paint suitable for outer jacket skin temperatures of application.

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E. Design, fabricate, and install gastight to prevent products of combustion from leaking into building.
   1. Securely connect inner joints, and seal with factory-supplied overlapping V-bands and appropriate sealant in accordance with manufacturer's instructions.
   2. Design system to compensate for all flue-gas-induced thermal expansion.

2.03 TYPE B DOUBLE WALL GAS VENTS

A. Manufacturers:
   1. Amerivent**<< ; _____; or None - N/A>>**: www.ameri-vent.com/#sle.
   2. Hart & Cooley, LLC**<< ; _____; or None - N/A>>**: www.hartandcooley.com/#sle.
   3. Selkirk Corporation**<< ; _____; or None - N/A>>**: www.selkirkcommercial.com/#sle.

B. Fabrication: Inner pipe of sheet aluminum, and outer pipe of galvanized sheet steel, tested in compliance with **<<UL 441>>**.

C. Electrically Actuated Vent Dampers: Same size as draft hood collar, constructed of stainless steel or galvanized steel, with corrosion-resistant components, in compliance with **<<ANSI Z21.66>>**.

2.04 SINGLE WALL METAL STACKS

A. Manufacturers:
   1. AMPCO**<< ; Model N; ; _____; or None - N/A>>**: www.ampcostacks.com/#sle.
   2. Selkirk Corporation**<< ; Model G; ; _____; or None - N/A>>**: www.selkirkcommercial.com/#sle.

B. Provide single-wall metal stacks, tested to **<<UL 1777>>** or **<<ULC CAN-S635>>** and UL listed with positive pressure rating for use with building heating equipment; comply with **<<NFPA 211>>**.

C. Fabricate with **<< 20-gauge, 0.0375-inch>><< 304 stainless steel; 316 stainless steel; or _____>>**.

D. Design, fabricate, and install gastight to prevent products of combustion from leaking into building.
   1. Securely connect inner joints, and seal with factory-supplied overlapping V-bands and appropriate sealant in accordance with manufacturer's instructions.
   2. Design system to compensate for flue-gas-induced thermal expansion.

E. Accessories, UL Labeled:
   1. Ventilated Roof Thimble: Consists of roof penetration, vent flashing with spacers, and storm collar.
   2. Rain/Stack Cap: Consists of conical rainshield with inverted cone for partial rain protection with low flow resistance.

2.05 DOUBLE WALL METAL STACKS

A. Manufacturers:
   1. AMPCO**<< ; _____; or None - N/A>>**: www.ampcostacks.com/#sle.
   2. Selkirk Corporation**<< ; _____; or None - N/A>>**: www.selkirkcommercial.com/#sle.

B. Provide double-wall metal stacks, tested to **<< UL 103; UL 127; UL 641; or _____>>** and UL listed with positive pressure rating for use with building heating equipment; comply with **<<NFPA 211>>**.

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C. Fabricate with **<< 1-inch; ___-inch; or _____>>** minimum **<< body soluble fiber insulation; ceramic fiber insulation; air space; or _____>>** between walls, and construct inner liner of **<< 20 gauge, 0.0375-inch>><< 304; 316; or _____>>** stainless steel, and outer jacket of **<< 24 gauge, 0.0239-inch>><< aluminized steel; 304 stainless steel; 316 stainless steel; or _____>>**.

1. Protect aluminized steel surfaces exposed to elements with minimum of one base coat of primer and one finish coat of corrosion-resistant paint suitable for outer jacket skin temperatures of application.

D. Design, fabricate, and install gastight to prevent products of combustion from leaking into building.

1. Securely connect inner joints, and seal with factory-supplied overlapping V-bands and appropriate sealant in accordance with manufacturer's instructions.
2. Design system to compensate for flue-gas-induced thermal expansion.

E. Accessories, UL Labeled:

1. Ventilated Roof Thimble: Consists of roof penetration, vent flashing with spacers, and storm collar.
2. Rain/Stack Cap: Consists of conical rainshield with inverted cone for partial rain protection with low flow resistance.

2.06 SPECIAL GAS VENTING (CATEGORY II, III, AND IV)

A. Application:

1. Category II Appliances: Non-positive pressure and condensing type.
2. Category IV Appliances: Positive pressure and condensing type.

B. Single-Wall Special Gas Venting:

1. Manufacturers:
   a. Heatfab Saf-T Vent**<< ; Model EZ Seal; ; _____; or None - N/A>>**: www.heatfab.com/#sle.
   b. Z-Flex U.S. Inc**<< ; _____; or None - N/A>>**: www.z-flex.com/#sle.
2. Provide single-wall metal stacks, tested to **<<UL 1738>>** and UL listed with positive pressure rating for use with building heating equipment; comply with **<<NFPA 54>>**.
3. Fabricate with **<< 28-gauge, 0.0156-inch>><< 29-4C stainless steel; 316 stainless steel; or _____>>** minimum.
4. Design, fabricate, and install gastight to prevent products of combustion from leaking into building. Securely connect inner joints and seal in accordance with manufacturer's instructions.
5. Accessories, UL Labeled:
   a. Ventilated Roof Thimble: Consists of roof penetration, vent flashing with spacers, and storm collar.
   b. Rain/Stack Cap: Consists of conical rainshield with inverted cone for partial rain protection with low flow resistance.

C. Listed Special Gas Venting, Double-Wall:

1. Manufacturers:
   a. Schebler Chimney Systems.
   b. Selkirk, Inc. - HeatFab
   c. Metal-Fab, Inc.

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d. Heatfab Saf-T Vent**<< ; Model CI Plus; ; _____; or None - N/A>>**: www.heatfab.com/#sle.

e. Z-Flex U.S. Inc**<< ; _____; or None - N/A>>**: www.z-flex.com/#sle.

2. Provide double-wall metal stacks, tested to **<<UL 1738>>** and UL listed with positive pressure rating for use with building heating equipment; comply with **<<NFPA 54>>**.

3. Fabricate with **<< 1-inch; or ___-inch>>** minimum **<< air space; fiber insulation; ceramic fiber insulation; or _____>>** between walls and construct inner liner of **<< 28-gauge, 0.015-inch>><< 29-4C stainless steel; 316 stainless steel; or _____>>** minimum and outer jacket of **<< 24 gauge, 0.025-inch>><< stainless steel; aluminized steel; or _____>>** minimum.

   a. Protect aluminized steel surfaces exposed to elements with minimum of one base coat of primer and one finish coat of corrosion-resistant paint suitable for outer jacket skin temperatures of application.

4. Design, fabricate, and install gastight to prevent products of combustion from leaking into building. Securely connect inner joints and seal in accordance with manufacturer's instructions.

5. Accessories, UL Labeled:

   a. Ventilated Roof Thimble: Consists of roof penetration, vent flashing with spacers, and storm collar.

   b. Rain/Stack Cap: Consists of conical rainshield with inverted cone for partial rain protection with low flow resistance.

   c. Fittings, draft-hood connectors, terminations, adjustable roof flashings and counterflashing, storm collars, support assemblies, guides, expansion joints or bellows, guying, bracing, firestop spacers, anchors, and fasteners; listed for the assembly.

2.07 GUYING AND BRACING MATERIALS

A. Provide galvanized steel cable and guying tensioners, galvanized steel pipe, and/or galvanized steel angle to provide guying and bracing where chimneys or vents have a termination height above the roof that requires lateral guying or bracing above the roof as determined by the manufacturer of the chimney or vent.

2.08 DRAIN MATERIAL

A. Piping: ASTM A 53, Schedule 40 galvanized steel pipe, minimum NPS 1.5 (DN 40) with galvanized malleable iron threaded fittings, ASME B16.3, Class 150.

B. Drain Valve: Ball valve, Class 150 SWP, bronze, two-piece body, full port, TFE seats and seals, stainless steel ball and stem, threaded ends.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with **<< NFPA 54; NFPA 31; or _____ .>>**

C. Install breechings with minimum of joints. Align accurately at connections, with internal surfaces smooth.

D. Rigidly support breechings from building structure with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and

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stacks at **<< 12-foot>>** spacing, to adjacent structural surfaces, or at floor penetrations. Refer to **<<SMACNA (DCS)>>** for equivalent duct support configuration and size.

E. Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack.

F. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified**<< in Section 078400; in Section _____; _____; or None - N/A>>**.

G. For Type B, double-wall gas vents, maintain UL-listed minimum clearances from combustibles. Assemble pipe and accessories as required for complete installation.

H. Assemble and install stack sections in accordance with **<<NFPA 82>>**, UL Listings, and industry practices. Join sections with acid-resistant joint cement. Connect base section to foundation using anchor lugs.

I. Level and plumb chimney and stacks.

3.02 LISTED SPECIAL GAS VENT INSTALLATION

A. Slope vent down in direction of appliance.

B. Seal between sections according to manufacturer's written installation instructions using factory-supplied sealants and V-bands. Perforated V-bands not permitted.

C. Make 90-degree changes in direction with

D. Clean breechings, chimneys, and stacks during installation, removing dust and debris.

E. At appliances, provide slip joints permitting removal of appliances without removal or dismantling of breechings, breeching insulation, chimneys, or stacks.

END OF SECTION 235100

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SECTION 235213
ELECTRIC BOILERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Boiler.

B. Boiler controls.

C. Indoor/outdoor reset controller.

D. Water connections.

E. Electrical hook-up.

1.02 REFERENCE STANDARDS

A. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers.

B. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels.

C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.03 SUBMITTALS

A. Product Data: Provide literature indicating general assembly components, controls, safety controls, wiring diagrams with electrical characteristics and connection requirements, and service connections.

B. Shop Drawings: Indicate assembly, weights, heater configuration, and electrical characteristics and connection requirements.

C. Manufacturer's Instructions: Indicate rigging, installation, and start-up procedures.

D. Manufacturer's Field Reports: Indicate conditions observed after start-up, including control settings.

E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in **<<Owner>>**'s name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum **<< three; or _____>>** years of**<< documented; _____; or None - N/A>>** experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect units before, during, and after installation from damage to casing by leaving factory shipping packaging in place until immediately prior to final acceptance.

1.06 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Provide **<< five; or ____>>** year warranty to include coverage for boiler package.

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PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ACME Engineering Products Ltd.

B. Bradford White Corporation.

C. Bryan Steam Corporation.

D. INDEECO.

E. PVI Industries, Inc.

F. Substitutions: **<< See Section 016000 - Product Requirements; or Not Permitted>>**.

2.02 REGULATORY REQUIREMENTS

A. Comply with **<< applicable codes; NFPA 70; or _____>>** for internal wiring of factory wired equipment.

B. Comply with **<<ASME BPVC-IV>>** and **<<ASME BPVC-VIII-1>>** for boiler construction.

C. Units: **<<UL (DIR)>>** listed and labeled**<< per UL 834; _____; or None - N/A>>**.

D. Products Requiring Electrical Connection: Listed and classified by **<< UL (DIR); testing firm acceptable to authorities having jurisdiction; or _____>>** as suitable for the purpose specified and indicated.

2.03 PERFORMANCE REQUIREMENTS

A. Performance rating in accordance with **<<AHRI 1500 (I-P)>>**.

2.04 MANUFACTURED UNITS

A. Description: Electric **<< hot water; steam; or ____>>** boiler completely packaged, factory assembled, ready for operation except for connections of piping and electrical connections.

2.05 FABRICATION

A. Assembly: **<< Welded steel; Cast iron; or _____>>** shell; heater support nipples or flanges; inspection handhole; necessary fittings to accept gauges, safety and operating controls; threaded or flanged inlet and outlet connections; inlet diffuser; and lifting lugs, complying with **<<ASME BPVC-IV>><< and ASME BPVC-VIII-1; _____; or None - N/A>>** requirements, and tested for maximum working pressure of **<< 160 psig>>**.

B. Heating Elements: Threaded or flanged, **<< incoloy; copper; stainless steel; or _____>>** sheathed, with maximum density of **<< 75 W/sq in>>**, suitable for operation at **<< 160 psig>>**. Attach each element to tube sheet by mechanical assembly permitting single elements to be replaced without replacing entire tube bundle.

C. Enclose in**<< galvanized; _____; or None - N/A>>** steel jacket with factory applied baked enamel, insulated with **<< 2 inch; 3 inch; or __ inch>>** thick fiberglass insulation.

2.06 TRIM

A. ASME rated pressure relief valve.

B. Assemble with pressure gauge, thermometer in brass separable well, automatic air vent, and drain valve.

C. Low water cut-off with manual reset**<< and inlet flow switch; _____; or None - N/A>>** to automatically prevent operation when water falls below safe level**<< or on low flow through boiler; _____; or None - N/A>>**.

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D. Operating temperature controller**<< with outdoor reset; _____; or None - N/A>>** with remote bulb in brass separable well to control heating elements to maintain supply water temperature.

E. Electronic operating temperature controller with full cover for wall mounting, ambient temperature range **<< minus 30 to 150 degrees F>>**, adjustable reset ration of outside air temperature change to discharge control point change 1:2 to 100:1, integral setpoint adjustment **<< 80 to 230 degrees F>>**, electronic primary and outdoor sensors, for on-off switching of pilot duty relays.

F. High limit temperature controller with **<< automatic; manual; or _____>>** reset to prevent boiler water temperature from exceeding safe system temperature.

2.07 CONTROLS

A. Provide pre-wired, factory assembled electric controls enclosed in **<<NEMA EN 10250>>**, Type 1 cabinet, factory mounted integral with unit.

B. Controls:
   1. Unfused disconnect switch with door interlock.
   2. Splitter arrangement and fused magnetic contactors for each element.
   3. Fused control circuit transformer with control circuit on/off switch.
   4. Proportioning step controller.
   5. Remote bulb operating thermostat complete with brass separable well.
   6. Remote bulb high limit thermostat complete with brass separable well.
   7. Pilot lights for each step of control.
   8. Terminals for connection of: **<< _____>>**.

C. Peak load control system.
   1. Pump motor starter auxiliary contact.
   2. Flow switch.
   3. Remote mounted three wire temperature controller.

D. BAS, SCADA, or other Integrated Automation Link: **<< ASHRAE Std 135 BACnet IP; ASHRAE Std 135 BACnet MS/TP; ASHRAE Std 135 BACnet SC; Modbus (PS) Modbus IP; Modbus (PS) Modbus RTU; LonMark Interoperability Guide LonWorks; Bluetooth CS Bluetooth wireless; IEEE 802.11 Wi-Fi; IEEE 802.15.4 Zig-bee wireless; or _____>>**.
   1. External Point Mapping: Provide mapping table for each parameter included in the local visual interface with software-toggle flag to allow reduced mapping of available points.
   2. Remotely coordinated by boiler plant demand optimization controller; see Section **<< 251400>>**.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install boiler on concrete housekeeping base, sized minimum **<< 4 inches>>** larger than boiler base; see Section **<< 033000>>**.

C. Provide piping connections and accessories as indicated; see Section **<< 232114>>**.

D. Provide piping connections and accessories as indicated; see Section **<< 232214>>**.

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E. Pipe relief valves to nearest floor drain.

F. Provide for connection to electrical service; see Section **<< 260583>>**.

G. Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s) and remote **<< front-end interface; see Section 251500; software app or terminal; see Section 253500; or _____>>**.

3.02 SYSTEM STARTUP

A. Provide the services of manufacturer's field representative for starting and testing unit.

3.03 CLOSEOUT ACTIVITIES

A. See Section **<< 017800 - Closeout Submittals>>** for closeout submittals.

B. See Section **<< 017900 - Demonstration and Training>>** for additional requirements.

C. Train operating personnel in operation and maintenance of units.

D. Provide the services of manufacturer's field representative to conduct training.

3.04 MAINTENANCE

A. See Section **<< 017000 - Execution and Closeout Requirements>>** for additional requirements.

B. Provide a separate maintenance contract for specified maintenance service.

C. Provide service and maintenance of boilers for **<< one; or __>>** year from Date of Substantial Completion.

END OF SECTION 235213

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SECTION 235216
CONDENSING BOILERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured units.

B. Boiler construction.

C. Boiler trim.

D. Fuel burning system.

E. Factory installed controls.

1.02 RELATED REQUIREMENTS

A. Section **<< 033000 - Cast-in-Place Concrete>>**.

B. Section **<< 230913 - Instrumentation and Control Devices for HVAC>>**.

C. Section **<< 232123 - Hydronic Pumps>>**.

D. Section **<< 235100 - Breechings, Chimneys, and Stacks>>**.

E. Section **<< 251500 - Integrated Automation Software>>**.

1.03 REFERENCE STANDARDS

A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI).

B. ANSI Z21.13 - American National Standard for Gas-Fired Low-Pressure Steam and Hot Water Boilers.

C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings.

D. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks.

E. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers.

F. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI).

G. NFPA 54 - National Fuel Gas Code.

H. SCAQMD 1146.1 - Emissions of Oxides of Nitrogen from Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters.

1.04 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittals procedures.

B. Product Data: Provide data indicating general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements, and service connections.

C. Manufacturer's Installation Instructions: Indicate assembly, support details, connection requirements, and include start up instructions.

D. Manufacturer's Factory Inspection Report: Submit boiler inspection prior to shipment.

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E. Manufacturer's Field Reports: Burner manifold gas pressure, percent carbon monoxide (CO), percent oxygen (O), percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output.

F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

G. Warranty: Submit manufacturer warranty and ensure forms have been completed in **<<Owner>>**'s name and registered with manufacturer.

H. Certifications:
   1. Mayland State Boiler Inspection Certificate.
   2. CSD-1, CG-500, and DLLR Notice of Installation forms.
      a. Obtain and complete all forms. Samples of select forms are included at the end of this section.
      b. Leave a copy of each form with each boiler provided under this Section.

I. Service agreement specfied in Maintenance Service below, executed to the Owner and notarized.

J. Preventative Maintenance During Warranty: Listing of seasonal maintenance requirements to be performed during the warranty period.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum **<< three; or _____>>** years of**<< documented; _____; or None - N/A>>** experience.

B. Test condensing boilers to comply with UL 795 "Commercial-Industrial Gas Heating Equipment."

C. ASHRAE 90.1 Compliance: Condensing boilers shall have minimum efficiency required in Table 10-8.

1.06 REGULATORY REQUIREMENTS

A. Before construction begins, obtain and complete forms, and apply for the permit and registration of the burners and boilers with the Authority Having Jurisdiction.

B. Components and installation, including sequences of operation, shall comply with the applicable requirements of ASME CSD-1, Controls and Safety Devices for Automatically Fired Boilers.

C. Costs of complying with these and other applicable regulatory requirements shall be included in the Contract sum.

1.07 MAINTENANCE SERVICE

A. In addition to the startup service specified in Section 230100, the qualified service and maintenance organization shall provide a 5-year service agreement covering all parts and labor for regular service, emergencies, and repairs.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Protect boilers from damage by leaving factory inspection openings and shipping packaging in place until final installation.

1.09 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

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B. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of condensing boilers that fail in materials or workmanship within specified warranty period.

C. Warranty Period:
   1. Boiler: Two years from date of Substantial Completion.
   2. Pressure Vessel / Heat Exchanger: Ten years from date of Substantial Completion for corrosion, thermal stress failure, material defects, or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Natural Gas, Propane, or Combination Natural Gas/Propane for Indoor Applications:
   1. Advanced Thermal Hydronics - Hydrotherm.
   2. Fulton Heating Solutions.
   3. Harsco / Patterson-Kelley.
   4. Riello.
   5. Viessmann.

2.02 MANUFACTURED UNITS

A. Factory assembled, factory fire-tested, self-contained, readily transported unit ready for automatic operation except for connection of water, fuel, electrical, and vent services.

B. Unit: Metal membrane wall, water or fire tube, condensing boiler on integral structural steel frame base with integral fuel burning system, firing controls, boiler trim, insulation, and removable jacket, suitable for **<< indoor; outdoor; or _____>>** application.

2.03 BOILER CONSTRUCTION

A. Comply with the minimum requirements of **<< ASME BPVC-IV; ANSI Z21.13; and _____>>** for construction of boilers.

B. Assembly to bear the ASME "H" stamp and comply with the efficiency requirements of the latest edition of **<<ASHRAE Std 90.1 I-P>>**.

C. Required Directory Listings:
   1. **<<AHRI Directory of Certified Product Performance>>** - Air-Conditioning, Heating, and Refrigeration Institute (AHRI)**<<>>**.
   2. **<<NBBI Manufacturer and Repair Directory>>** - The National Board of Boiler and Pressure Vessel Inspectors (NBBI)**<<>>**.

D. Heat Exchanger: Construct with materials that are impervious to corrosion where subject to contact with corrosive condensables.

E. Provide adequate tappings, observation ports, removable panels, and access doors for entry, cleaning, and inspection.

F. Insulate casing with insulation material, protected and covered by heavy-gauge metal jacket.

G. Factory apply boiler base and other components, that are subject to corrosion, with durable, **<< acrylic; powder coated; painted; weather-proofed; or _____>>** finish.

2.04 BOILER TRIM

A. ASME rated pressure relief valve.

B. Flow switch.

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C. Electronic Low Water Cut-off: Complete with test light and manual reset button to automatically prevent firing operation whenever boiler water falls below safe level.

D. Temperature and pressure gauge.

E. Pressure Switches:
   1. High gas pressure.
   2. Low gas pressure.
   3. Air pressure.

F. Manual reset high limit.

G. Boiler Pump (where required by boiler design):
   1. Primary pump, factory supplied and sized for field installation to ensure minimum, continuous circulation through boiler.
   2. Where pump is not provided by boiler manufacturer, provide pump in accordance with boiler manufacturer's recommendations.
   3. Pump time delay.

2.05 FUEL BURNING SYSTEM

A. Provide **<< forced draft automatic burner; pulse combustion; or _____>>**, integral to boiler, designed to burn **<< natural gas; propane; No. 2 fuel oil; and _____>>**, and maintain fuel-air ratios automatically.
   1. Blower Design: Statically and dynamically balanced to supply combustion air; direct connected to motor.
   2. Forced Draft Design: Mixes combustion air and gas to achieve **<< 90; or ___>>** percent combustion efficiency.
   3. Pulse Combustion Design: Self-aspirating, not requiring blower for combustion.
   4. Combustion Air Filter: Protects fuel burning system from debris.

B. Gas Train: Plug valve, safety gas valve, gas-air ratio control valve, and pressure regulator controls air and gas mixture.

C. Emission of Oxides of Nitrogen Requirements: Comply with **<< SCAQMD 1146.1; SCAQMD 1146.2; and _____>>** for natural gas fired system, as applicable.

D. Intakes: Combustion air intake capable of accepting free mechanical room air or direct outside air through a sealed intake pipe.

2.06 FACTORY INSTALLED CONTROLS

A. Option for internal or external (0-10) VDC control.

B. Temperature Controls:
   1. Automatic reset type to control fuel burning system **<< on-off; firing rate; and _____>>** to maintain temperature.
   2. Manual reset type to control fuel burning system to prevent boiler water temperature from exceeding safe system water temperature.
   3. Low-fire start time delay relay.

C. Electronic PI setpoint/modulation control system.

D. Microprocessor-based, fuel/air mixing controls.

E. BAS, SCADA, or other Integrated Automation Link: **<< ASHRAE Std 135 BACnet IP; ASHRAE Std 135 BACnet MS/TP; ASHRAE Std 135 BACnet SC; Modbus (PS) Modbus IP; Modbus (PS) Modbus RTU; LonMark Interoperability Guide LonWorks; Bluetooth**

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CS Bluetooth wireless; IEEE 802.11 Wi-Fi; IEEE 802.15.4 Zig-bee wireless; or _____>>.

1. External Point Mapping: Provide mapping table for each parameter included in the local visual interface with software-toggle flag to allow reduced mapping of available points.
2. BAS shall monitor and control hot water supply temperature setpoint and display boiler status and alarms.

2.07 COMBUSTION AIR INTAKE

A. Schedule 40 PVC. Piping, fittings, and solvent cement shall conform to ANSI and ASTM standards

2.08 ACCESSORIES

A. Device plate for emergency boiler switch. As specified in Section 230500, engraved plastic, red letters on white background, reading "EMERGENCY BOILER DISCONNECT."

B. PH Neutralization Kit: Polyethylene container, six 1-pound bags of magnesium oxide neutralizing medium, 1.5 inch NPT plastic pipe fittings.

C. Provide boiler disconnect switch at each boiler.

2.09 SOURCE QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

B. Provide factory tests to check construction, controls, and operation of unit.

C. Manufacturer to conduct boiler inspection prior to shipment; submit copy of inspection report to **<<Architect>>**.

D. Non-Complying Work: See Section **<< 014000>>**.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install boiler and provide connection of natural gas service in accordance with requirements of **<<NFPA 54>>** and applicable codes.

C. Install boiler on concrete housekeeping base, sized minimum of **<< 4 inches>>** larger than boiler base in accordance with Section **<< 033000>>**.

D. Coordinate factory installed controls with Section **<< 230913>>**.

E. Pipe relief valves to nearest floor drain.

F. Pipe cooled condensate produced by the combustion process from the boiler condensate connection and/or flue stack with suitable piping material to neutralizer prior to discharging into nearest floor drain.

G. Install primary boiler pump in accordance with Section **<< 232123>>**.

H. Connect vent combustion generated fumes to breeching, chimney or exhaust stack; see Section **<< 235100>>**.

I. Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s) and remote **<< front-end interface; see Section 251500; software app or terminal; see Section 253500; or _____>>**.

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3.02 CLOSEOUT ACTIVITIES

A. See Section **<< 017800 - Closeout Submittals>>** for closeout submittals.

B. See Section **<< 017900 - Demonstration and Training>>** for additional requirements.

C. Training: Train **<<Owner>>**'s personnel on operation and maintenance of system.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of **<< two hours; one day; or _____>>** of training.
3. Instructor: Manufacturer's training personnel.

3.03 EXAMPLE FORMS

A. Samples of CG-500 and DLLR forms follow Section.

END OF SECTION 235216

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SECTION 235700
HEAT EXCHANGERS FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shell and tube type heat exchangers.

B. Plate type heat exchangers.

1.02 RELATED REQUIREMENTS

A. Section **<< 232114 - Hydronic Specialties>>**.

1.03 REFERENCE STANDARDS

A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels.

1.04 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Product Data: Provide data with dimensions, locations, and size of tappings and performance data.

C. Shop Drawings: Indicate dimensions, locations, and size of tappings and performance data.

1. Design Data: Indicate in sufficient detail to verify that heat exchangers meet or exceed specified requirements.

D. Certificates: Certify that **<< Products; or _____>>** meet or exceed **<< specified requirements; or _____>>**.

E. Manufacturer's Instructions: Indicate installation and support requirements.

F. Operation and Maintenance Data: Include start up and shut down instructions, assembly drawings, and spare parts lists.

G. Warranty: Submit manufacturer's warranty and ensure forms have been completed in **<<Owner>>**'s name and registered with manufacturer.

H. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.

1. See Section **<< 016000 - Product Requirements>>** for additional provisions.
2. Extra Gaskets: **<< One set; Two sets; or _____>>** of each type and size.
3. Plate Type Heat Exchanger Tools: **<< One set; or _____ sets>>** of wrenches for disassembly.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect internals from entry of foreign material by temporary caps on flanged openings.

1.06 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Provide **<< five; or _____>>** year manufacturer warranty for **<< _____>>**.

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PART 2 PRODUCTS

2.01 PLATE AND FRAME TYPE HEAT EXCHANGER

A. Manufacturers:
   1. Alfa Laval**<< ; _____; or None - N/A>>**: www.alfalaval.com/#sle.
   2. Armstrong Pumps Inc**<< ; _____; or None - N/A>>**: www.armstrongpumps.com/#sle.
   3. Bradford White Corporation**<< ; _____; or None - N/A>>**: www.bradfordwhite.com/#sle.
   4. ITT Standard**<< ; _____; or None - N/A>>**: www.ittstandard.com/#sle.

B. Comply with **<<ASME BPVC-VIII-1>>** for manufacture of **<< plate and frame type heat exchangers; and _____>>**.

C. Plates: **<< Stainless steel Type 304; Stainless steel Type 316; Titanium; Incoloy; Hastelloy; or _____>>**.

D. Gaskets: **<< Nitrile rubber; Ethylene propylene diene monomer (EPDM); Viton; Neoprene; Hypalon; Resin-cured butyl rubber; Silicone; or _____>>**.

E. Nozzles: **<< 125 psi; 150 psi; 300 psi; or ___ psi>>** rated lined flange type.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install to permit removal of **<< tube bundle; plates; or ____>>** with minimum disturbance to installed equipment and piping.

C. Support heat exchangers **<< from structure; on concrete housekeeping pad; or _____>>**.

D. Pitch shell to completely drain condensate.

E. Pipe relief valves to nearest floor drain.

F. Pipe drain valves to nearest floor drain.

3.02 WATER TO WATER HEAT EXCHANGER TRIM

A. Water Inlets and Outlets: Thermometer wells, pressure gauge tappings.

B. Heated Water Outlet: Thermometer well for temperature regulator sensor, ASME rated pressure and temperature relief valve, valved drain; see Section **<< 232114>>**.

END OF SECTION 235700

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SECTION 236416
CENTRIFUGAL WATER CHILLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Centrifugal water chiller.

1.02 RELATED REQUIREMENTS

A. Section **<< 230513 - Common Motor Requirements for HVAC Equipment>>**.

B. Section **<< 230593 - Testing, Adjusting, and Balancing for HVAC>>**.

C. Section **<< 251500 - Integrated Automation Software>>**.

D. Section **<< 260583 - Wiring Connections>>**.

E. Section **<< 284400 - Refrigerant Detection and Alarm>>**.

1.03 REFERENCE STANDARDS

A. AHRI 550/590 (I-P) - Standard for Performance Rating of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle.

B. ASHRAE Std 15 - Safety Standard for Refrigeration Systems.

C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings.

D. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks.

E. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels.

F. UL 508 - Industrial Control Equipment.

G. UL 1995 - Heating and Cooling Equipment.

1.04 SUBMITTALS

A. Product Data: Provide rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.

B. Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.

C. Manufacturer's Certificate: Certify that components of package not furnished by manufacturer have been selected in accordance with manufacturer's requirements.

D. Test Reports: Indicate energy input versus cooling load output from 0 to 100 percent of full load**<< at specified and minimum condenser water temperature;**
_____; or None - N/A>>.

E. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.

F. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.

G. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories. Include trouble- shooting guide.

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H. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in **<<Owner>>**'s name and registered with manufacturer.

I. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.

1. See Section **<< 016000 - Product Requirements>>** for additional provisions.
2. Extra Refrigerant: **<< One container; Two containers; or ____>>**.
3. Extra Lubricating Oil: **<< One container; Two containers; or ____>>**.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum **<< three; or _____>>** years**<< documented; _____; or None - N/A>>** experience.

B. Provide certification of inspection in compliance with the requirements of **<< Authority Having Jurisdiction; or _____>>**.

C. Products Requiring Electrical Connection: Listed and classified by **<< Underwriters Laboratories Inc.; testing firm acceptable to the Authority Having Jurisdiction; or _____>>** as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

1.07 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Provide a **<< two; five; or ____>>** year warranty to include coverage for **<< compressor; compressor motor; evaporator; condenser; complete chiller package as manufactured and delivered to site; and _____>>** including **<< materials only; labor only; materials and labor; or _____>>**.

C. Variable Frequency Drives of Variable Speed Drives: Provide manufacturer warranty for period of twelve months from date of installation or eighteen months from date of shipment whichever comes first. Warranty to include parts, labor, travel costs, and living expenses incurred by manufacturer to provide factory-authorized on-site services.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Carrier Corporation**<< ; _____; or None - N/A>>**: www.carrier.com/#sle.

B. Trane Technologies, PLC**<< ; _____; or None - N/A>>**: www.trane.com/#sle.

C. York, a brand of Johnson Controls International, PLC**<< ; _____; or None - N/A>>**: www.york.com/#sle.

D. Substitutions: **<< See Section 016000 - Product Requirements; or Not Permitted>>**.

1. The chilled water system has been designed based on specific capacities and characteristics of equipment specified in this section and other sections.
2. When substitution of a different manufacturer or model number is desired, submit sufficient information to demonstrate to **<<Architect>>** that the substitute will have the same or better performance as that specified AND that the related equipment in the system will perform acceptably with the substitute.

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3. If the related equipment must be modified to perform acceptably with the substitute, the entity proposing the substitution is responsible for all additional costs due to re-design and provision of different related equipment.

2.02 CENTRIFUGAL WATER CHILLER CONSTRUCTION REQUIREMENTS

A. Factory assembled and tested, packaged, water cooled chillers consisting of centrifugal compressors, compressor motor, condenser, evaporator, refrigeration accessories, instrument and control panel including gauges and indicating lights, auxiliary components and accessories, and motor starters.
   1. Rating: Comply with **<<AHRI 550/590 (I-P)>>**.
   2. Safety: Comply with **<<UL 1995>>**.
   3. Comply with **<<ASME BPVC-VIII-1>>** for construction and testing of centrifugal chillers.
   4. Comply with **<<ASHRAE Std 15>>** for safe construction and operation of centrifugal chillers.

B. Energy Efficiency: **<< ASHRAE Std 90.1; Federal Energy Management Program; or _____>>**.
   1. kW/Ton of Refrigeration: Equal or lower than **<< _____>>** at full load and **<< _____>>** at integrated part load value.
   2. Energy Efficiency Ratio: Equal or higher than **<< _____>>** at full load and **<< _____>>** at integrated part load value.

C. Evaporator Side:
   1. Provide evaporator of shell and tube type, seamless or welded steel construction with cast iron or fabricated steel heads, seamless copper tubes or red brass tubes with integral fins, rolled or silver brazed into tube sheets. Position intermediate tube support sheets along length of shell to avoid contact and relative motion between adjacent tubes.
   2. Test and, where applicable, stamp refrigerant side for **<< 45 psi; 185 psi; 180 psi; _____ psi; or _____>>** working pressure and water side for **<< 150 psi; 300 psi; _____ psi; 1.5 times; or _____>>** working pressure, in accordance with **<<ASME BPVC-VIII-1>>**.
   3. Provide marine type water boxes, machine welded to heat exchanger with tapped drain and vent connections, and flanged or mechanical joint connections arranged to permit inspection of tubes from either end without disturbing refrigerant and removable without disturbing water piping.
   4. Insulate evaporator and cold surfaces with **<< 0.75 inch; _____ inch; or _____>>** minimum thick flexible**<< expanded polyvinyl chloride; _____; or None - N/A>>** insulation with maximum K factor of **<< 0.28.; 0.26.; or ___ .>>**
   5. Provide thermometer wells or thermistors for temperature controller and low temperature cutout.
   6. Design and construct evaporator to prevent liquid refrigerant from entering the compressor.
   7. Provide carbon rupture disc or relief valve on shell in accordance with **<<ASHRAE Std 15>>**.
   8. Construction and materials to comply with **<<ASME BPVC-VIII-1>>** or **<<ASHRAE Std 15>>** as applicable to chiller manufacturer and chiller model.

D. Condenser Side:
   1. Provide condensers of shell and tube type, seamless or welded steel construction with cast iron or fabricated steel heads, seamless copper tubes or red brass tubes with integral fins, rolled or silver brazed into tube sheets. Position intermediate tube support sheets

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along shell length to avoid contact and relative motion between adjacent tubes.**<< Provide additional condensers on heat recovery units.; _____ .; or None - N/A>>**

2. Test and, where applicable, stamp refrigerant side for **<< 45 psi; 185 psi; 180 psi; _____ psi; or _____>>** working pressure and water side for **<< 150 psi; 300 psi; _____ psi; 1.5 times; or _____>>** working pressure, in accordance with **<<ASME BPVC-VIII-1>>**.
3. Provide marine type water boxes, machine welded to heat exchanger with tapped drain and vent connections, and flanged or mechanical joint connections arranged to permit inspection of tubes from either end without disturbing refrigerant and removable without disturbing water piping.
4. Provide carbon rupture disc or relief valve on shell in accordance with **<<ASHRAE Std 15>>**.
5. Provide baffles to ensure even distribution of incoming gas and to concentrate noncondensible gases.
6. Construction and materials to comply with **<<ASME BPVC-VIII-1>>**.

E. Purge System:
1. Provide purge system on positive pressure units, incorporating a low temperature refrigeration system to automatically remove noncondensibles, water and air.
2. Limit system discharge to maximum of **<< 0.60 pound>>** of refrigerant per **<< pound>>** of air discharged.

F. Centrifugal Compressor:
1. Compressor Casing: Cast iron, horizontally or vertically split with machined passages and leak tested to **<< 45 psi; 185 psi; or _____ psi>>**. Provide refrigerant sight glass.
2. Impellers: Single or multi-stage, in-line design, fully shrouded, statically and dynamically balanced, tested to 20 percent over operating speed, mounted on heat treated forged or rolled steel shaft, nonferrous, labyrinth seals between stages.
3. Guide Vanes: Modulating radial blade dampers, on each stage, with externally mounted **<< electric; or _____>>** operator, suitable for capacity reduction to 10 percent of specified load without hot gas bypass when supplied with design entering water quantity and temperature.
4. Bearings: Steel or aluminum journal bearings, pressure lubricated.
5. Gear Box: Double helical design, symmetrical and center supported by spherically seated, self-aligning bearing, arranged for inspection without disassembly.
   a. Provide speed increasing transmissions for variable speed chillers to not exceed 10,000 rpm compressor speed.
6. Motor: Hermetically sealed, single speed, low slip induction type; see Section **<< 230513>>**.
7. Lubrication: Oil pump, with oil cooler, pressure regulator, oil filters, thermostatically controlled oil heater, and motor controls. Interlock to start before chiller motor and run after motor is shut down. Provide sight glass or electronic sensors for monitoring oil level.
8. Refrigerant: **<< Factory precharge unit with refrigerant specified above; Site-charge unit with refrigerant specified above; or _____>>**.

G. Electrical Starters and Drives, **<< Low Voltage (208 to 600 VAC); Medium Voltage (2,300 to 6,600 VAC); Medium Voltage (10,000 to 13,800 VAC); or _____>>**:
1. **<< Air-Cooled; Water-Cooled; or _____>>**, **<< Unit-Mounted; Remote-Mounted Free-Standing; Remote-Mounted Wall-Cabinet; or _____>>** Variable Frequency Drive (VFD):

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a. Specifically design VFD to interface with the centrifugal water chiller controls and allow for the operating ranges and specific characteristics of the chiller. VFD-control logic is to optimize chiller efficiency by coordinating compressor motor speed and compressor inlet guide vane position to maintain the chilled water setpoint while avoiding surge. If surge is detected, VFD is to move away from and avoid surge at similar conditions in the future.
b. Efficiency: 97 percent or better at full speed and full load.
c. Fundamental Displacement Power Factor: Minimum of 0.97.
d. Provide voltage and current regulated, solid state, microprocessor-based pulse-width modulated (PWM). Output power devices to be IGBT transistors.
e. Provide liquid- or air-cooled heatsink to cool power semiconductor and capacitor.
f. House VFD in NEMA Type 1 metal enclosure having a minimum short circuit withstand rating of 65,000 amps per **<<UL 508>>**. Include three phase input lugs plus a grounding lug for electrical connections, output motor connection via factory installed bus bars and components properly segregated and completely enclosed in a single metal enclosure.
    1) Enclosure to include padlockable, door-mounted circuit breaker with minimum AIC rating of 65,000 amps.
    2) Entire chiller package to be listed by **<< Underwriter's Laboratories Inc; testing firm acceptable to the Authority Having Jurisdiction; or _____>>**.
g. Test VFD according to **<<UL 508>>** and listed by a National Recognized Testing Laboratory (NRTL) as designated by OSHA.
h. Comply with recommendations for harmonic mitigation.
    1) Include a DC link reactor on positive and negative rails to minimize power line harmonics and protect the VFD from power line transients.
i. Line Frequency: 38 to 60 Hertz with plus or minus 10 percent tolerance.
j. VFD is to include the following features:
    1) Control circuit voltages physically and electrically isolated from power circuit voltage.
    2) 150 percent instantaneous torque available for improved surge control.
    3) Soft start, adjustable linear acceleration, coast-to-stop.
    4) Adjustable current limiting and UL-approved electronic motor overload protection.
    5) Insensitivity to incoming power phase sequence.
    6) VFD and motor protection from the following faults:
        (a) Output line-to-line short circuit.
        (b) Line-to-ground short circuit.
        (c) Phase loss at AFD input.
        (d) Phase reversal/imbalance.
        (e) Over-voltage.
        (f) Under-voltage.
        (g) Over-temperature.
k. VFD Status Indicators:
    1) Output speed in hertz and rpm.
    2) Input line voltage.
    3) Input line kW.

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4) Output/load amps.
5) Average current in percent RLA.
6) Load power factor.
7) Fault.
8) VFD transistor temperature.

l. Service Conditions:
1) Operating Ambient Temperature: **<< 14 to 104 degrees F>>**.
2) Room Ambient Relative Humidity: Up to 95 percent.
3) Elevation: Up to **<< 3,300 feet>>**. For every **<< 3,300 feet>>** above **<< 3,300 feet>>**, decrease the rated output current by 4 percent up to **<< 9,900 feet>>**.

H. Controls Package:
1. Unit Controls: **<< Factory-installed DDC; see Section 251400; Factory-supplied DDC; or _____>>**:
a. Control-panel mounted with required input-output expansions, power supply, fused disconnect, hand switches, knobs, and accessories required to control chiller unit to manufacturer required sequences to meet intended use with listed performance.
b. Factory configured to interface prewired sensors, switches, and safeties with allowance to add up to four chiller valves and flow sensors.
c. Graphic-based touchscreen to include unit operation controls and user filter based interface for faults, alarms, performance, unit diagnostics, and data recording up to 12 months.
d. BAS, SCADA, or other Integrated Automation Link: **<< ASHRAE Std 135 BACnet IP; ASHRAE Std 135 BACnet MS/TP; ASHRAE Std 135 BACnet SC; Modbus (PS) Modbus IP; Modbus (PS) Modbus RTU; LonMark Interoperability Guide LonWorks; Bluetooth CS Bluetooth wireless; IEEE 802.11 Wi-Fi; IEEE 802.15.4 Zig-bee wireless; or _____>>**.
e. External Point Mapping: Provide mapping table for each parameter included in the local visual interface with software-toggle flag to allow reduced mapping of available points.
f. Isolation Valves: Field-installed, **<< 2-position; modulating; position-adjusted; or _____ >>**, butterfly type**<< with position tracking; with open-closed status; _____; or None - N/A>>**; **<< manufacturer provided; see Section 253519; or _____>>**.
2. Disconnect Switch: Factory mount disconnect switch **<< in starter control panel.; on equipment under provisions of Section 262717.; or _____ .>>**
3. On or near chiller, provide microprocessor based control panel containing solid state, fully automatic operating and safety controls.
4. Provide the following manufacturer's standard safety controls, including the following minimum functions, so that operating any one will shut down machine and require manual reset:
a. Low evaporator refrigerant temperature.
b. High condenser refrigerant pressure.
c. Low oil pressure.
d. Low refrigerant evaporator pressure.
5. Provide the manufacturer's standard safety controls arranged so that operating any one will shut down machine and automatically reset.
6. Provide the following devices on control panel:

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a. Manual Switches:
   1) Machine off-auto switch.
   2) Oil pump switch, manual or automatic.
   3) Purge pump switch, manual-off-auto.
   4) Machine selector switch to allow load, unload, hold or automatic operation.
b. Manual Setpoint Adjustments:
   1) Leaving chilled water temperature.
   2) Current demand limit.
c. Status Lights:
   1) Chilled water flow proven.
   2) Cooling required.
   3) Unit running.
   4) Unit loading.
   5) Unit unloading.
   6) Manual reset required.
   7) Remote chilled water setpoint active.
   8) Remote current water setpoint active.
d. Setpoint and Temperature Display:
   1) Chilled water setpoint.
   2) Current limit setpoint.
   3) Entering evaporator water temperature.
   4) Leaving evaporator water temperature.
   5) Entering condenser water temperature.
   6) Leaving condenser water temperature.

7. Provide the following operating controls:
   a. Solid state, chilled water temperature controller that controls electronic guide vane operator**<< and hot gas bypass; _____; or None - N/A>>**. Locate temperature sensor in **<< entering; leaving; or _____>>** chilled water.
   b. Adjustable thirty minute off timer prevents compressor from short cycling.
   c. Demand limit device to manually set maximum current infinitely between 40 percent and 100 percent of full load amperes.
   d. Automatic start that determines demand for chilled water from proof of chilled water flow and temperature differential between chilled water setpoint and supply temperature.

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PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide for connection to electrical service.

C. Provide for connection of electrical wiring between starter and chiller control panel, oil pump, and purge unit.

D. Align chiller on concrete foundations, sole plates, and sub-bases. Level, grout, and bolt in place.

E. Install units on vibration isolation.

F. Provide evaporator connections to chilled water piping.
   1. On inlet, provide:
      a. Thermometer well for temperature controller.
      b. Thermometer well and thermometer.
      c. Nipple and flow switch.
      d. Flexible pipe connector.
      e. Pressure gauge.
      f. Shut-off valve.
   2. On outlet, provide:
      a. Thermometer well and thermometer.
      b. Flexible pipe connector.
      c. Pressure gauge.
      d. **<< Shut-off; Balancing; or _____>>** valve.

G. Furnish and install necessary auxiliary water piping for oil cooling units and purge condensers.

H. Insulate evaporator and cold surfaces.

I. Provide condenser connection to condenser water piping.
   1. On inlet, provide:
      a. Thermometer well for temperature controller.
      b. Thermometer well and thermometer.
      c. Strainer.
      d. Nipple and flow switch.
      e. Flexible pipe connector.
      f. Pressure gauge.
      g. Shut-off valve.
   2. On outlet, provide:
      a. Thermometer well and thermometer.
      b. Flexible pipe connector.
      c. Pressure gauge.
      d. **<< Shut-off; Balancing; or _____>>** valve.

J. Arrange piping for easy dismantling to permit tube cleaning.

K. Provide piping from chiller rupture disc to outdoors. Size as recommended by manufacturer.

L. Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s) and remote **<< front-end interface; see Section 251500; software app or terminal; see Section 253500; or _____>>**.

M. Provide refrigerant detection systems for units and piping; see Section **<< 284400>>**.

3.02 SYSTEM STARTUP

A. See Section **<< 017800 - Closeout Submittals>>** for closeout submittals.

B. See Section **<< 017900 - Demonstration and Training>>** for additional requirements.

C. Provide services of factory trained representative for minimum of **<< one day; _____ days; or _____>>** to leak test, refrigerant pressure test, evacuate, dehydrate, charge, start-up, and calibrate controls.

D. Supply initial charge of refrigerant and oil.

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E. Demonstrate system operation and verify specified performance; see Section **<< 230593>>**.

3.03 CLOSEOUT ACTIVITIES

A. See Section **<< 017800 - Closeout Submittals>>** for closeout submittals.

B. See Section **<< 017900 - Demonstration and Training>>** for additional requirements.

C. Train operating personnel in operation and maintenance of units.

D. Provide the services of the manufacturer's field representative to conduct training.

3.04 MAINTENANCE

A. See Section **<< 017000 - Execution and Closeout Requirements>>** for additional requirements.

B. Furnish service and maintenance of complete assembly for **<< one year; ___ years; or _____>>** from Date of Substantial Completion.

END OF SECTION 236416

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SECTION 236423
SCROLL WATER CHILLERS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section **<< 033000 - Cast-in-Place Concrete>>**: Concrete housekeeping pads.

B. Section **<< 232113 - Hydronic Piping>>**.

C. Section **<< 232114 - Hydronic Specialties>>**.

D. Section **<< 251500 - Integrated Automation Software>>**.

E. Section **<< 260583 - Wiring Connections>>**.

1.02 REFERENCE STANDARDS

A. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings.

1.03 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Product Data: Provide rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.

C. Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.

D. Manufacturer's Performance Data: Indicate energy input versus cooling load output from 0 to 100 percent of full load at specified and minimum condenser water temperature for water-cooled chillers and at specified and minimum outdoor air temperature for air-cooled chillers.

E. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories; include trouble-shooting guide.

F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in **<<Owner>>**'s name and registered with manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's written installation instructions for rigging, unloading, and transporting units.

B. Deliver units to the job site completely assembled and charged with refrigerant and oil by manufacturer.

1.05 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Manufacturer's Warranty: Provide minimum **<< five; or _____>>** year warranty to include coverage for **<< materials only; labor only; materials and labor; or _____>>** for **<< compressor; evaporator; condenser; complete assembly; and _____>>**.

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PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Carrier Corporation**<< ; _____; or None - N/A>>**: www.carrier.com/#sle.

B. Daikin Applied Americas, Inc**<< ; _____; or None - N/A>>**: www.daikinapplied.com/#sle.

C. Trane Technologies, PLC**<< ; _____; or None - N/A>>**: www.trane.com/#sle.

D. York, a brand of Johnson Controls International, PLC**<< ; _____; or None - N/A>>**: www.york.com/#sle.

2.02 SCROLL-WATER CHILLER PERFORMANCE REQUIREMENTS

A. Packaged **<< Water-Cooled; Air-Cooled; or _____>>** Chiller**<< , CH-1; , _____; or None - N/A>>**:

1. Refrigerant: **<< R-454B; R-410A; R-407C; or _____>>**; use only refrigerants that have ozone depletion potential (ODP) of **<< zero; or _____>>** and global warming potential (GWP) **<< no greater than that allowed by federal code; of less than 50; or _____>>**.
2. Energy Efficiency: **<< ASHRAE Std 90.1; Federal Energy Management Program; or _____>>**.
3. Evaporator:
   a. Fouling Factor: **<< 0.00010 sq ft-hr-degrees F/Btu>>**.
4. Packaged Water-Cooled Condenser:
   a. Fouling Factor: **<< 0.00025 sq ft-hr-degrees F/Btu>>**.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Align chiller package on steel or concrete foundations.

C. Install units on vibration isolators.

D. Connect to electrical service.

E. Connect to chilled water piping.

F. Arrange piping for easy dismantling to permit tube cleaning and removal.

G. Coordinate BAS Integrated Automation linking between unit controller(s) and remote **<< front-end interface; see Section 251500; software app or terminal; see Section 253500; or _____>>**.

3.02 CLOSEOUT ACTIVITIES

A. See Section **<< 017800 - Closeout Submittals>>** for closeout submittals.

B. Demonstration: Demonstrate operation of system to **<<Owner>>**'s personnel.

1. Use operation and maintenance data as reference during demonstration.
2. Briefly describe function, operation, and maintenance of each component.

C. Training: Train **<<Owner>>**'s personnel on operation and maintenance of system.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of **<< two hours; one day; or _____>>** of training.

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3.03 MAINTENANCE

A. See Section **<< 017000 - Execution and Closeout Requirements>>** for additional requirements.

B. Provide a separate maintenance contract for the service and maintenance for **<< 12>><< years; months; or _____>>** from Date of Substantial Completion.

END OF SECTION 236423

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SECTION 236426
ROTARY-SCREW WATER CHILLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water-cooled rotary-screw chiller.

B. Air-cooled rotary-screw chiller.

1.02 RELATED REQUIREMENTS

A. Section **<< 033000 - Cast-in-Place Concrete>>**: Concrete housekeeping pads.

B. Section **<< 230593 - Testing, Adjusting, and Balancing for HVAC>>**.

C. Section **<< 230800 - Commissioning of HVAC>>**.

D. Section **<< 230923 - Direct-Digital Control System for HVAC>>**.

E. Section **<< 230993 - Sequence of Operations for HVAC Controls>>**.

F. Section **<< 232113 - Hydronic Piping>>**.

G. Section **<< 232114 - Hydronic Specialties>>**.

H. Section **<< 251500 - Integrated Automation Software>>**.

I. Section **<< 253519 - Integrated Automation Control Valves>>**.

J. Section **<< 260583 - Wiring Connections>>**.

1.03 REFERENCE STANDARDS

A. AHRI 550/590 (I-P) - Standard for Performance Rating of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle.

B. ASHRAE Std 15 - Safety Standard for Refrigeration Systems.

C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings.

D. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks.

E. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels.

F. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

G. IEEE 519 - IEEE Standard for Harmonic Control in Electric Power Systems.

H. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

I. NEMA MG 00001 - Motors and Generators.

J. UL 984 - Hermetic Refrigerant Motor-Compressors.

K. UL 1995 - Heating and Cooling Equipment.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate physical size, weight and location of major pieces of equipment to be installed. Notify **<<Architect>>** of any major deviations from the equipment originally specified prior to ordering equipment.

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1.05 SUBMITTALS

A. Product Data: Provide rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.

B. Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.

C. Manufacturer's Certificate: Certify that components furnished but not produced by manufacturer meet or exceed manufacturer's requirements.

D. Manufacturer's Performance Data: Indicate energy input versus cooling load output from 0 to 100 percent of full load at specified and minimum condenser water temperature for water-cooled chillers and at specified and minimum outdoor air temperature for air-cooled chillers.

E. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.

F. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.

G. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories; include trouble-shooting guide.

H. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in **<<Owner>>**'s name and registered with manufacturer.

I. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.

1. See Section **<< 016000 - Product Requirements>>** for additional provisions.
2. Extra Refrigerant: **<< One container; Two containers; or _____>>**.
3. Extra Lubricating Oil: **<< One container; Two containers; or _____>>**.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum **<< three; or _____>>** years of**<< documented; _____; or None - N/A>>** experience.

B. When required, provide certification of inspection in compliance with the requirements of **<< Authority Having Jurisdiction; or _____>>**.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's written installation instructions for rigging, unloading, and transporting units.

B. Deliver units to the job site completely assembled and charged with refrigerant and oil by manufacturer.

1.08 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Manufacturer's Warranty: Provide minimum **<< five; or ___>>** year warranty to include coverage for **<< materials only; labor only; materials and labor; or _____>>** for **<< compressor; evaporator; condenser; complete assembly; and _____>>**.

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PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Carrier Corporation**<< ; _____; or None - N/A>>**: www.carrier.com/#sle.

B. Daikin Applied**<< ; _____; or None - N/A>>**: www.daikinapplied.com/#sle.

C. Trane Technologies, PLC**<< ; _____; or None - N/A>>**: www.trane.com/#sle.

D. York, a brand of Johnson Controls International, PLC**<< ; _____; or None - N/A>>**: www.york.com/#sle.

E. Substitutions: **<< See Section 016000 - Product Requirements; or Not Permitted>>**.

1. The chilled water system has been designed based on specific capacities and characteristics of equipment specified in this section and other sections.
2. When substitution of a different manufacturer or model number is desired, submit sufficient information to demonstrate to **<<Architect>>** that the substitute will have the same or better performance as that specified AND that the related equipment in the system will perform acceptably with the substitute.
3. If the related equipment must be modified to perform acceptably with the substitute, the entity proposing the substitution is responsible for all additional costs due to re-design and provision of different related equipment.

2.02 << AIR-COOLED; WATER-COOLED; OR _____>>, ROTARY-SCREW, WATER CHILLER CONSTRUCTION REQUIREMENTS

A. Factory assembled and tested chiller consisting of compressor(s), compressor motor(s), motor starter(s) or variable frequency drives as indicated, evaporator, condenser, enclosure, refrigeration circuits(s) and specialties, interconnecting piping, microprocessor-based controls, readouts, and diagnostics.

1. Rating: **<<AHRI 550/590 (I-P)>>**.
2. Safety: **<<ASHRAE Std 15>>** and **<<UL 1995>>**.
3. Construction and Testing: **<<ASME BPVC-VIII-1>>**.
4. Energy Efficiency: **<< ASHRAE Std 90.1; Federal Energy Management Program; or _____>>**.
5. Enclosures:
   a. Structural Framing: Mount structural steel on welded steel base**<< with hot-dip galvanized; with air-dried paint; _____; or None - N/A>>** finish.
   b. Steel Cabinet:
      1) Factory apply **<< baked on enamel; baked on powder paint; corrosion resistant paint ; zinc coating; or _____>>**prior to assembly.
      2) Provide gasketing and weatherproofing to panels with fully opening doors containing starters or variable frequency drives, terminal blocks, through-the-door type disconnects and circuit breaker with lockable handles indicating "power-on" or "power-off".
      3) Provide door stays.
   c. Perform 500-hour salt spray test in accordance with **<<ASTM B117>>** for outdoor applications.

B. Rotary-Screw Compressors:

1. Unit: **<< Semi-hermetic; Open; or _____>>** type with **<< two; or _____>>**, **<< direct; variable speed; or _____>>** drive compressors with **<< multiple; or**

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_____>> independent refrigeration circuit(s)**<< , internal muffler; , _____; or None - N/A>>**, **<< discharge; check; suction; and _____>>** service valves.

2. Oil Lubrication System: Positive pressure system, oil heater, oil separator, check valves, solenoid valves, and filtration devices.
3. Valves: Check valves in compressor discharge.
4. Capacity Reduction System: **<< Load/unload valve; Variable speed; or _____>>** control down to **<< 20; 15; 10; 7.5; 5; or _____>>** percent of full load without the activation of hot gas bypass.
5. Motors: **<<UL 984>>**, **<< 3,600; 3,570; or _____>>** rpm, suction gas-cooled, hermetically sealed, squirrel cage induction with **<< starter; variable frequency drive; or _____>>**.

C. Evaporator, Shell and Tube Type:
1. **<<ASME BPVC-VIII-1>>**, **<< three; two; single; or _____>>** pass type, with **<< three; two; or _____>>** independent refrigeration circuits.
2. Shell, Removable Heads and Tube Support Sheets: Carbon steel.
3. Tubes: Mechanically treated copper tubes fixed and aligned into intermediate tube support sheets across the shell to maintain consistent spacing between tubes with the capability of being **<< cleanable; individually replaceable; or _____>>**.
4. Working Pressure Rating, Refrigerant-Side: **<< 200 psi; 220 psi; 235 psi; 300 psi; 354 psi; or ____ psi>>**.
5. Working Pressure Rating, Water-Side: **<< 150 psi; 225 psi; 300 psi; or _____ psi>>**.
6. Cold Surface Insulation:
   a. **<< Factory; Field; or _____>>** install on shell and all other cold surfaces.
   b. **<< 0.75-inch; or ____-inch>>** minimum thickness, closed cell, expanded **<< polyvinyl chloride; polyurethane; or _____>>** flexible foam insulation with a maximum K factor of **<< 0.28; or _____>>**.

D. Provide vents and water drain connections.

E. Provide fittings for temperature control sensors.

F. Freeze Protection: Provide evaporator heater with thermostat to protect from freezing at ambient temperatures down to **<< minus 20 degrees F; or ____ degrees F>>**.

G. Air-Cooled Condenser:
1. Heat Exchanger:
   a. Arrangement: **<< Two; or _____>>** pass, **<< round; flat; or _____>>** tubes.
   b. Mechanically bond aluminum fins to internally enhanced, **<< seamless copper; aluminum alloy; or _____>>** tubing and protect with corrosion resistant materials or coatings.
   c. Clean, dehydrate and test.
   d. Leak Test: **<< 506 psi; 450 psi; 375 psi; or ____ psi>>**.
   e. Seal: **<< Nitrogen; Refrigerant; or _____>>** holding charge.
2. Coil Guards: Provide **<< expanded metal; louvered; PVC coated wire mesh screen; grilles; or _____>>** with **<< lint screens; or _____>>**. Protect condenser coil by enclosing with heavy plastic to prevent damage during shipping or rigging.
3. Fans and Motors:
   a. Dynamically balanced **<< propeller; shrouded-axial; airfoil; or _____>>** type, direct drive fans of **<< reinforced polymer; fiberglass reinforced composite; or**

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_____>> corrosion resistant construction and equip with sealed, permanently lubricated ball bearings.

b. Discharge Fan Guards: **<< Coated steel wire; PVC coated; Close-meshed; or _____>>**.

c. Discharge Direction: Vertical.

d. Motors: Totally enclosed, high efficiency, suitable for outdoor use, three phase, permanent split capacitor, single speed with **<< internal overload; current overload; or _____>>** protection.

H. Refrigeration Circuits:

1. Provide **<< two; or _____>>** independent refrigeration circuit(s) with **<< two; or _____>>** compressor(s) per circuit.
2. Minimum Refrigerant Specialties per Circuit:
   a. Isolation and service valves for refrigerant removal and charging.
   b. Removable-core filter driers.
   c. **<<ASHRAE Std 15>>** compliant relief valves.
   d. Liquid line sight glass with moisture indicator.
   e. Refrigerant expansion valves or metering devices.
   f. Complete **<< operating; holding; or _____>>** charge of both refrigerant and oil.

I. Starters and Drives:

1. Starters: Design **<< unit mounted; remote mounted; or _____>>**, **<< across-the-line; wye-delta closed transition; reduced voltage solid state; or _____>>** starter to operate in temperatures up to **<< 104 degrees F; or ____ degrees F>>**.
   a. Provide incoming line provisions for **<< aluminum; or _____>>**, mechanical type incoming line lugs based on the number and cable sizes shown on drawings.
   b. Provide properly sized, double break main contacts with weld resistant silver cadmium faces and low resistance auxiliary interlocks with **<< palladium silver; or _____>>** contacts for interlocks that interface with control panel.
   c. Provide control power transformer with fused primary, secondary, and current transformers of the proper size, ratio, and burden capacity.
   d. Provide control relays to interface with control panel.
   e. Wiring:
      1) Power and Control: Type MTW copper stranded **<< 194 degrees F>>**.
      2) **<< 14 gauge, 0.0641 inch>>**, minimum, for control wiring.
   f. Motor Protection System Attributes:
      1) Three phase overload protection.
      2) Startup overload protection.
      3) Phase imbalance, loss, and reversal.
      4) Low voltage.
      5) Distribution fault protection.
2. Variable Frequency Drives: Completely assemble, wire, pipe, and factory test, factory or field mounted variable frequency drive (VFD). Limit the field electrical connections for compressor motor power to the main power leads to the VFD, wiring of liquid pumps and tower fans to the control panel.
   a. Characteristics:
      1) **<< Refrigerant; or _____>>** cooled.

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2) Microprocessor based pulse width modulation (PWM) with input/output power devices, DC voltage rectifier, and inverter/control regulator to convert DC voltage to sinusoidal PWM waveform.
3) Physically isolate low voltage control from main power sections.
4) Control motor speed by integrated controls over wide range of operating conditions.
5) Provide short circuit interrupt and withstand rating suitable for available current.

b. Performance:
1) Do not exceed **<<IEEE 519>>** requirements for voltage total harmonic distortion (THD) and harmonic current total demand distortion (TDD) using VFD circuit breaker input terminals as the point of common coupling (PCC).
2) Full Load Efficiency: Minimum 97 percent at 100 percent VFD rated capacity.
3) Unity Displacement Power Factor: 0.99 minimum.
4) Voltage Boost Capability: Full motor voltage at reduced line voltage conditions.
5) Soft start, linear acceleration, and coast to stop capabilities.
6) Base Motor Adjustable Frequency Range: Control to 15 percent capacity at nameplate voltage.
7) Torque Generation: 150 percent instantaneous.

c. Heat Sink and Mating Flange:
1) Design for **<< 185 psi; or ____ psi>>** waterside working pressure.
2) Meter to maintain temperature within acceptable limits.

d. Suitable Ratings:
1) Operation at plus or minus 10 percent nameplate voltage.
2) Continuous Operation at:
(a) 100 percent of nameplate amperes and 5 seconds at 15 percent.
(b) Ambient temperature range of **<< 40 to122 degrees F; or _____ degrees F>>**, 95 percent humidity noncondensing for altitudes up to **<< 6,000 feet; or _____ feet>>**.
3) Comply with **<<NEMA EN 10250>>** and **<<NEMA MG 00001>>**.

e. User Interface for Programming and Display of the Following Parameters:
1) Operating, configuration and fault messages.
2) Hertz frequency.
3) VFD load, line side voltage, and current.
4) kW.
5) Input/output power devices temperature.

f. Electrical Service, Single Point Power:
1) Input Circuit Breaker: Suitable for the available current indicated.
2) Provide power for chiller oil pump via factory wired standard branch circuit breaker.
3) Provide power for oil heater, VFD and controls via 3 kVA control power transformer and factory wired circuit breaker.

g. Discrete Dry-Contact Outputs:
1) Circuit breaker shunt trip.
2) Chilled water pump.
3) Condenser water pump.

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4) Alarm status.

h. Analog Outputs: 4 to 20 mA for head pressure reference and condenser water control valve as applicable.

i. Provide protection for under/over-voltage, phase loss/reversal/unbalance, ground fault, single cycle voltage loss, programmable auto restart after power loss, and motor overload/over temperature protection.

J. Controls Package:

1. Unit Controls: **<< Factory-installed DDC; see Section 251400; Factory-supplied DDC; or _____>>**:

a. Control-panel mounted with required input-output expansions, power supply, fused disconnect, hand switches, knobs, and accessories required to control chiller unit to manufacturer required sequences to meet intended use with listed performance.

b. Factory configured to interface prewired sensors, switches, and safeties with allowance to add up to four chiller valves and flow sensors.

c. Graphic-based touchscreen to include unit operation controls and user filter based interface for faults, alarms, performance, unit diagnostics, and data recording up to 12 months.

d. BAS, SCADA, or other Integrated Automation Link: **<< ASHRAE Std 135 BACnet IP; ASHRAE Std 135 BACnet MS/TP; ASHRAE Std 135 BACnet SC; Modbus (PS) Modbus IP; Modbus (PS) Modbus RTU; LonMark Interoperability Guide LonWorks; Bluetooth CS Bluetooth wireless; IEEE 802.11 Wi-Fi; IEEE 802.15.4 Zig-bee wireless; or _____>>**.

e. External Point Mapping: Provide mapping table for each parameter included in the local visual interface with software-toggle flag to allow reduced mapping of available points.

f. Isolation Valves: Field-installed, **<< 2-position; modulating; position-adjusted; or _____>>**, butterfly type**<< with position tracking; with open-closed status; _____; or None - N/A>>**; **<< manufacturer provided; see Section 253519; or _____>>**.

2. Control Components for Preventing Shutdown:

a. Provide high pressure limit with indicating light for each compressor, set lower than factory pressure switch to automatically unload compressor and prevent nuisance high pressure condenser control trip.

b. Provide one protector with indicating light for each compressor, with current limit setpoint of 120 percent of compressor running load amperage to automatically unload compressor preventing over-current trip.

c. Provide low refrigerant limit to automatically unload each compressor preventing a low evaporator temperature trip.

3. Chiller Operation in Abnormal Operating Conditions:

a. Unloaded Running: Adequate chilled water production.

b. Trip-out Limit Reached: Chiller goes off-line and manual reset is required for continued operation.

4. Control Panel Display:

a. Evaporator pressure.

b. Condenser refrigerant pressure.

c. Entering and leaving evaporator water temperature.

5. Points for Remote Monitoring and Control:

a. Entering and leaving condenser water temperature as applicable.

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b. Chilled water setpoint.
c. Electrical 3 phase current limit and percent RLA setpoint.
d. Electrical 3 phase amp draw.
e. Chiller operating mode.
f. Condenser refrigerant temperature.
g. Elapsed time and number of starts counter.
h. Chiller compressor run status relay.
i. Minimum of 20 diagnostics with time and date stamp.
j. Identification of the fault, date, time and operating mode at time of occurrence, type of reset required, and help message.
k. Relay output energized upon detecting a fault requiring manual reset.
l. Relay output energized whenever unit is operating in a limit mode for an extended period of time.
m. Analog input to control leaving chilled water temperature setpoint based upon a 4-20ma or 0-10 VDC signal from the building automation system.
n. Programmable soft during pull-down period via ramped current limit or fully adjustable, temperature pull-down rate.
o. Leaving chilled water reset based upon return water temperature.
p. Provide RS-232 for printer interface.

K. Electrical Characteristics (Single Point Power Connection):
1. Electrical: **<<NEMA EN 10250>>** or **<<UL 1995>>** as applicable.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Align chiller package on steel or concrete foundations.
C. Install units on vibration isolators.
D. Connect to electrical service.
E. Connect to chilled water piping.
F. Arrange piping for easy dismantling to permit tube cleaning and removal.
G. Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s) and remote **<< front-end interface; see Section 251500; software app or terminal; see Section 253500; or _____>>**.

3.02 MANUFACTURER'S FIELD SERVICES

A. Perform factory startup of the chiller by factory trained and authorized servicing technicians confirming equipment has been correctly installed prior to equipment becoming operational and covered under the manufacturer's warranty.
B. Supply initial charge of refrigerant and oil if not completely factory charged.
C. Demonstrate system operations and verify specified performance.

3.03 CLOSEOUT ACTIVITIES

A. Demonstrate proper operation of **<< equipment; or _____>>** to **<<Owner>>**'s designated representative.

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B. Demonstration: Demonstrate operation of system to **<<Owner>>**'s personnel.
   1. Use operation and maintenance data as reference during demonstration.
   2. Briefly describe function, operation, and maintenance of each component.

C. Training: Train **<<Owner>>**'s personnel on operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of **<< two hours; one day; or _____>>** of training.

3.04 MAINTENANCE

A. See Section **<< 017000 - Execution and Closeout Requirements>>** for additional requirements.

END OF SECTION 236426

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SECTION 236513
FORCED-DRAFT COOLING TOWERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Forced-draft cooling towers.

B. Controls.

1.02 RELATED REQUIREMENTS

A. Section **<< 221005 - Plumbing Piping>>**.

B. Section **<< 230548 - Vibration and Seismic Controls for HVAC>>**.

C. Section **<< 232113 - Hydronic Piping>>**.

1.03 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

F. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

G. CTI STD-201 RS - Performance Rating of Evaporative Heat Rejection Equipment.

H. UL (DIR) - Online Certifications Directory.

1.04 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Product Data: Provide rated capacities, dimensions, weights and point loadings, accessories, required clearances, electrical requirements and wiring diagrams, and location and size of field connections. Submit schematic indicating capacity controls.

C. Shop Drawings: Indicate suggested structural steel supports including dimensions, sizes, and locations for mounting bolt holes.

D. Manufacturer's Certificate: Certify that cooling tower performance, based on **<< ASME PTC 23; CTI ATC-105; CTI STD-201 OM; CTI STD-201 RS; or _____>>** meets or exceeds specified requirements and submit performance curve plotting leaving water temperature against wet bulb temperature.

E. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories.

F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in **<<Owner>>**'s name and registered with manufacturer.

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1.05 DELIVERY, STORAGE, AND HANDLING

A. Factory assemble complete unit. For shipping, disassemble into as large as practical sub-assemblies so that minimum amount of field work is required for re-assembly.

B. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

1.06 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Provide a **<< five; or ____>>** year warranty to include **<< labor only; materials only; labor and materials; or _____>>** coverage for **<< corrosion resistance of cooling tower structure; cooling tower package; fan drive; motor; and _____>>**.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Baltimore Aircoil Company.

B. EvapcoO, Inc.

C. Reymsa Cooling Towers, Inc.

2.02 FORCED-DRAFT COOLING TOWERS

A. General Requirements:

1. Provide units for outdoor use, factory assembled, sectional, counterflow, vertical discharge, blow-through design, with fan assemblies built into pan and casing.
2. Products Requiring Electrical Connection: Listed and classified by **<< UL (DIR); testing firm acceptable to authority having jurisdiction; or _____>>** as suitable for purpose specified and indicated.

B. **<< Forced-Draft Cooling Tower; Open-Circuit, Forced-Draft, Counter-Flow Cooling Tower; Closed-Circuit, Forced-Draft, Counter-Flow Cooling Tower; Closed-Circuit, Forced-Draft, Cross-Flow Cooling Tower; or _____>><< Type _____; for _____; or None - N/A>>**:

1. Pan and Casing: Galvanized steel, **<< 12 gauge, 0.1046 inch; 14 gauge, 0.0747 inch; or ____ gauge, _____ inch>>** for casing and **<< 8 gauge, 0.1644 inch>>** for reinforcing angles and channels with access doors at both ends of tower to air plenum.
2. Cold Water Basin: Heavy-gauge stainless steel with access doors at both ends of tower to air plenum. Provide sloped basin with drain/clean-out connection.
3. Fans: **<< Multiblade, cast aluminum, axial type; Forward curved centrifugal type mounted on steel shaft; or _____>>**, with belt drive, bearings with **<<ABMA STD 9>>** or **<<ABMA STD 11>>** L-10 life at 75,000 hours, with extended grease fittings. Fan and motor sheaves shall be fabricated from corrosion-resistant materials for low maintenance and maximum operating life. Fan motor shall be TEAO or TEFC and suitable for use with variable frequence drive.
4. Fan VFD: Provide VFD for cooling tower fan(s) with ICM Controls Model ICM450 phase monitor.
5. Fan Guard: Welded steel rod and wire guard, hot-dipped-galvanized after fabrication.
6. Safety: Safety railings, and ladder**<< with safety cage; _____; or None - N/A>>** from **<< grade; roof; or ____>>** to fan deck.

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7. Distribution Section: **<< Polyvinyl chloride; Galvanized steel; or _____>>** piping header and branches with**<< ABS; ____; or None - N/A>>** plastic spray nozzles.
8. Fill:
   a. Self-supporting, fluted polyvinyl chloride plastic**<< with flame spread index of 5 or less, when tested in accordance with ASTM E84; with flame spread index of 10 or less, when tested in accordance with ASTM E84; _____; or None - N/A>>**.
   b. Fungal Resistance: No growth when tested in accordance with **<<ASTM G21>>**.
9. Drift Eliminators: Two- or three-pass hot-dipped-galvanized steel, drift loss limited to **<< 0.7; 0.2; or ___>>** percent of total water circulated.
10. Electric Water Level Control: Provide electric probe and a motorized valveElectric Switch: Probe type, mounted in a stilling chamber external of the tower, with a solid-state control relay, in a weatherproof enclosure.Valve: Slow-acting, motorized, voltage shown on drawings, installed in make-up
11. Hardware: **<< Galvanized steel; Stainless steel; or _____>>** nuts, bolts, washers, and nails**<< ; assembled with phenolic-epoxy-coated, corrosion-resistant washer head fasteners; ; _____; or None - N/A>>**.
12. Galvanized Steel Sheet Components: Hot-dipped-galvanized steel, **<<ASTM A653/A653M>>**, with G210/Z600 coating, and finished with zinc-chromatized-aluminum paint.
13. Steel Angles, Plates, Bars, and Shapes: Galvanized after fabrication to comply with **<<ASTM A123/A123M>>**, Coating Thickness Grade 100.

2.03 CONTROLS

A. Provide a dedicated control panel for each cooling tower. Each control panel shall be fully assembled, internally wired, and tested for field mounting. Include:
   1. Enclosure: NEMA 250 Type 4X stainless steel cabinet
      a. Circuit Protection: Type HMCP.
      b. Disconnect switch with a lockable, external operating handle accessible from the exterior of the control panel.
   2. Control Power Transformer: Step down primary voltage to 120 volts, single phase. Two fuses on primary side and single fuse on secondary side.
   3. Motor drive: Factory-mounted and wired, pulse-width modulating variable frequency drive (VFD) utilizing IGBT and microprocessor technology. Size the VFD for fan motor horsepower with a three contactor bypass circuit. Selector mode through an inverter-off-bypass selector switch.
      a. Provide ICM Controls Model ICM450 phase monitor, including all required wiring for final connections between phase monitor and motor/VFD.
   4. Terminal Strip: 120-volt Control Circuit:Allow field supplied dry contact to enable or disable cooling tower operation. Contact shall not disable basin heater circuit.
   5. Basin Heater Control: Provide three-pole contactor with branch fuse protection. Extend holding coil control circuit to the terminal strip for field connection for a remote thermostat and low-water cutout device. Provide a pilot light to annunciate heater activation.
   6. Cooling Fan: Fan shall provide cooling air across cabinet and across the VFD heat sink.
   7. Water Level Control: Control panel shall provide power for the electric water level control.
   8. BAS controls to start, stop, and provide the required speed signal to the VFD in response to the condenser water temperature shall be provided in the control panel. A Hand-Off-Auto selector switch shall be provided to bypass BAS control.

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9. Status Indicating Lights: For power on, inverter, and bypass.
10. Mechanical and electrical interlocks on all electrical controls required to operate the fan motors. Provide hard-wired interlock from condenser pumps to tower fan motors/VFDs so that tower fan(s) cannot start unless condenser water pumps are running.

2.04 ACCESSORIES

A. Electric Immersion Heaters: In pan, suitable to maintain temperature of water in pan at **<< 42 degrees F>>** when outside temperature is **<< 0 degrees F>>** and wind velocity is **<< 15 mph>>**; immersion thermostat and float control operate heaters on low temperature when pan is filled.

B. Provide external factory-assembled basin level platform and ladders from cooling tower manufacturer from grade/roof to service platform.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide the services of the manufacturer's field representative to supervise rigging, hoisting, and installation, allowing for minimum of **<< one 8-hour day; two 8-hour days; or ____ 8-hour days>>** per tower.

C. Install tower on structural steel beams as instructed by manufacturer.

D. Where indicated, install tower on vibration isolators. See Section **<< 230548>>**.

E. Connect condenser water piping with flanged connections to tower. Pitch condenser water supply to tower and condenser water suction away from tower. See Section **<< 232113>>**.

F. Connect make-up water piping with flanged or union connections to tower. Pitch to tower. See Section **<< 221005>>**.

G. Connect overflow, bleed, and drain, to **<< floor drain; storm sewer; or _____>>**.

H. Install piping to tower and provide electric heat trace on piping prior to installing insulation where indicated on drawings.

I. Mount tower control panel.

J. Install water level control in a standpipe in piping beside tower.

K. Install basin heater controls.

L. Control wiring shall comply with Section 230900 and with cooling tower manufacturer's instructions.

M. Field wire fan motors, basin heaters, temperature sensors, and any remote control devices for the cooling tower to control panel.

N. Maintain manufacturer's recommended clearances for service and maintenance.

3.02 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Provide the services of the manufacturer's field representative to inspect tower after installation and submit report prior to start-up, verifying installation is in accordance with specifications and manufacturer's recommendations.

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3.03 SYSTEM STARTUP

A. Start-up tower in presence of and instruct **<<Owner>>**'s operating personnel.

3.04 WARRANTY PERIOD OPERATION

A. Contractor shall provide all maintenance and cleaning during warranty period with a minimum of six inspections per year. Pull and clean strainer.

END OF SECTION 236513

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SECTION 236514
INDUCED-DRAFT COOLING TOWERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Induced-draft cooling towers.

B. Controls.

1.02 RELATED REQUIREMENTS

A. Section **<< 221005 - Plumbing Piping>>**.

B. Section **<< 230548 - Vibration and Seismic Controls for HVAC>>**.

C. Section **<< 232113 - Hydronic Piping>>**.

1.03 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

F. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

G. CTI STD-201 RS - Performance Rating of Evaporative Heat Rejection Equipment.

H. UL (DIR) - Online Certifications Directory.

1.04 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Product Data: Provide rated capacities, dimensions, weights and point loadings, accessories, required clearances, electrical requirements and wiring diagrams, and location and size of field connections. Submit schematic indicating capacity controls.

C. Shop Drawings: Indicate suggested structural steel supports including dimensions, sizes, unit weight, clearances, and locations for mounting bolt holes.

D. Manufacturer's Certificate: Certify that cooling tower performance, based on **<< ASME PTC 23; CTI ATC-105; CTI STD-201 OM; CTI STD-201 RS; or _____>>**, meets or exceeds specified requirements and submit performance curve plotting leaving water temperature against wet bulb temperature. Unit sound performance rating shall be tested in accordance with CTI ATC-128 standard

E. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.

F. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories.

G. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in **<<Owner>>**'s name and registered with manufacturer.

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1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum **<< three; or _____>>** years of**<< documented; _____; or None - N/A>>** experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Factory assemble unit. For shipping, disassemble into as large as practical sub-assemblies so that minimum amount of field work is required for re-assembly.

B. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

1.07 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Provide a **<< five; or ____>>** year warranty to include **<< labor only; materials only; labor and materials; or _____>>** coverage for **<< corrosion resistance of cooling tower structure; cooling tower package; fan drive; motor; and _____>>**.

C. Provide a **<< two; one; and _____>>** year warranty to include **<< labor and materials>>** coverage for all other components of the tower for corrosion resistance of cooling tower structure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Baltimore Aircoil Company.

B. Evapco, Inc:

C. Reymsa Cooling Towers, Inc.

2.02 INDUCED-DRAFT COOLING TOWERS

A. General Requirements:

1. Provide units for outdoor use, factory assembled, sectional, counterflow, vertical discharge, blow-through design, with fan assemblies built into pan and casing.
2. Products Requiring Electrical Connection: Listed and classified by **<< UL (DIR); testing firm acceptable to authority having jurisdiction; or _____>>** as suitable for purpose specified and indicated.

B. **<< Induced-Draft Cooling Tower; Open-Circuit, Induced-Draft, Counter-Flow Cooling Tower; Open-Circuit, Induced-Draft, Cross-Flow Cooling Tower; Closed-Circuit, Induced-Draft, Counter-Flow Cooling Tower; Closed-Circuit, Induced-Draft, Cross-Flow Cooling Tower; or _____>><< Type _____; for _____; or None - N/A>>**:

1. Casing and Frame: Galvanized steel, **<< 12 gauge, 0.1046 inch; 14 gauge, 0.0747 inch; or ____ gauge, _____ inch>>** for casing and **<< 8 gauge, 0.1644 inch>>** for reinforcing angles and channels with access doors at both ends of tower to air plenum.
2. Cold Water Basin: Heavy-gauge 304 stainless steel l**<< None - N/A; or , ____ gauge, _____ inch>>** with access doors at both ends of tower to air plenum. Provide sloped basin with bottom drain/clean-out connection. Provide large area, lift-out stainless steel strainer with perforated openings sized smaller than water distribution nozzle orifices.
3. Fans: **<< Multiblade, cast aluminum, axial type; Forward curved centrifugal type mounted on steel shaft; or _____>>**, ultra low sound, belt drive with one piece, multi-

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groove belt designed for cooling tower service, bearings with **<<ABMA STD 9>>** or **<<ABMA STD 11>>** L-10 life at 75,000 hours, with extended grease fittings. Fan and motor sheaves shall be fabricated from corrosion-resistant materials for low maintenance and maximum operating life. Fan motor shall be TEAO or TEFC and suitable for use with variable frequence drive.

4. Fan VFD: Provide VFD for cooling tower fan(s) with ICM Controls Model ICM450 phase monitor.
5. Fan Guard: Welded steel rod and wire guard, hot-dipped-galvanized after fabrication, OSHA-compliant.
6. Safety: Safety railings, and ladder**<< with safety cage; _____; or None - N/A>>** from **<< grade; roof; or ____>>** to fan deck.
7. Distribution Section: **<< Polyvinyl chloride; Galvanized steel; or _____>>** piping header and branches with**<< ABS; ____; or None - N/A>>** plastic spray nozzles.
8. Fill:
   a. Self-supporting, fluted polyvinyl chloride plastic**<< with flame spread index of 5 or less, when tested in accordance with ASTM E84; with flame spread index of 10 or less, when tested in accordance with ASTM E84; _____; or None - N/A>>**.
   b. Fungal Resistance: No growth when tested in accordance with **<<ASTM G21>>**.
9. Drift Eliminators: Two- or three-pass hot-dipped-galvanized steel, drift loss limited to **<< 0.7; 0.2; or ___>>** percent of total water circulated.
10. Electric Water Level Control: Provide electric probe and a motorized valve
    a. Electric Switch: Probe type, mounted in a stilling chamber external of the tower, with a solid-state control relay, in a weatherproof enclosure.
    b. Valve: Slow-acting, motorized, voltage shown on drawings, installed in make-up
11. Hardware: **<< Galvanized steel; Stainless steel; or _____>>** nuts, bolts, washers, and nails**<< ; assembled with phenolic-epoxy-coated, corrosion-resistant washer head fasteners; ; _____; or None - N/A>>**.
12. Galvanized Steel Sheet Components: Hot-dipped-galvanized steel, **<<ASTM A653/A653M>>**, with G210/Z600 coating, and finished with zinc-chromatized-aluminum paint.
13. Steel Angles, Plates, Bars, and Shapes: Galvanized after fabrication to comply with **<<ASTM A123/A123M>>**, Coating Thickness Grade 100.

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2.03 CONTROLS

A. Provide a dedicated control panel for each cooling tower. Each control panel shall be fully assembled, internally wired, and tested for field mounting. Include:
   1. Enclosure: NEMA 250 Type 4X stainless steel cabinet
      a. Circuit Protection: Type HMCP.
      b. Disconnect switch with a lockable, external operating handle accessible from the exterior of the control panel.
   2. Control Power Transformer: Step down primary voltage to 120 volts, single phase. Two fuses on primary side and single fuse on secondary side.
   3. Motor drive: Factory-mounted and wired, pulse-width modulating variable frequency drive (VFD) utilizing IGBT and microprocessor technology. Size the VFD for fan motor horsepower with a three contactor bypass circuit. Selector mode through an inverter-off-bypass selector switch.

a. Provide ICM Controls Model ICM450 phase monitor, including all required wiring for final connections between phase monitor and motor/VFD.

4. Terminal Strip: 120-volt Control Circuit:Allow field supplied dry contact to enable or disable cooling tower operation. Contact shall not disable basin heater circuit.
5. Basin Heater Control: Provide three-pole contactor with branch fuse protection. Extend holding coil control circuit to the terminal strip for field connection for a remote thermostat and low-water cutout device. Provide a pilot light to annunciate heater activation.
6. Cooling Fan: Fan shall provide cooling air across cabinet and across the VFD heat sink.
7. Water Level Control: Control panel shall provide power for the electric water level control.
8. BAS controls to start, stop, and provide the required speed signal to the VFD in response to the condenser water temperature shall be provided in the control panel. A Hand-Off-Auto selector switch shall be provided to bypass BAS control.
9. Status Indicating Lights: For power on, inverter, and bypass.
10. Mechanical and electrical interlocks on all electrical controls required to operate the fan motors. Provide hard-wired interlock from condenser pumps to tower fan motors/VFDs so that tower fan(s) cannot start unless condenser water pumps are running.

2.04 ACCESSORIES

A. Electric Immersion Heaters: In pan, suitable to maintain temperature of water in pan at **<< 42 degrees F>>** when outside temperature is **<< 0 degrees F>>** and wind velocity is **<< 15 mph>>**; immersion thermostat and float control operate heaters on low temperature when pan is filled.

B. Provide external factory assembled basin level platform and ladders from cooling tower manufacturer from grade/roof to service platform.

C. Davit hoist for replacement of fan motor.

D. Fan vibration cut-off switch.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide the services of the manufacturer's field representative to supervise rigging, hoisting, and installation, allowing for minimum of **<< one 8-hour day; two 8-hour days; or ____ 8-hour days>>** per tower.

C. Install tower on structural steel beams as instructed by manufacturer.

D. Where indicated, install tower on vibration isolators. See Section **<< 230548>>**.

E. Connect condenser water piping with flanged connections to tower. Pitch condenser water supply to tower and condenser water suction away from tower. See Section **<< 232113>>**.

F. Connect make-up water piping with flanged or union connections to tower. Pitch to tower. See Section **<< 221005>>**.

G. Connect overflow, bleed, and drain, to **<< floor drain; storm sewer; or _____>>**.

H. Install piping to tower and provide electric heat trace on piping prior to installing insulation where indicated on drawings.

I. Mount tower control panel.

J. Install water level control in a standpipe in piping beside tower.

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K. Install basin heater controls.

L. Control wiring shall comply with Section 230900 and with cooling tower manufacturer's instructions.

M. Field wire fan motors, basin heaters, temperature sensors, and any remote control devices for the cooling tower to control panel.

N. Maintain manufacturer's recommended clearances for service and maintenance.

3.02 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

B. Provide the services of the manufacturer's field representative to inspect tower after installation and submit report prior to start-up, verifying installation is in accordance with specifications and manufacturer's recommendations.

3.03 SYSTEM STARTUP

A. Start-up tower in presence of and instruct **<<Owner>>**'s operating personnel.

3.04 WARRANTY PERIOD OPERATION

A. Contractor shall provide all maintenance and cleaning during warranty period with a minimum of six inspections per year. Pull and clean strainer.

END OF SECTION 236514

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SECTION 237200
AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Energy recovery ventilators.

B. Energy recovery heat exchangers.

C. Heat recovery ventilators.

D. Heat recovery heat exchangers.

1.02 RELATED REQUIREMENTS

A. Section **<< 077200 - Roof Accessories>>**: Equipment roof curb.

B. Section **<< 230548 - Vibration and Seismic Controls for HVAC>>**.

C. Section **<< 230923 - Direct-Digital Control System for HVAC>>**.

D. Section **<< 251500 - Integrated Automation Software>>**: BAS, BMS, or SCADA.

E. Section **<< 260583 - Wiring Connections>>**.

1.03 REFERENCE STANDARDS

A. AHRI 1060 (I-P) - Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment.

B. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings.

D. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks.

E. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.

F. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

G. NFPA 70 - National Electrical Code.

H. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.

I. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.

1.04 SUBMITTALS

A. Product Data: Manufacturer's installation instructions, product data, and engineering calculations.

B. Shop Drawings: Show design and assembly of energy recovery unit and installation and connection details.

1.05 DELIVERY, STORAGE, AND HANDLING

A. See Section **<< 017419 - Construction Waste Management and Disposal>>** for packaging waste requirements.

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B. Store products in manufacturer's unopened packaging until ready for installation.

C. Store equipment and products to be installed indoors in dry heated area.

1.06 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Manufacturer Warranty: Provide **<< 1-year; 3-year; or _____>>** manufacturer warranty for equipment including parts, materials, workmanship, and operation commencing on date of Substantial Completion. Complete forms in **<<Owner>>**'s name and register with manufacturer.

C. Motor Warranty: Provide **<< 18-month; 24-month; 30-month; 36-month; or _____>>** manufacturer warranty against breakdowns, malfunctions, or defects in material and workmanship under expected service conditions.

D. Energy Wheel Warranty: Provide **<< 5-year; or _____>>** manufacturer warranty against desiccant coating or wheel material and workmanship defects including issues arising from reduced performance under circumstances of normal use from listed design figures.

PART 2 PRODUCTS

2.01 ENERGY RECOVERY VENTILATOR

A. Manufacturers:
1. Greenheck**<< ; _____; or None - N/A>>**: www.greenheck.com/#sle.
2. RenewAire**<< ; _____; or None - N/A>>**: www.renewaire.com/#sle.
3. Ruskin Company**<< ; EnERVent+ Series; ; _____; or None - N/A>>**: www.ruskin.com/#sle.
4. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. ERV Equipment Construction Requirements:
1. Energy Recovery Exchanger Type: **<< Energy wheel; Membrane plate; Liquid desiccant; Multiple; Energy and heat wheels; Multiple; Energy and heat wheels with heat recovery loop; Multiple; Liquid desiccant system with energy and heat wheels; or _____>>**.
2. Supply and Return Duct Connection Orientation: **<< As indicated on drawings; Downward; Over unit; Side-by-side; or _____>>**.
3. Casing and Frame:
   a. Frame: Galvanized steel body or welded extruded aluminum tubular frame capable of supporting components and casings including integral **<< base lifting holes; suspension brackets; or _____>>**.
   b. Double Wall Panels: Minimum of **<< 18 gauge, 0.040 inch; 20 gauge, 0.036 inch; 22 gauge, 0.029 inch; or ___ gauge, _____ inch>><< aluminum; aluminzed steel; galvanized steel; or _____>>**.
   c. Doors: Construct doors of same construction and thickness as wall panels. Include p-shaped extruded neoprene gasket, prop rod, chain with spring, exterior handle, and interior 3-point latching device. Label each door to identify equipment located within.
   d. Insulation Requirements:
      1) Mold Resistance: **<< "Pass" when tested in accordance with ASTM C1338; and _____>>**.
      2) Fungal Resistance: **<< No growth when tested in accordance with ASTM G21; and _____>>**.

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3) Bacteria Resistance: **<< No growth when tested in accordance with UL 181; and _____>>**.

4) Flame spread index of 25 or less and maximum smoke developed index of 50.

e. Isolation and Sealing: Form continuous, thermally isolated, weathertight seal between inner wall of panels and structural framing with closed cell PVC foam gasketing and seal seams to prevent job site caulking.

f. Access Panels: Provide access to components through a large, tightly sealed and easily removable hinged or screwed access panel.

g. Finish: **<< Polyurethane enamel; Baked powder paint; or _____>>** over weather-protected, corrosion-resistant assembly.

h. Nameplate: Permanent name plate listing **<< manufacturer; model number; serial number; voltage with tolerance; amp ratings; and _____>>** mounted inside door near electrical panel.

4. Supply and Exhaust Fans:

a. Provide separate non-overloading, statically and dynamically balanced, draw-through, forward curved centrifugal fan or fan-array for each air stream.

b. Fan Motor: **<< Constant Speed; Variable Frequency Drive; or _____>>**, **<< high; premium; or _____>>** efficiency, load matched, belt-driven, open drip proof, thermal overload protected **<< ODP; TEFC; ODP or TEFC; or _____>>** motor with **<< fixed; variable; or _____>>** sheave belt drive, and adjustable-removable motor-slide base. Size drives to 150 percent of load, minimum.

c. Belt Guards: Full sized, hinged, painted with high-visibility safety color, and accessible with standard tools.

d. Motor Bearings: Permanently lubricated sealed ball bearings rated for not less than 200,000 hours of operation with accessible greased fittings.

5. Filter Sections:

a. Outdoor-Intake and Exhaust Sides: **<< 2 inch; or ___ inch>>** thick, pleated**<< , washable; , _____; or None - N/A>>**, **<< MERV 7; MERV 11; MERV 13; 30-30 pleated prefilters; or _____>>** filters, **<<ASHRAE Std 52.2>>**.

b. Filter Racks: Bolt-on rack constructed of aluminum with minimum size of **<< 1/12 inch; or ___ inch>>** thick. Include hinged side access door and snap fasteners.

6. Roof Curbs:

a. Curbs: Provide full perimeter, watertight, **<< flat; sloped; flat and sloped; or _____>>**, weight-supporting roof curb fabricated from minimum of **<< 10 gauge, 0.1345 inch; 12 gauge, 0.1046 inch; or ___ gauge, _____ inch>>** aluminized steel.

b. Isolation Rails: Provide factory-installed, **<< 12 gauge, 0.1046 inch; or ___ gauge, _____ inch>>** aluminized steel angles top and bottom, connected with flexible, outdoor rated membrane and factory-installed vibration isolation springs.

c. Gaskets: Provide closed cell PVC foam, field **<< installed top of curb; installed between top flange of isolation rail and bottom; or _____>>**.

7. Vibration Isolation: Provide corrosion-resistant vibration isolation products for internal motors and other revolving parts. See Section **<< 230548>>**.

8. Electrical:

a. **<< 575; 480; 460; 220; or _____>>** VAC, **<< 1-; 3-; or _____>>**phase with single-point power connection to nonfused main disconnect interlocked with control panel and other components.

b. Install internal wiring in accordance with **<<NFPA 70>>** within **<< flexible, liquid tight steel conduit; S/O cord; or _____>>**.

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9. Controls and Local Control Panel:
   a. Unit Controls: **<< Factory installed DDC; see Section 251400; Factory supplied DDC; or _____>>** with sensors, limit switches, and frost control.
   b. Provide fused disconnect within local control panel with power supplies, transformers, terminal strip or terminal blocks for interface of field installed components.
   c. Service Status: Provide both local and remote indication of sensor readings and status of safeties and other status items including power on, wheel-rotation alarm, outside-air loaded filter and exhaust-air loaded filter.
   d. Provide temperature, humidity, dewpoint temperature, CO2, and wheel rotation sensors.
   e. Freeze Protection Thermostat: Provide and configure to stop unit when outdoor air intake**<< dewpoint; _____; or None - N/A>>** temperature drops below **<< 23 degrees F; 38 degrees F; or ___ degrees F>>**, adjustable.
10. BAS, SCADA, or other Integrated Automation Link: **<< ASHRAE Std 135 BACnet IP; ASHRAE Std 135 BACnet MS/TP; ASHRAE Std 135 BACnet SC; Modbus (PS) Modbus IP; Modbus (PS) Modbus RTU; LonMark Interoperability Guide LonWorks; Bluetooth CS Bluetooth wireless; IEEE 802.11 Wi-Fi wireless; IEEE 802.15.4 Zig-bee wireless; or _____>>**.
11. Configuration: Adjust listed requirements in conformance with **<<ASHRAE Std 90.1 I-P>>**.
12. Certification: **<<AHRI 1060 (I-P)>>** labeled, include copy of published ratings for operating conditions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that structure is ready for installation including openings, ductwork, mechanical utilities, and electrical utilities.

B. Rooftop Installation: Verify that equipment supplied roof curbs are installed and ready to receive intended unit otherwise provide equipment matched roof curbs; see Section **<< 077200>>**.

3.02 INSTALLATION

A. Install equipment in accordance with manufacturer's written installation instructions.

B. Do not obstruct maintenance access to equipment piping, electrical conduit, or any other utility.

C. Vibration Isolation: Provide corrosion-resistant equipment isolation products; see Section **<< 230548>>**.

D. Electrical: Provide equipment raceway, wiring, and cables; see Section **<< 260583>>**.

E. Coordinate installation and fire alarm system interface of system compatible duct-mounted smoke detectors and other appurtenances following **<<NFPA 90A>>** guidelines.

F. Start system and adjust controls and equipment for satisfactory operation.

G. Coordinate hardwired or software interfacing links to enable coordinate as minimum start-stop, occupied, unoccupied functions as well as specific schedules and setpoints functions with other DDC controls onboard airside systems serving common spaces; see Section **<< 230923>>**.

H. Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s) and remote **<< front-end interface; see Section 251500; software app or terminal; see Section 253500; or _____>>**.

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3.03 SYSTEM STARTUP

A. Provide services of manufacturer's authorized representative to provide start up of unit.

3.04 CLEANING

A. See Section **<< 017000 - Execution and Closeout Requirements>>** for additional requirements.

B. Clean filters, air plenums, interior and exposed-to-view surfaces prior to Substantial Completion.

3.05 CLOSEOUT ACTIVITIES

A. See Section **<< 017800 - Closeout Submittals>>** for additional submittals.

B. See Section **<< 017900 - Demonstration and Training>>** for additional requirements.

C. Demonstrate proper operation of **<< equipment; or _____>>** to **<<Owner>>**'s designated **<< representative; personnel; or _____>>**.

D. Training: Train **<<Owner>>**'s personnel on operation and maintenance of system.

1. Training Reference: Operation and maintenance manual and additional training materials as required.
2. Provide minimum of **<< two hours; one day; or _____>>** of training.

END OF SECTION 237200

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SECTION 237313
MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 2 PRODUCTS

1.01 CASING CONSTRUCTION

A. Full Perimeter Base Rail:
   1. Construct of **<< galvanized steel; or _____>>**.
   2. Provide base rail of sufficient height to raise unit for external trapping of condensate drain pans.

B. Casing:
   1. Construct of one piece, insulated, double wall panels.
   2. Provide mid-span, no through metal, internal thermal break.
   3. Construct outer panels of **<< galvanized steel; stainless steel; or _____>>** and inner panels of **<< galvanized steel; stainless steel; or _____>>**.
   4. Casing Air Pressure Performance Requirements:
      a. Able to withstand up to **<< 8 in-wc; or __ in-wc>>** positive or negative static pressure.
      b. Not to exceed **<< 0.0042 inches per inch; or _____ inches per inch>>** deflection at **<< 1.5; or ___>>** times design static pressure up to a maximum of plus **<< 8 in-wc; or ___ in-wc>>** in positive pressure sections and minus **<< 8 in-wc; or __ in-wc>>** in negative pressure sections.

C. Access Doors:
   1. Construction, thermal and air pressure performance same as casing.
   2. Provide surface mounted handles on hinged, swing doors.

D. Outside Air and Exhaust Air Weather Hood:
   1. Fabricate from same material as casing outer panel.
   2. Extend hood past perimeter of unit casing opening so as not to instruct airflow path.
   3. Paint hoods with same finish as external surface of outdoor units.
   4. Provide inlet hood for each fresh air damper with a**<< sine wave; _____; or None - N/A>>** moisture eliminator to prevent entrainment of water into the unit from outside air.
   5. Provide exhaust hoods for each exhaust air opening.
   6. Size each hood for 100 percent of nominal fresh air damper capacities.
   7. Protect each hood with **<< bird screen; and _____>>** to prevent **<< nesting; and _____>>** at intake or exhaust airflow paths.

E. Unit Flooring: Construct with sufficient strength to support expected people and equipment loads associated with maintenance activities.

F. Casing Leakage: Seal joints and provide airtight access doors so that air leakage does not exceed **<< one; or ___>>** percent of design flow at the specified casing pressure.

G. Insulation:
   1. Provide minimum thermal thickness of **<< 12 R; or ___ R>>** throughout.
   2. Completely fill panel cavities in each direction to prevent voids and settling.
   3. Comply with **<<NFPA 90A>>**.

H. Drain Pan Construction:

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1. Provide **<< cooling coil; humidifier; and _____>>** sections with an insulated, double wall, **<< galvanized steel; stainless steel; or _____>>** drain pan complying with **<<ASHRAE Std 62.1>>** for indoor air quality and sufficiently sized to collect all **<< condensate; and _____>>**.
2. Slope in two planes to promote positive drainage and eliminate stagnate water conditions.
3. Locate outlet of sufficient diameter at lowest point of pan to prevent overflow at normal operating conditions.
4. Provide**<< threaded; _____; or None - N/A>>** drain connections constructed of drain pan material, extended sufficient distance beyond the base to accommodate field installed, condensate drain trapping.

I. Louvers: **<< Stationary; Adjustable; or _____>>**, of galvanized steel, **<< 4 inches; 6 inches; or _____ inches>>** deep with plenum,**<< nylon bearings,; _____ ,; or None - N/A>> << 1/2-inch>>** mesh, **<< 0.04-inch>>** galvanized wire bird screen in **<< aluminum; galvanized; or _____>>** frame, and bearing AMCA Certified Ratings Seal in accordance with **<<AMCA 500-L>>**. Furnish adjustable louvers with hollow vinyl bulb edging on blades and foam side stops to limit leakage to maximum 2 percent at **<< 4 in-wc>>** differential pressure when sized for **<< 2000 fpm>>** face velocity.

J. Finish:

1.02 FAN SECTION

A. Type: **<< Forward curved,; Backward inclined,; Air foil,; or _____>> << single width, single inlet, centrifugal; double width, double inlet, centrifugal; vane axial; or _____>> << plug; or None - N/A>>** fan, in accordance with **<<AMCA 99>>**. **<< See Section 233413; See Section 233416; or None - N/A>>**

B. Performance Ratings: Determined in accordance with **<<AMCA 210>><< and labeled with AMCA Certified Rating Seal; _____; or None - N/A>>**.

C. Sound Ratings: **<<AMCA 301>>**; tested to **<<AMCA 300>><< and label with AMCA Certified Sound Rating Seal; _____; or None - N/A>>**.

D. Bearings: Self-aligning, grease lubricated, with lubrication fittings extended to exterior of casing with **<< plastic; aluminum; copper; or _____>>** tube and grease fitting rigidly attached to casing.

E. External Motor Junction Box: Factory mount NEMA 4 external junction box and connect to extended motor leads from internally mounted motors.

F. Motor Wiring Conduit: Factory wire fan motor wiring to the unit mounted **<< starter-disconnect; variable frequency drive; external motor junction box; and _____>>**.

G. Fan Accessories:

H. Flexible Duct Connections:
1. For separating fan, coil, and adjacent sections.

I. Drives:
1. Comply with **<<AMCA 99>>**.
2. Bearings: Heavy duty pillow block type, **<< ball bearings, with ABMA STD 9 L-10 life at 50,000 hours; ball bearings, with ABMA STD 9 L-50 life at 100,000 hours; roller bearings with ABMA STD 11 L-10 life at 120,000 hours; roller bearings with ABMA STD 11 L-50 life at 400,000 hours; or _____>>**.
3. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

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4. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts, and keyed. Variable and adjustable pitch sheaves for motors **<< 15 hp>>** and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for **<< 20 hp>>** and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.
5. Belt Guard: Fabricate to **<<SMACNA (DCS)>>**; **<< 0.106 inch>>** thick, **<< 3/4 inch>>** diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

1.03 COIL SECTION

A. Casing: Provide access to both sides of coils. Enclose coils with headers and return bends **<< exposed outside; fully contained within; or _____>>** casing. Slide coils into casing through removable end panel**<< with blank off sheets and sealing collars at connection penetrations; _____; or None - N/A>>**.

B. Drain Pans: **<< 24 inch>>** downstream of coil and down spouts for cooling coil banks more than one coil high.

C. Eliminators: Three break of **<< PVC; galvanized steel; Type 304 stainless steel; or _____>>**, mounted over drain pan.

D. Air Coils:
1. Certify capacities, pressure drops, and selection procedures in accordance with **<<AHRI 410>>**.

E. Fabrication:
1. Tubes: **<< 5/8 inch>>** OD seamless copper expanded into fins, brazed joints.
2. Fins: Aluminum.
3. Casing: Die formed channel frame of galvanized steel.

1.04 FILTER AND AIR CLEANER SECTION

A. General: Provide filter sections with filter racks, minimum of one access door for filter removal, and filter block-offs to prevent air bypass.

B. Differential Pressure Gauge:
1. Provide factory installed dial type differential pressure gauge, flush mounted with casing outer wall, and fully piped to both sides of each filter to indicate status.
2. Maintain plus/minus **<< 5 percent; or _____ percent>>** accuracy within operating limits of **<< 20 degrees F; or ___ degrees F>>** to **<< 120 degrees F; or ____ degrees F>>**.

1.05 DAMPER SECTION

A. **<< Mixing; Filter-Mixing; or _____>>** Section: Provide a functional section to support the damper assembly for modulating the volume of **<< outdoor; return; exhaust; and _____>>** air.

B. Damper Blades:
1. Double-skin airfoil design with metal, compressible jamb seals and extruded-vinyl blade-edge seals on each blade.
2. Self-lubricating stainless steel or synthetic sleeve bearings.
3. Comply with **<<ASHRAE Std 90.1 I-P>>** for rated maximum leakage rate.
4. Provide leakage testing and pressure ratings in compliance with **<<AMCA 500-D>>** test methods.

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5. Arrange in parallel or opposed-blade configuration.

C. Barometric Relief Dampers:
1. Frame: Roll formed galvanized steel.
2. Blades: Roll formed galvanized steel.
3. Blade Seals: Extruded vinyl, mechanically attached to the blade edge.
4. Material:

END OF SECTION 237313

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SECTION 237413
PACKAGED OUTDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 2 PRODUCTS

1.01 MANUFACTURED UNITS

A. General: Roof mounted units having **<< gas burner; electric heating elements; or _____>>** and electric refrigeration.

B. Description: Self-contained, packaged, factory assembled and prewired, consisting of cabinet and frame, supply fan,**<< return fan,; _____ ,; or None - N/A>><< heat exchanger and burner,; electric heating elements,; _____ ,; or None - N/A>><< heat recovery coil,; _____ ,; or None - N/A>>** controls, air filters, refrigerant cooling coil and compressor, condenser coil and condenser fan.

C. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of **<< zero; or _____>>** and global warming potential (GWP) **<< no greater than that allowed by federal code.; of less than 50.; or _____>>**

1.02 FABRICATION

A. Cabinet: **<< Steel; Galvanized steel; or _____>>** with baked enamel finish, including access **<< panels with screwdriver operated flush cam type fasteners; doors with piano hinges and locking handle; or _____>>**. Structural members shall be minimum **<< 18 gauge, 0.0478 inch>>**, with access doors or panels of minimum **<< 20 gauge, 0.0359 inch>>**.

B. Heat Exchangers: **<< Aluminized; Stainless; or _____>>** steel, of welded construction.

C. Supply**<< and Return; and Exhaust; _____; or None - N/A>>** Fan: Forward curved centrifugal type, resiliently mounted with V-belt drive,**<< adjustable variable pitch pulley,; _____ ,; or None - N/A>>** and rubber isolated hinge mounted**<< high efficiency; _____; or None - N/A>>** motor**<< or direct drive; _____; or None - N/A>>**; see Section **<< 230548>>**.**<< Isolate complete fan assembly.; _____ .; or None - N/A>>**

1.03 BURNER

A. Gas Burner: **<< Atmospheric; Induced draft; Forced draft; or _____>>** type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shut-off, intermittent spark or glow coil ignition, flame sensing device, and automatic 100 percent shut-off pilot.

B. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after airflow proven and slight delay, allow gas valve to open.

1.04 << EVAPORATOR; INDOOR; OR _____>> COIL

A. Provide copper tube aluminum fin coil assembly with galvanized drain pan and connection.

B. Provide capillary tubes or thermostatic expansion valves for units of **<< 6 Tons of refrigeration>>** capacity and less, and thermostatic expansion valves and alternate row circuiting for units **<< 7.5 Tons of refrigeration>>** cooling capacity and larger.

1.05 COMPRESSOR

A. Provide **<< hermetic; semi-hermetic; or _____>>** compressors, 3600 rpm maximum, resiliently mounted with positive lubrication, crankcase heater, high and low pressure safety

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controls, motor overload protection, suction and discharge service valves and gauge ports, and filter drier.

1.06 << CONDENSER; OUTDOOR; OR _____>> COIL

A. Provide copper tube **<< aluminum; copper; or _____>>** fin coil assembly with subcooling rows**<< and coil guard; _____; or None - N/A>>**.

B. Provide direct drive propeller fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor.**<< Provide high efficiency fan motors.; _____ .; or None - N/A>>**

1.07 HEAT RECOVERY COIL

A. Provide copper tube aluminum fin coil assembly**<< with multiple circuits; _____; or None - N/A>>** arranged to provide heat recovery.

END OF SECTION 237413

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SECTION 237416
PACKAGED ROOFTOP AIR-CONDITIONING UNITS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section **<< 230548 - Vibration and Seismic Controls for HVAC>>**.

1.02 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Product Data: Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.

C. Shop Drawings: Indicate capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.

D. Manufacturer's Instructions: Indicate assembly, support details, connection requirements, and include start-up instructions.

E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in **<<Owner>>**'s name and registered with manufacturer.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Protect units from physical damage by storing off site until roof mounting curbs are in place and ready for immediate installation of units.

1.04 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Provide a **<< five; or _____>>** year warranty to include coverage for **<< refrigeration compressors; heat exchangers; or _____>>**.

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PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Carrier Corporation**<< ; _____; or None - N/A>>**: www.commercial.carrier.com/#sle.

B. Johnson Controls International, PLC**<< ; _____; or None - N/A>>**: www.johnsoncontrols.com/#sle.

C. Rheem Manufacturing Company Inc**<< ; _____; or None - N/A>>**: www.rheem.com/#sle.

D. Trane Technologies, PLC**<< ; _____; or None - N/A>>**: www.trane.com/#sle.

2.02 PACKAGED, SMALL-CAPACITY, ROOFTOP AIR-CONDITIONING UNITS

A. General: Roof mounted units having **<< gas burner; electric heating elements; or _____>>** and electric refrigeration that are 6 tons and smaller in capacity.

B. Description: Self-contained, packaged, factory assembled and prewired, consisting of cabinet and frame, supply fan,**<< return fan,; _____ ,; or None - N/A>><< heat exchanger and**

burner,; electric heating elements,; _____ ,; or None - N/A>><< heat recovery coil,; _____ ,; or None - N/A>> controls, air filters, refrigerant cooling coil and compressor, condenser coil and condenser fan.

C. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of **<< zero; or _____>>** and global warming potential (GWP) **<< no greater than that allowed by federal code; of less than 50; or _____>>**.

2.03 PACKAGED, INTERMEDIATE-CAPACITY, ROOFTOP AIR-CONDITIONING UNITS

A. General: Roof mounted units having **<< gas burner; electric heating elements; or _____>>** and electric refrigeration that are 7.5 tons to 25 tons in capacity.

B. Description: Self-contained, packaged, factory assembled and prewired, consisting of cabinet and frame, supply fan,**<< return fan,; _____ ,; or None - N/A>><< heat exchanger and burner,; electric heating elements,; _____ ,; or None - N/A>><< heat recovery coil,; _____ ,; or None - N/A>>** controls, air filters, refrigerant cooling coil and compressor, condenser coil and condenser fan.

C. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of **<< zero; or _____>>** and global warming potential (GWP) **<< no greater than that allowed by federal code; of less than 50; or _____>>**.

2.04 PACKAGED, LARGE-CAPACITY, ROOFTOP AIR-CONDITIONING UNITS

A. General: Roof mounted units having **<< gas burner; electric heating elements; or _____>>** and electric refrigeration that are 25 tons and larger in capacity.

B. Description: Self-contained, packaged, factory assembled and prewired, consisting of cabinet and frame, supply fan,**<< return fan,; _____ ,; or None - N/A>><< heat exchanger and burner,; electric heating elements,; _____ ,; or None - N/A>><< heat recovery coil,; _____ ,; or None - N/A>>** controls, air filters, refrigerant cooling coil and compressor, condenser coil and condenser fan.

C. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of **<< zero; or _____>>** and global warming potential (GWP) **<< no greater than that allowed by federal code; of less than 50; or _____>>**

2.05 SPLIT-SYSTEM ROOFTOP UNITS

A. General: Roof mounted units having **<< gas burner; electric heating elements; or _____>>** and electric refrigeration that are 3 to 6 tons in capacity.

B. Description: Split-system, packaged, factory assembled and prewired, consisting of cabinet and frame, supply fan,**<< return fan,; _____ ,; or None - N/A>><< heat exchanger and burner,; electric heating elements,; _____ ,; or None - N/A>><< heat recovery coil,; _____ ,; or None - N/A>>** controls, air filters, refrigerant cooling coil.

C. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of **<< zero; or _____>>** and global warming potential (GWP) **<< no greater than that allowed by federal code; of less than 50; or _____>>**.

2.06 CASING

A. Cabinet: **<< Steel; Galvanized steel; or _____>>** with baked enamel finish, including access **<< panels with screwdriver-operated flush, cam type fasteners; doors with piano hinges and locking handle; or _____>>**. Structural members to be minimum **<< 18 gauge, 0.0478 inch>>**, with access doors or panels of minimum **<< 20 gauge, 0.0359 inch>>**.

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B. Insulation: **<< One-inch>>** thick, neoprene-coated glass fiber with edges protected from erosion.

2.07 FANS

A. Supply**<< and Return; and Exhaust; _____; or None - N/A>>** Fan: Forward curved centrifugal type, resiliently mounted with V-belt drive,**<< adjustable variable pitch pulley,; _____ ,; or None - N/A>>** and rubber isolated hinge mounted. Provide with**<< high efficiency; _____; or None - N/A>>** motor**<< or direct drive as indicated; _____; or None - N/A>>.<< Isolate complete fan assembly.; _____ .; or None - N/A>>** See Section **<< 230548>>**.

2.08 BURNERS

A. Gas Burner: **<< Atmospheric; Induced draft; Forced draft; or _____>>** type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shut-off, intermittent spark or glow coil ignition, flame-sensing device, and automatic 100 percent shutoff pilot.

B. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after airflow proven and slight delay, allow gas valve to open.

2.09 ELECTRIC HEATING COIL

A. **<< Finned tube heating elements; Helical nickel-chrome resistance wire coil heating elements with refractory ceramic support bushings; or _____>>** easily accessible with automatic reset thermal cut-out. Provide with built-in **<< magnetic; mercury; or _____>>** contactors, galvanized steel frame,**<< control circuit transformer and fuse,; _____ ,; or None - N/A>><< manual reset thermal cut-out,; _____ ,; or None - N/A>><< airflow proving device,; _____ ,; or None - N/A>><< pilot duty toggle switch.; _____ ,; or None - N/A>>** load fuses.

B. Controls: Start supply fan before electric elements are energized and continue operating until air temperature reaches minimum setting, with switch for continuous fan operation.

2.10 << EVAPORATOR; INDOOR; OR _____>> COIL

A. Provide copper tube aluminum fin coil assembly with galvanized drain pan and connection.

B. Provide capillary tubes or thermostatic expansion valves for units of **<< 6 tons>>** capacity and less, and thermostatic expansion valves and alternate row circuiting for units **<< 7.5 tons>>** cooling capacity and larger.

2.11 << CONDENSER; OUTDOOR; OR _____>> COIL

A. Provide copper tube **<< aluminum; copper; or _____>>** fin coil assembly with subcooling rows**<< and coil guard; _____; or None - N/A>>**.

B. Provide direct drive propeller fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor.**<< Provide high efficiency fan motors.; _____ .; or None - N/A>>**

2.12 COMPRESSORS

A. Provide **<< hermetic; semi-hermetic; or _____>>** compressors, 3600 rpm maximum, resiliently mounted with positive lubrication, crankcase heater, high and low pressure safety controls, motor overload protection, suction and discharge service valves and gauge ports, and filter drier.

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B. For heat pump units, provide reversing valve, suction line accumulator,**<< discharge muffler.; _____ .; or None - N/A>>** flow control check valve, and solid-state defrost control utilizing thermistors.

2.13 AIR FILTERS:

A. **<< 2-inch>>** thick, glass fiber disposable media in metal frames.

2.14 OPERATING CONTROLS

A. Provide low voltage, adjustable**<< room; ____; or None - N/A>>** thermostat to control **<< burner operation; heater stages in sequence with delay between stages; or _____>><< , compressor and condenser fan.; , _____ .; or None - N/A>>** and supply fan to maintain temperature setting.

1. Include system selector switch **<< heat-off-cool; off-heat-auto-cool; or _____>><< and auto-on fan control switch; _____; or None - N/A>>**.

B. Provide remote-mounted auto-on fan control switch.

2.15 OPERATING CONTROLS - SINGLE ZONE UNITS

A. Electric solid state microcomputer-based room thermostat,**<< located as indicated in service area with remote sensor; _____; or None - N/A>><< located as indicated in service area with remote sensor; _____; or None - N/A>>**.

2.16 OPERATING CONTROLS - VARIABLE VOLUME UNITS

A. Temperature transmitter located in supply air to signal electronic logic panel to control mixing dampers and cooling in sequence. Mixing section to operate as first stage of cooling and revert to minimum outside air above approximately **<< 75 degrees F>>** as determined by **<< enthalpy; temperature; or _____>>** of return and outdoor air.

B. Control cooling by cycling compressors, cylinder unloading, and hot gas bypass.

2.17 ROOF CURBS

A. Roof Mounting Curb: **<< 24 inches>>** high, galvanized steel, channel frame with gaskets, nailer strips.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that roof is ready to receive work and opening dimensions are as **<< indicated on shop drawings.; required by manufacturer.; or _____ .>>**

B. Verify that proper power supply is available.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Mount units on factory built roof mounting curb providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.

3.03 SYSTEM STARTUP

A. Prepare and start equipment. Adjust for proper operation.

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3.04 CLOSEOUT ACTIVITIES

A. See Section **<< 017800 - Closeout Submittals>>** for additional submittals.

B. See Section **<< 017900 - Demonstration and Training>>** for additional requirements.

C. Demonstrate proper operation of **<< equipment; or _____>>** to **<<Owner>>**'s designated **<< representative; personnel; or _____>>**.

3.05 MAINTENANCE

A. See Section **<< 017000 - Execution and Closeout Requirements>>** for additional requirements relating to maintenance service.

B. Provide service and maintenance of packaged rooftop units for **<< one year; ____ years; or _____>>** from Date of Substantial Completion.

C. Provide routine maintenance service with a two-month interval as maximum time period between calls.

D. Include maintenance items as outlined in manufacturer's operating and maintenance data, including minimum of six filter replacements, minimum of one fan belt replacement, and controls check-out, adjustments, and recalibration.

E. After each service call, submit copy of service call work order or report that includes description of work performed.

END OF SECTION 237416

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SECTION 237433
DEDICATED OUTDOOR AIR UNITS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section **<< 230513 - Common Motor Requirements for HVAC Equipment>>**.

B. Section **<< 230548 - Vibration and Seismic Controls for HVAC>>**.

C. Section **<< 230934 - Variable-Frequency Motor Controllers>>**.

D. Section **<< 233300 - Air Duct Accessories>>**: Flexible duct connections.

E. Section **<< 251400 - Integrated Automation Local Control Units>>**.

F. Section **<< 251500 - Integrated Automation Software>>**: BAS, BMS, or SCADA.

1.02 REFERENCE STANDARDS

A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

B. AHRI 270 (SI/I-P) - Sound Performance Rating of Outdoor Unitary Equipment.

C. AHRI 520 - Performance Rating of Positive Displacement Condensing Units.

D. ASHRAE Std 23 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Compressor Units.

E. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings.

F. NFPA 70 - National Electrical Code.

G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.

H. UL (DIR) - Online Certifications Directory.

I. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical.

1.03 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Product Data: Provide data with dimensions, duct and service connections, accessories, controls, electrical nameplate data, and wiring diagrams.

C. Shop Drawings: Indicate dimensions, duct and service connections, accessories, controls, electrical nameplate data, and wiring diagrams.

D. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.

E. Operation And Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

F. Warranty: Submit manufacturers warranty and ensure forms have been filled out in **<<Owner>>**'s name and registered with manufacturer.

1.04 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Provide **<< five; or _____>>** year manufacturers warranty for **<< compressor/condenser unit; or _____>>**.

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PART 2 PRODUCTS

2.01 MANUFACTURERS

A. AAON, Inc.

B. Annexair.

C. Innovent.

D. Venmar - Nortek Air Solutions.

E. XeteX.

2.02 << INDOOR-MOUNTED; MODULAR-INDOOR; OUTDOOR-MOUNTED; ROOF-MOUNTED; OR _____>> DOAS PERFORMANCE REQUIREMENTS

A. Performance Ratings: **<< ASHRAE Std 90.1; ASHRAE Std 90.2; or _____>>**, EER and COP as applicable.

B. Regulatory Requirements: **<<AHRI 270 (SI/I-P)>>** rated, **<<NFPA 70>>**, and **<<UL (DIR)>>** listed.

C. Electrical: **<< 480; 220; or _____>>** VAC, 3-phase, 60 Hz, single point to factory-mounted fused disconnect switch internally wired into motors and compressors, and other powered components including system safeties.

2.03 << INDOOR-MOUNTED; MODULAR-INDOOR; OUTDOOR-MOUNTED; ROOF-MOUNTED; OR _____>> DOAS

A. Packaged Unit:

1. Casing and Components:
   a. Fabrication: **<<AHRI 210/240>><< and UL 207; _____; or None - N/A>>** construction, **<<ASHRAE Std 23>>** tested.
   b. **<< 18 gauge, 0.0478 inch>>** steel panels reinforced with structural angles and channels to ensure rigidity.
   c. Provide bolted access panels to access each sections from either side of unit.
   d. Provide hinged door with lockable handle for serviceable sections.
   e. Drain Pan: Galvanized steel with corrosion-resistant coating.
2. Performance Ratings: **<< ASHRAE Std 90.1; ASHRAE Std 90.2; or _____>>**, EER and COP as applicable.
3. Regulatory Requirements: **<<AHRI 270 (SI/I-P)>>** rated, **<<NFPA 70>>**, and **<<UL (DIR)>>** listed.
4. Insulation: Minimum **<< 1/2 inch>>** thick acoustic duct liner for lining cabinet interior.
5. External Surface Finish: Heat resistant baked enamel.
6. Outdoor Installation: Weatherproofed casing, with intake louver or hood.
7. Outside Air Damper with Rain Hood and Screen:
   a. Dampers to modulate when unit is on economizer, space pressurization, or CO2 control.

B. Filter Section:

1. Filter: Removable, **<< 2 inches; 4 inches; or _____ inches>>** thick **<< MERV-7; MERV-8; MERV-11; MERV-13; MERV-14; MERV-___; combined MERV-8 and MERV-14; or _____>>**.

C. **<< Heating; Preheating; Preheating and Heating; or _____>>** Section:

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1. Indirect Gas-Fired Furnace:
   a. Fully sealed **<< natural gas; propane gas; or _____>>** burning assembly configured for modulated 25:1 turn down ratio using electrically operated devices including modulating main gas valve, shut down valve, main gas, and pilot gas regulators. Manual main gas shut-off valve and pilot adjustment valve.
   b. Insulation: Neoprene faced glass fiber insulation, **<< 1 inch>>** thick, on **<< inlet components to burner profile plate; complete unit; or _____>>**.
   c. Observation Port: On burner section for observing main and pilot flames.
   d. Pilot: Electrically ignited by spark rod through high voltage ignition transformer.
   e. Damper: Motorized with end switch to prove position before burner will fire.
2. Electrical:
   a. **<< Finned tube heating elements; Helical nickel-chrome resistance wire coil heating elements with refractory ceramic support bushings; or _____>>** easily accessible with automatic reset thermal cut-out, built-in **<< magnetic contactors; mercury contactors; silicone-controlled rectifier (SCR) interface; or _____>>**, galvanized steel frame with **<< airflow proving switch; load fuse; manual reset switch; pilot-duty toggle switches; step-down controls transformer; service lights; service GFCI receptacle; thermal cut-out switch; and _____>>**.
   b. Controls: Start supply fan before electric elements are energized and continue operating until air temperature reaches minimum setting, with switch for continuous fan operation. Integrate or coordinate controls with unit controller.

D. Cooling Section:
1. **<< Chilled; Glycol; or _____>>** Water:
   a. Provide copper tube aluminum fin coil assembly with galvanized drain pan and connection.
   b. Provide capillary tubes or thermostatic expansion valves for units of **<< 6 Tons>>** capacity and less, and thermostatic expansion valves and alternate row circuiting for units **<< 7.5 Tons>>** cooling capacity and larger.
2. Air-Source Heat Pump:
   a. Packaged air-source heat pump with integrated or coordinated controls.
   b. Compressor Section:
      1) Hermetically sealed, direct-driven **<< single-stage scroll; dual-stage scroll; or _____>>** type with centrifugal type oil pumps.
      2) Motor: Suction gas-cooled with voltage utilization range of plus/minus 10 percent of unit nameplate voltage.
      3) Internal spring isolation and sound muffling to minimize vibration transmission and noise.
      4) External high-and low-pressure switches.
   c. Refrigerant Load Control: Provide **<< hot-gas bypass; hot-gas reheat coil; and _____>>**.
   d. Evaporator Section: Internally finned **<< aluminum; copper; cupro-nickel; or _____>>** tubes mechanically bonded to aluminum plate fins.
3. **<< Packaged; Split; or _____>>** DX Cooling:
   a. Configuration: **<<AHRI 520>>**-rated, **<< R-454B; R-410A; or _____>>** refrigerant system with hot gas bypass.
   b. Evaporator Coil: Copper tube aluminum fin coil assembly with alternate row circuiting, and with galvanized drain pan and thermostatic expansion valve.

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c. Compressor: **<< One; Two; Inverter-duty; or ___>>** hermetic **<< single-stage scroll; dual-stage scroll; reciprocating; or _____>>**, 3,600 rpm maximum resilience with positive lubrication, crankcase heater, high pressure control, low pressure control, motor overload protection, service valves and dryer.

d. Condenser Side: Aluminum fin and copper tube coil, direct drive axial fan resiliently mounted, galvanized fan guard. ECM condenser fans.

e. Operating and Safety Controls: Internally coordinated with main unit controls.

E. Fan Section:

1. Provide direct or plenum mounted **<< 2 speed; 5 speed; constant volume; variable-speed; or _____>>** fan motors; see Section **<< 230513>>**.
2. Draw-through, **<< forward; backward; or _____>>**-curved fan, constructed of corrosion-resistant, galvanized material and designed for efficient, quiet operation.
3. Factory program for both soft start and constant flow output over static pressure range.
4. Provide preinstalled neutral wire protection when required to support specified fan type.
5. Motor to include thermal overload protection, quick disconnect plug, and permanently lubricated bearings.
6. Belt-Driven Motor Requirements: Provide adjustable blower motor/sheave combination device based on indicated flow performance requirements. Statically and dynamically balanced centrifugal fan mounted on solid steel shaft with heavy-duty, self-aligning, prelubricated ball bearings and V-belt drive with matching motor sheaves and belts.
7. Variable Speed Control: Configure controller to maintain adjustable flow setpoint for modulating or speed-switched units; see Section **<< 230934>>**.
8. Fan Turndown: Design control features to allow fan speed reduction to adjustable **<< 50; or __>>** percent of its capacity when the zone set point temperature is satisfied or when unit runs in fan-only mode.

F. Unit Controls:

1. DDC:
   a. Application Specific Controller; see Section **<< 251400>>** unless factory-provided.
   b. Tested to monitor and handle sequencing functions and other operational modes using field-mounted thermostat and other sensors.
   c. Coordination and Sequencing:
      1) Internal Devices: Include compressors, blower, sensors, switches, valves, safeties, other components.
      2) Field-Installed Devices: Solenoid valves, thermostat, EWT sensors, LWT sensors, internal and remote contacts, and other devices required for operation.
      3) Safeties: At minimum include anti-short-cycle compressor protection, condensate overflow, refrigerant high pressure, refrigerant low pressure, loss-of-charge, refrigerant freeze protection, and freezestat.
2. Thermostat:
   a. Field mounted and wired, tied into prewired control-interface terminals.
   b. Smart Thermostat:
      1) BASIntegrated Automation linked programmable thermostat; see Section **<< 251400>>**.
   c. Programmable Thermostat:
      1) Electro-mechanical type with **<< key- or pushbutton-operated display; touchscreen; or _____>>**.
      2) Programmable occupied/unoccupied weekly and holiday schedule.

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d. Nonprogrammable Thermostat:
1) Electro-mechanical type with **<< key- or pushbutton-operated display; touchscreen; or _____>>**.
2) User-configurable, precoded options aligned with equipment functions.
e. Thermostat: Single-gang-box-mounted platinum or thermistor.
1) Local Interface to Include:
(a) Filter maintenance indicating status.

3. Local Control Panel: Interface to include on-off**<< -auto; - ____; or None - N/A>>** switch,**<< summer-winter switch,; _____ ,; or None - N/A>><< heat-off-cool switch,; _____ ,; or None - N/A>>** indicating lights for supply fan,**<< exhaust fan,; return fan,; return-exhaust fan,; _____ ,; or None - N/A>>** pilot operation, burner operation,**<< lockout indication,; _____ ,; or None - N/A>>** and clogged filter indication.

G. Electrical: **<< 480; 220; or _____>>** VAC, 3-phase, 60 Hz, single point to factory-mounted **<< fused; nonfused; or _____>>** disconnect switch internally wired into motors and compressors, and other powered components including system safeties.

H. Furnish dedicated outdoor air unit and associated components and accessories produced by a single manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide unit- or duct-mounted smoke detectors and other **<<NFPA 90A>>** provisions.

C. Install unit on vibration isolator pad or roof curb; see Section **<< 230548>>**.

D. Provide flexible duct connections on**<< inlet and; _____; or None - N/A>>** outlet from unit; see Section **<< 233300>>**.

E. Connect drain pan outlet to nearest building drain system piping.

F. Adjusting: Use plenum static pressure readings against manufacturer calibration chart to adjust primary airflow as other measuring methods will not work.

G. Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s) and remote **<< front-end interface; see Section 251500; software app or terminal; see Section 253500; or _____>>**.

END OF SECTION 237433

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SECTION 238126.13
SMALL-CAPACITY SPLIT-SYSTEM AIR CONDITIONERS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units.

C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems.

D. ASHRAE Std 23 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Compressor Units.

E. NEMA MG 00001 - Motors and Generators.

F. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.

G. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

H. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical.

1.02 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>**, for submittal procedures.

B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.

D. Design Data: Indicate refrigerant pipe sizing.

E. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.

F. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.

G. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

H. Warranty: Submit manufacturers warranty and ensure forms have been filled out in **<<Owner>>**'s name and registered with manufacturer.

1.03 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Carrier Corporation.

B. Daikin AC.

C. LG, Inc.

D. Mitsubishi Electric Trane

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2.02 SYSTEM DESIGN

A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.

1. Heating and Cooling: **<< Air-source; Water-source; or _____>>** electric heat pump located in outdoor unit with evaporator**<< ; auxiliary electric heat; ; _____; or None - N/A>>**.
2. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.

2.03 INDOOR AIR HANDLING UNITS FOR DUCTED SYSTEMS

A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating and cooling element(s), controls, and accessories; wired for single power connection with control transformer.

1. Air Flow Configuration: **<< Upflow; or Horizontal>>**.
2. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.

B. Supply Fan: Centrifugal type rubber mounted with direct or belt drive with adjustable variable pitch motor pulley.

1. Motor:**<< NEMA MG 1;; _____ ;; or None - N/A>>** 1750 rpm **<< single speed; two-speed; multiple speed; or _____ >>**, permanently lubricated**<< , hinge mounted; , _____; or None - N/A>>**.

C. Air Filters: **<< 1 inch>>** thick **<< urethane, washable; glass fiber, disposable; or _____>>** type arranged for easy replacement.

D. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.

1. Construction and Ratings: In accordance with **<<AHRI 210/240>><< and UL 207; _____; or None - N/A>>**.
2. Manufacturers: System manufacturer.

2.04 OUTDOOR UNITS

A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.

1. Refrigerant: **<< R-454B; or R-32>>**.
2. Cabinet: **<< Galvanized steel; Steel; or _____>>** with **<< baked enamel; baked powder; powder coat paint; or _____>>** finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
3. Construction and Ratings: In accordance with **<<AHRI 210/240>>** with testing in accordance with **<<ASHRAE Std 23>><< and UL 207; _____; or None - N/A>>**.

B. Compressor: **<< Hermetic; Scroll; or _____>>,<< two speed 1800 and; _____; or None - N/A>>** 3600 rpm,**<< AHRI 520; _____; or None - N/A>>** resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high-pressure control, motor overload protection, service valves and drier. Provide time delay control to prevent short cycling**<< and rapid speed changes; _____; or None - N/A>>**.

C. Air Cooled Condenser: Aluminum fin and copper tube coil,**<< AHRI 520; _____; or None - N/A>>** with direct drive axial propeller fan resiliently mounted, galvanized fan guard.

1. Condenser Fans: **<< Direct-drive propeller type; or _____>>**.

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2. Condenser Fan Motor: Enclosed, **<< 1-phase type; or _____>>**, permanently lubricated.

D. Coil: Air-cooled, aluminum fins bonded to copper tubes.

E. Accessories: Filter drier, high-pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).
   1. Provide thermostatic expansion valves.
   2. Provide heat pump reversing valves.

F. Operating Controls:
   1. Control by room thermostat to maintain room temperature setting.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.

B. Install in accordance with **<< NFPA 90A; NFPA 90B; NFPA 90A and NFPA 90B; or _____>>**.

C. Install refrigeration systems in accordance with **<<ASHRAE Std 15>>**.

END OF SECTION 238126.13

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SECTION 238129
VARIABLE REFRIGERANT FLOW HVAC SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air-source outdoor units.

B. Water-source outdoor units.

C. Refrigerant piping.

D. Refrigerant branch units.

E. Indoor units.

1.02 RELATED REQUIREMENTS

A. Section **<< 230529 - Hangers and Supports for HVAC Piping and Equipment>>**.

B. Section **<< 230719 - HVAC Piping Insulation>>**.

C. Section **<< 230800 - Commissioning of HVAC>>**.

D. Section **<< 232300 - Refrigerant Piping>>**.

E. Section **<< 250800 - Commissioning of Integrated Automation>>**.

F. Section **<< 251500 - Integrated Automation Software>>**.

1.03 REFERENCE STANDARDS

A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

B. AHRI 1230 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment.

C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems.

E. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants.

F. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings.

G. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks.

H. ITS (DIR) - Directory of Listed Products.

I. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

J. NFPA 70 - National Electrical Code.

K. UL 1995 - Heating and Cooling Equipment.

1.04 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Product Data: Submit manufacturer's standard data sheets showing the following for each item of equipment, marked to correlate to equipment item markings indicated in Contract Documents:

1. Outdoor Units:

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a. Refrigerant Type and Size of Charge.
b. Output and Input Cooling Capacity: **<< Btu/h>>**.
c. Output and Input Heating Capacity: **<< Btu/h>>**.
d. Operating Temperature Range, Cooling and Heating.
e. Fan Capacity: Flow in **<< cfm>>** with respective fan curves.
f. External Static Pressure (ESP): **<< In-wc>>**.
g. Sound Pressure Level: dB(A).
h. Electrical Data: Complete including motor size.
i. Maximum number of indoor units that can be served.
j. Maximum refrigerant piping run from outdoor unit to indoor unit(s).
k. Maximum height difference between outdoor unit to Indoor unit(s), both above and below.

2. Indoor Units:
a. Output and Input Cooling Capacity: **<< Btu/h>>**.
b. Output and Input Heating Capacity: **<< Btu/h>>**.
c. Fan Capacity: Flow in **<< cfm>>** with respective fan curves.
d. External Static Pressure (ESP): **<< In-wc>>**.
e. Electrical Data: Complete including motor size.
f. Maximum Lift of Built-in Condensate Pump.

3. Control Panels: Complete data of controllers, input-output points, and zones.

C. Shop Drawings: Installation drawings custom-made for this project; include as-designed HVAC layouts, locations of equipment items, refrigerant piping sizes and locations, condensate piping sizes and locations, remote sensing devices, control components, electrical connections, control wiring connections. Include:
1. Detailed piping diagrams, with branch balancing devices.
2. Condensate piping routing, size, and pump connections.
3. Detailed power wiring diagrams.
4. Detailed control wiring diagrams.
5. Locations of required access through fixed construction.
6. Drawings required by manufacturer.

D. Design Data:
1. Provide design calculations showing that system will achieve performance specified.
2. Provide design data with respective calculations for respective climate zone in accordance with **<<ASHRAE Std 90.1 I-P>>**, **<<ASHRAE Std 15>>**, and **<<ASHRAE Std 34>>**.
3. Outdoor units' connection ratio shall not exceed 130%.

E. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.

F. Operating and Maintenance Data:
1. Manufacturer's complete standard instructions for each unit of equipment and control panel.
2. Custom-prepared system operation, troubleshooting, and maintenance instructions and recommendations.
3. Identification of replaceable parts and local source of supply.

G. Warranty: Executed warranty, made out in **<<Owner>>**'s name.

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H. Project Record Documents: Record the following:
   1. As-installed routing of refrigerant piping and condensate piping.
   2. Locations of access panels.
   3. Locations of control panels.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Company that has been manufacturing variable refrigerant volume heat pump equipment for at least **<< 5 years; or _____>>**.
   2. Company that provides system design software to installers.

B. Installer Qualifications: Trained and approved by manufacturer of equipment.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle equipment and refrigerant piping according to manufacturer's recommendations.

1.07 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Provide a manufacturer's extended ten year warranty from date of Substantial Completion for material to replace compressors, indoor units, branch controllers, and outdoor units that fail in materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Carrier Corporation - Carrier-Toshiba.

B. Daikin Comfort Technologies North America, Inc.

C. LG Electronics U.S.A., Inc.

D. Mitsubishi Electric Trane HVAC US, LLC.

E. Coordinate any changes from the basis of design manufacturer with all other trades. Any additional costs with the alternate manufacturer shall be covered by the equipment manufacturer. No additional costs shall be incurred by the Owner.

2.02 VARIABLE REFRIGERANT FLOW SYSTEM

A. Minimum System Requirements:
   1. System Testing, Capacity Rating, and Performance:
      a. **<<AHRI 1230>>** when cooling capacity is equal or greater than **<< 65,000 Btu/h>>**.
      b. **<<AHRI 210/240>>** when cooling capacity is below **<< 65,000 Btu/h>>**.
   2. Safety Certification: Bear **<<UL 1995>>** tested and **<<ITS (DIR)>>** listed certification label.
   3. Outdoor Units: Furnish installation and surface support hardware products in accordance with **<<ASCE 7>>** for**<< seismic and; _____; or None - N/A>>** wind restraint.

B. System Design and Installation Considerations:
   1. Conditioned spaces and zones are indicated on drawings.
   2. Outside unit locations **<< are; are not; or _____>>** indicated on drawings.

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3. Indoor unit locations **<< are; are not; or _____>>** indicated on drawings.
4. Branch refrigerant unit locations **<< are not; are; or _____>>** indicated on drawings.
5. Required equipment unit capacities are **<< indicated on drawings; indicated in the attached equipment list; not defined in Contract Documents; or _____>>**.
6. Refrigerant piping sizes are not indicated on drawings.
7. Condensate piping to nearest drain **<< is; is not; or _____>>** indicated on drawings.
8. Provide calculations showing **<<ASHRAE Std 15>>** guideline compliance.

2.03 AIR-SOURCE OUTDOOR UNITS

A. **<< Air Conditioning; Heat Pump; Heat Recovery; or _____>>** Type:
   1. DX refrigeration unit piped to one or more compatible indoor units either directly or indirectly through one or more intermediate refrigeration branch units.
   2. Manifold two or to three units as recommended by manufacturer to handle sequencing and coordination of multiple indoor units.

B. Unit Cabinet:
   1. Capable of being installed with wiring and piping to the left, right, rear or bottom.
   2. Designed to allow side-by-side installation with minimum spacing and vibration isolation.
   3. Weatherproof and corrosion resistant; rust-proofed mild steel panels coated with baked enamel finish.
   4. Sound Pressure Level: **<< 54; 55; 59; 60; or ___>>** dB measured at **<< 3 feet; or ___ feet>>** from front of unit**<< ; provide night setback sound control with selectable sound level steps of 55 dB, 50 dB, and 45 dB; ; _____; or None - N/A>>**.

C. Heat Sink Side:
   1. Condenser Fans:
      a. Provide minimum of 2 fans for each condenser within the outdoor unit.
      b. Minimum External Static Pressure: Factory set at **<< 0.12 in-wc; or ___ in-wc>>**.
      c. Fan Type: Vertical discharging, direct-driven propeller type with variable speed operation using DC-controlled ECM motors mechanically connected using permanently lubricated bearings having whole assembly protected with fan guards.
   2. Condenser Coils:
      a. **<< Copper; Hi-X seamless copper; or _____>>** tubes expanded into aluminum fins to form mechanical bond; waffle louver fin and rifled bore tube design to ensure high efficiency performance.

D. Refrigeration Side:
   1. Factory assembled and wired with instrumentation, switches, and controller(s) to handle unit specifics with direct coordination of remote controller(s) from indoor unit(s).
   2. Refrigeration Circuit: ECM driven dual scroll compressors, fans, condenser heat sink coil, expansion valves, solenoid valves, distribution headers, capillaries, filters, shutoff valves, oil separators, service ports, and refrigerant regulator.
   3. Refrigerant: **<< R-454B; or R-32>>** factory charged. Controller to alarm when charge is below capacity.
   4. Variable Volume Control: Modulate compressed refrigerant capacity automatically to maintain constant suction and condensing pressures under varying refrigerant volume required to handle remote loads. Include defrost control.
   5. Provide refrigerant subcooling to ensure the liquid refrigerant does not flash when supplying to use indoor units.

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6. Capable of heating operation at low end of operating range as specified, without additional low ambient controls or auxiliary heat source; during heating operation, reverse cycle, oil return, or defrost is not permitted due to potential reduction in space temperature.
7. Power Failure Mode: Automatically restarts operation after power failure without loss of programmed settings.
8. Safety Devices: High pressure sensor with cut-out switch, low pressure sensor with cut-out switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, overcurrent protection for the inverter and antirecycling timers.
9. Oil Recovery Cycle: Automatic, occurring 2 hours after start of operation and then every 8 hours of operation; maintain continuous heating during oil return operation.

E. Local Controls:
1. Include factory-wired instruments, sensors, switches, and safeties for unit control.
2. Configured to coordinate internal unit operation with remote indoor units and with built-in capacity to coordinate other manifolded outdoor units and remote refrigerant branch unit(s).
3. Include **<< color touchscreen; monochrome touchscreen; screen and button; or _____>>** interface to setup operating schedules, setpoints, alarms, and remote unit setpoint coordination. Also used for system troubleshooting.
4. Self diagnostic, auto-check functions to detect malfunctions and display the type and location.

F. BAS Integrated Automation Link: **<< ASHRAE Std 135 BACnet IP; ASHRAE Std 135 BACnet SC; ASHRAE Std 135 BACnet MS/TP; Modbus (PS) Modbus IP; Modbus (PS) Modbus RTU; LonMark Interoperability Guide LonWorks; Bluetooth CS Bluetooh wireless; IEEE 802.11 Wi-Fi wireless; IEEE 802.15.4 Zig-Bee wireless; or _____>>**.

G. Power:
1. Electrical Requirement: **<< 208 to 230; or 460>>** VAC, 3-phase, 60 Hz.
2. Outdoor Mounted: Provide fused **<<NEMA EN 10250>>** Type 4X disconnect switch.
3. Interior Mounted: Provide fused **<<NEMA EN 10250>>** Type 1 disconnect switch.

2.04 WATER-SOURCE OUTDOOR UNITS

A. **<< Air Conditioning; Heat Pump; Heat Recovery; or _____>>** Type:
1. DX refrigeration unit piped to one or more compatible indoor units either directly or indirectly through one or more intermediate refrigeration branch units.
2. Manifold two or to three units as recommended by manufacturer to handle sequencing and coordination of multiple indoor units.

B. Unit Cabinet:
1. Capable of being installed with wiring and piping to the left, right, rear or bottom.
2. Designed to allow side-by-side installation with minimum spacing and vibration isolation.
3. Weatherproof and corrosion resistant; rust-proofed mild steel panels coated with baked enamel finish.
4. Sound Pressure Level: **<< 54; 55; 59; 60; or ___>>** dB measured at **<< 3 feet; or ___ feet>>** from front of unit**<< ; provide night setback sound control with selectable sound level steps of 55 dB, 50 dB, and 45 dB; ; _____; or None - N/A>>**.

C. Heat Exchanger Side:
1. High efficiency stainless steel plate and frame heat exchanger.

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2. Threaded piping-end connections for external **<< 2-pipe hot; 2-pipe cold; 2-pipe chilled; 2-pipe ground-loop; 4-pipe hot and chilled; 4-pipe hot and cold; or _____>>** water source.
3. Provide manual isolation valve and pete's plug on each pipe side for maintenance.
4. Provide unit-controlled solenoid valve on return water side to start source flow when in use.

D. Refrigeration Side:
1. Factory assembled and wired with instrumentation, switches, and controller(s) to handle unit specifics with direct coordination of remote controller(s) from indoor unit(s).
2. Refrigeration Circuit: ECM driven dual scroll compressors, fans, condenser heat sink coil, expansion valves, solenoid valves, distribution headers, capillaries, filters, shutoff valves, oil separators, service ports, and refrigerant regulator.
3. Refrigerant: **<< R-454B; R-32; or _____>>** factory charged. Controller to alarm when charge is below capacity.
4. Variable Volume Control: Modulate compressed refrigerant capacity automatically to maintain constant suction and condensing pressures under varying refrigerant volume required to handle remote loads. Include defrost control.
5. Provide refrigerant subcooling to ensure the liquid refrigerant does not flash when supplying to use indoor units.
6. Capable of heating operation at low end of operating range as specified, without additional low ambient controls or auxiliary heat source; during heating operation, reverse cycle, oil return, or defrost is not permitted due to potential reduction in space temperature.
7. Power Failure Mode: Automatically restarts operation after power failure without loss of programmed settings.
8. Safety Devices: High pressure sensor with cut-out switch, low pressure sensor with cut-out switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, overcurrent protection for the inverter and antirecycling timers.
9. Oil Recovery Cycle: Automatic, occurring 2 hours after start of operation and then every 8 hours of operation; maintain continuous heating during oil return operation.

E. Local Controls:
1. Include factory-wired instruments, sensors, switches, and safeties for unit control.
2. Configured to coordinate internal unit operation with remote indoor units and with built-in capacity to coordinate other manifolded outdoor units and remote refrigerant branch unit(s).
3. Include **<< color touchscreen; monochrome touchscreen; screen and button; or _____>>** interface to setup operating schedules, setpoints, alarms, and remote unit setpoint coordination. Also used for system troubleshooting.
4. Self diagnostic, auto-check functions to detect malfunctions and display the type and location.

F. BAS Integrated Automation Link: **<< ASHRAE Std 135 BACnet IP; ASHRAE Std 135 BACnet SC; ASHRAE Std 135 BACnet MS/TP; Modbus (PS) Modbus IP; Modbus (PS) Modbus RTU; LonMark Interoperability Guide LonWorks; Bluetooth CS Bluetooh wireless; IEEE 802.11 Wi-Fi wireless; IEEE 802.15.4 Zig-Bee wireless; or _____>>**.

G. Power:
1. Electrical Requirement: **<< 208 to 230; 460; or _____>>** VAC, 3-phase, 60 Hz.
2. Outdoor Mounted: Provide fused **<<NEMA EN 10250>>** Type 4X disconnect switch.

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3. Interior Mounted: Provide fused **<<NEMA EN 10250>>** Type 1 disconnect switch.

2.05 REFRIGERANT PIPING

A. Two-Pipe Run: Provide low-pressure vapor and high-pressure vapor gas pipes for each indoor unit selected for seasonal heating or cooling service.

B. Three-Pipe Run: Provide low-pressure vapor, high-pressure vapor gas, and liquid pipes for each indoor unit selected for off-season heating and cooling changeover service.

C. Refrigerant Flow Balancing: Provide refrigerant piping joints and headers specifically designed to ensure proper refrigerant balance and flow for optimum system capacity and performance; T-style joints are prohibited.

2.06 REFRIGERANT BRANCH UNITS

A. Outdoor unit interface to handle two or more indoor units required to do automatic off-season heating and cooling changeover.

B. Concealed box consisting internally-piped refrigeration loops, subcooling heat exchanger, and other devices coordinated by electronic valves to facilitate off-season load management between outdoor and indoor units.

C. Provide labeling and valve tags for each zone isolation valve and what equipment/ indoor unit it serves and include in valve tag schedule.

D. Minimum Requirements:

1. Control direction of refrigerant flow using electronic expansion valves; use of solenoid valves for changeover and pressure equalization is not permitted due to refrigerant noise; use of multi-port branch selector boxes is not permitted unless spare ports are provided for redundancy.
2. Provide one electronic expansion valve for each downstream indoor unit served except when multiple indoor units are connected, provide balancing joints in downstream piping to keep total capacity within branch unit capacity.
3. Energize subcooling heat exchanger during simultaneous heating and cooling service.
4. Casing: Galvanized steel sheet with flame and heat resistant foamed polyethylene sound and thermal insulation.
5. Refrigerant Connections: Braze type.
6. Condensate Drainage: Provide condensate drain where required by manufacturer.

2.07 INDOOR UNITS

A. Manufacturers:

B. Minimum Unit Requirements:

1. DX Evaporator Coil:
   a. Copper tubes expanded into aluminum fins to form a mechanical bond; waffle louver fin and high heat exchange, rifled bore tube design; factory tested.
   b. 2-, 3-, or 4-row cross fin design with 14 to 17 fins per inch and flare end-connections.
   c. Provide thermistor on liquid and gas lines wired into local controller.
   d. Refrigerant circuits factory-charged with dehydrated air for field charging.
2. Fan Section:
   a. Variable or three-speed ECM fan with automatic airflow adjustment; external static pressure selectable during commissioning.
   b. Thermally protected, direct-drive motor with statically and dynamically balanced fan blades.

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c. Minimum-adjustable external static pressure **<< 0.32 in-wc; or ___ in-wc>>**; provide for mounting of field-installed ducts.

3. Local Unit Controls:
   a. Exposed Thermostat: Wall-mounted thermostat wired into controller. Wall sensor shall display space temperature. Do not control based on return air temperature. Controller shall maintain setpoint for two hours after loss of power.
   b. Temperature Control: Wall thermostat air control using thermistor tied to computerized Proportional-Integral-Derivative (PID) control of superheat.
   c. Temperature Zones:
      1) Single Indoor Unit: Set served space(s) as the local temperature zone.
      2) Multiple Indoor Units: For large zones, group and coordinate related indoor units with served spaces as the local temperature zone with each indoor unit as sub-zone.
4. Return Air Filter:
   a. Provide air filter rack for non-manufacturer's standard filters.
5. Condensate:
   a. Built-in condensate drain pan with PVC drain connection for drainage.
   b. Units With Built-In Condensate Pumps: Provide condensate safety shutoff and alarm.
   c. Units Without Built-In Condensate Pump: Provide built-in condensate float switch and wiring connections.
6. Cabinet Insulation: Sound absorbing foamed polystyrene and polyethylene insulation.

C. Ceiling-Recessed Cassette, Indoor Units:
1. Ceiling mount, 4-way, 2-way, or 1-way supply air flow units with central return air grill, DX coil, tubed drain pan, and built-in controls with thermostat remotely coordinated by outdoor air unit to maintain local air temperature setpoint.
2. Cabinet Height: Maximum of **<< 10 inches; or ___ inches>>** above face of ceiling.
3. Exposed Housing: White, impact resistant, with washable decoration panel.
4. Supply Airflow Adjustment:
   a. Horizontally and vertically adjustable dampers with electronic actuators.
   b. Four-way distribution field-modifiable to 3-way and 2-way airflow.
   c. Three auto-swing positions, including standard, draft prevention and ceiling stain prevention.
5. Return Air Filter: **<< Manufacturer's standard; High efficiency, MERV 8; High efficiency, MERV 13; or _____>>**.
6. Sound Pressure Range: Between 28 to 33 dB(A) at low speed measured at **<< 5 feet>>** below the unit.
7. Fan: Direct-drive turbo type, with motor output range of **<< 1/16 to 1/8 hp; or ___ hp>>**.
8. Condensate Pump: Built-in with minimum lift of **<< 21 inches; or ___ inches>>**.

D. Ceiling-Concealed Ducted Indoor Units:
1. Type: Ducted unit with DX coil, tubed drain pan, and built-in controls with thermostat remotely coordinated by outdoor air unit to maintain local air temperature setpoint.
2. Ducted horizontal discharge and side or back-end return; galvanized steel cabinet.
3. Variable or three-speed ECM fan with automatic airflow adjustment; external static pressure selectable during commissioning.
4. Return Air Filter: **<< Manufacturer's standard; High efficiency, MERV 8; High efficiency, MERV 13; or _____>>**.

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5. Sound Pressure: Measured at low speed at **<< 5 feet>>** below unit.
6. Provide external static pressure switch adjustable for high efficiency filter operation
7. Condensate Pump: Built-in, with lift of **<< 9 inches; or ___ inches>>**, minimum.
8. Switchbox accessible from side or bottom.

E. Wall Mounted, Indoor Units:
1. DX coil, tubed drain pan, and built-in controls with thermostat remotely coordinated by outdoor air unit to maintain local air temperature setpoint.
2. Variable or three-speed ECM cross-flow fan with automatic airflow adjustment; external static pressure selectable during commissioning.
3. Return Air Filter: **<< Manufacturer's standard; High efficiency, MERV 8; High efficiency, MERV 13; or _____>>**.
4. Provide exposed unit casing with removable front grille; foamed polystyrene and polyethylene sound insulation; wall mounting plate; polystyrene condensate drain pan.
5. Airflow Control: Auto-swing louver that closes automatically when unit stops; five (5) steps of discharge angle, set using remote controller; upon restart, discharge angle defaults to same angle as previous operation.
6. Sound Pressure Range: Measured at low speed at **<< 3.3 feet>>** below and away from unit.
7. Condensate Pump: Built-in, concealed.
8. Condensate Drain Connection: **<< Back, with piping concealed in wall; Side (end), not concealed in wall; or _____>>**.

F. Air Handling, Indoor Units:
1. Vertical Configuration: Top discharge air and bottom return air; **<< floor mounted; mounted as indicated; or _____>>**.
2. Horizontal Right Configuration: Horizontal discharge air and horizontal return air.
3. DX coil, tubed drain pan, and built-in controls with thermostat remotely coordinated by outdoor air unit to maintain local air temperature setpoint.
4. Variable or three-speed ECM fan with automatic airflow adjustment; external static pressure selectable during commissioning.
5. Return Air Filter: **<< Manufacturer's standard; High efficiency, MERV 8; High efficiency, MERV 13; or _____>>**, provide pressure differential gauge with adjustable signal flag outside the unit for local monitoring.
6. Factory-painted heavy gauge steel casing insulated with sound absorbing foil faced insulation.
7. Secondary condensate drain pan; field installed.
8. Electric Heating: Field installed, with circuit breaker for each unit.
9. External insulation; field installed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that required electrical services have been installed and are in the proper locations prior to starting installation.

B. Verify that condensate piping has been installed and is in the proper location prior to starting installation.

C. Notify **<<Architect>>** if conditions for installation are unsatisfactory.

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3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install refrigerant piping in accordance with equipment manufacturer's instructions.

C. Perform wiring in accordance with **<<NFPA 70>>**, National Electric Code (NEC).

D. Coordinate with installers of systems and equipment connecting to this system.

E. Refrigerant Piping: See Section **<< 232300>>** with Section **<< 230719>>** for insulation, and Section **<< 230529>>** for hangers and supports unless following specific manufacturer recommendations.

F. Connect indoor units to condensate piping.

G. Coordinate BAS, BMS, or Integrated Automation linking between local controller(s) and remote front end interface.

3.03 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

B. Provide manufacturer's field representative to inspect installation prior to startup.

3.04 SYSTEM STARTUP

A. Provide manufacturer's field representative to **<< perform; observe and approve; or _____>>** system startup.

B. Prepare and start equipment and system in accordance with manufacturer's instructions and recommendations.

C. Adjust equipment for proper operation within manufacturer's published tolerances.

3.05 CLEANING

A. Clean exposed components of dirt, finger marks, and other disfigurements.

3.06 COMMISSIONING

A. See Section **<< 019113 - General Commissioning Requirements>>** for additional requirements.

B. Execute mechanical system commissioning as indicated on Section **<< 230800>>**.

C. Execute BAS, SCADA, or other linked integration automation system commissioning as indicated on Section **<< 250800>>**.

D. Replace components not functioning properly.

3.07 CLOSEOUT ACTIVITIES

A. See Section **<< 017900 - Demonstration and Training>>** for additional requirements.

B. Demonstration: Demonstrate operation of system to **<<Owner>>**'s personnel.

1. Use operation and maintenance data as reference during demonstration.
2. Briefly describe function, operation, and maintenance of each component.

C. Training: Train **<<Owner>>**'s personnel on operation and maintenance of system.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of **<< two hours; one day; or _____>>** of training.
3. Instructor: Manufacturer's training personnel.

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4. Location: At project site.

3.08 PROTECTION

A. Protect installed components from subsequent construction operations.

B. Replace exposed components broken or otherwise damaged beyond repair.

3.09 MAINTENANCE

A. See Section **<< 017000 - Execution and Closeout Requirements>>** for additional requirements.

B. Provide a separate maintenance contract for the service and maintenance of **<< VRF systems>>** for **<< 12>> << years; months; or _____>>** from Date of Substantial Completion.

END OF SECTION 238129

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SECTION 238146
WATER-SOURCE UNITARY HEAT PUMPS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section **<< 221005 - Plumbing Piping>>**: Condensate drains.

B. Section **<< 230593 - Testing, Adjusting, and Balancing for HVAC>>**.

C. Section **<< 232113 - Hydronic Piping>>**.

D. Section **<< 232114 - Hydronic Specialties>>**.

E. Section **<< 233300 - Air Duct Accessories>>**.

F. Section **<< 251400 - Integrated Automation Local Control Units>>**.

G. Section **<< 251500 - Integrated Automation Software>>**.

H. Section **<< 253519 - Integrated Automation Control Valves>>**.

1.02 REFERENCE STANDARDS

A. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

B. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks.

D. ASHRAE Std 13256-1 - Water-Source Heat Pumps - Testing and Rating for Performance - Part 1: Water-to-Air and Brine-to-Air Heat Pumps.

E. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

G. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

H. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.

I. UL 508 - Industrial Control Equipment.

J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

K. UL 1995 - Heating and Cooling Equipment.

1.03 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Product Data: Provide drawings indicating dimensions, rough-in connections, and electrical characteristics and connection requirements.

C. Manufacturer's Instructions: Include assembly instructions, support details, connection requirements, and start-up instructions.

D. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.

E. Operation and Maintenance Data: Provide maintenance data, parts lists, controls, and accessories. Include trouble-shooting guide.

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F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in **<<Owner>>**'s name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by**<< Underwriters Laboratories Inc.; testing firm acceptable to the Authority Having Jurisdiction; or _____>>** as suitable for the purpose specified and indicated.

B. Provide ARI certificaition for compliance with ARI 13256-1 "Water-Source Heat Pumps - Testing and Rating for Performance."

1.05 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Provide a **<< five; or _____>>** year warranty to include coverage for **<< all refrigeration components; or _____>>** from the date of Substantial Completion.

C. Provide a two year warranty for whole unit. For the first two years after Substantial Completion, warranty items shall warrant a response within 24 hours from contact by owner. Labor and refrigerant shall be included in the warranty in the first two years after Substantial Completion.

1.06 SERVICE

A. Contractor providing work under this Section shall provide all preventative maintenance on the equipment for a period of two years after the date of Substantial Completion.

B. Preventative maintenance shall include items required by the manufacturer with checking unit as required or every 6 months at a minimum.

1.07 EXTRA MATERIALS

A. Furnish one set of matched fan belts for each belt-driven fan. Furnish nine sets of filters for each unit type.

PART 2 PRODUCTS

2.01 GENERAL HEAT PUMP FABRICATION REQUIREMENTS

A. Energy Efficiency: **<<ASHRAE Std 90.1 I-P>>** EER and COP ratings, minimum.

B. **<<ASHRAE Std 13256-1>>**, factory-assembled unit including safety-controls, accessories, filters, piping, cables, wires, and precharged with **<< R-454B; R-410A; or _____>>** refrigerant prior to testing.

C. Include marked terminal strip to interface field-mounted components, accessories, and thermostat.

D. Comply with **<<UL 1995>>**; place service and caution labels on unit.

E. Cabinet Assembly:

1. Construct of zinc-coated, heavy-gauge, galvanized steel with exposed edges rounded.
2. Finish: Factory apply **<< electrostatic powder paint; baked enamel; or _____>>** finish. Coordinate with **<<Architect>>** for specific color finish requirements of console units or other units installed within occupied spaces.
3. Provide access panels for inspection, cleaning, and servicing of refrigerant, controls, condensate drain pan, coil, and blower.
4. Furnish **<< 1-inch; 3-inch; or _-inch>>** duct flange on open-discharge selections.

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5. Interior Insulation: Minimum **<< 1/2 inch; or __ inch>>** thick, dual density, bonded glass fiber.
6. Provide flame spread of less than 25, and smoke developed classification of less than 50 in compliance with **<<ASTM E84>>** and **<<UL 723>>**.
7. Sound and Noise Suppression:
   a. Compressor enclosure lined with **<< 1/2 inch; or __ inch>>** thick insulation.
   b. Include vibration isolation between compressor and heat exchanger.
   c. Include length-wise, unit base stiffeners.
   d. Foam gasket sealant around compressor and end panel perimeter.

F. Blower Section:
1. Draw-through, forward curved fan, constructed of corrosion-resistant, galvanized material and designed for efficient, quiet operation.
2. Factory program for both soft start and constant flow output over static pressure range.
3. Provide preinstalled neutral wire protection when required to support specified fan type.
4. Motor to include thermal overload protection, quick disconnect plug, and permanently lubricated bearings.
5. Variable Speed Control: Configure controller to maintain adjustable flow setpoint for modulating or speed-switched units.
6. Fan Turndown: Design control features to allow fan speed reduction to adjustable **<< 50; or __>>** percent of its capacity when the zone set point temperature is satisfied or when unit runs in fan-only mode.

G. Evaporator Section:
1. Internally finned, aluminum or copper tubes mechanically bonded to configured aluminum plate fin, corrosion inhibitor coated as indicated.
2. Refrigerant Coil Distributor Assembly: Orifice style with round copper distributor tubes.
3. Thermostatic Expansion Valve: Factory select and install for wide control range.
4. Factory leak test to minimum **<< 450 psi; or ___ psi>>** and pressure test to minimum **<< 600 psi; or ___ psi>>**.
5. Tubes: Size tubes consistent with coil capacity. Fabricate suction header from rounded copper pipe.
6. Completely evacuate air and charge with proper column of refrigerant prior to shipment.
7. Drain Pan:
   a. Construct of **<< ABS plastic; HDPE; stainless steel; other corrosion-resistant; or _____>>** material and flame rated in accordance with **<<UL 94>>** when using polymers.
   b. Slope on two planes to pitch condensate to drain connection**<< , include secondary drain; , _____; or None - N/A>>**.
   c. Float Switch: **<<UL 508>>**, rated for protection against condensate overflow, controller connected.

H. Compressor Section:
1. Provide rubber mounting devices located underneath compressor mounting base.
2. Safety Interlocked Devices:
   a. Thermal overload protection.
   b. High pressure switch for protection against excessive discharge pressure.
   c. Low pressure safety for protection against loss of refrigerant charge.

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I. Refrigerant Tubing Lines:
   1. Tubing made of **<< aluminum; copper; or _____>>** with service pressure ports on high- and low-pressure sides.
   2. Free from contaminants and conditions such as drilling fragments, dirt, and oil.
   3. Include drier, thermal expansion valve, and other related components.
   4. Freeze Protection: **<< 15 degrees F; 30 degrees F; or __ degrees F>>**, thermistor based.
   5. Insulation: Evaporator and heat exchanger sides; minimum **<< 3/8 inch; or __ inch>>** thick elastomeric insulation.

J. Water-to-Refrigerant Heat Exchanger:
   1. Coaxial Type: Provide **<< aluminum; copper; cupro-nickel; or _____>>** tube and fins**<< , corrosion-inhibitor coated; , corrosion-inhibitor coated, and insulated; , insulated; , _____; or None - N/A>>**.
   2. Insulate heat exchanger, water lines, and refrigerant suction lines for prevention of condensation at temperatures below **<< 60 degrees F; or ___ degrees F>>**.
   3. Provide rubber isolation to heat exchanging device for enhanced sound attenuation.
   4. Freeze Protection: **<< 35 degrees F; 20 degrees F; or __ degrees F>>** by thermistor sensing.
   5. Minimum Working Pressure: **<< 400 psi; or ___ psi>>** water side, **<< 600 psi; or ___ psi>>** DX side.
   6. End Connections: Copper NPT. Provide flow shut-off ball valves.
   7. Accessories:
      a. Strainer, PT test plug, and flow regulator.
      b. Unit-controlled, return-water-side solenoid valve**<< ; see Section 253619; ; _____; or None - N/A>>**.

K. Filter Section:
   1. MERV **<< 13; or _____>>** filters per **<<ASHRAE Std 52.2>>**.
   2. Filter Box: Provide field-installed return duct-mounted filter housing with side access.
   3. For horizontal units above ceiling, provide return filter grille in lieu of filter at unit.

L. Electrical:
   1. Provide factory-installed phase loss safety device for 3-phase units.
   2. Configure unit for single point connection, include terminal for field-installed components.
   3. Include separate holes and knockouts with plastic ferrules for respective electrical and controls wiring.

M. Unit Controls:
   1. DDC:
      a. Application Specific Controller; see Section **<< 251400>>** unless factory-provided.
      b. Tested to monitor and handle sequencing functions and other operational modes using field-mounted thermostat and other sensors.
      c. Coordination and Sequencing:
         1) Internal Devices: Include compressors, blower, sensors, switches, valves, safeties, other components.
         2) Field-Installed Devices: Solenoid valves, thermostat, EWT sensors, LWT sensors, load-pump contact, source pump contact, and other devices required for operation.

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3) Safeties: At minimum include anti-short-cycle compressor protection, condensate overflow, refrigerant high pressure, refrigerant low pressure, loss-of-charge, refrigerant freeze protection, and freezestat.

2. Thermostat:
   a. Field mounted and wired, tied into prewired control-interface terminals.
   b. Smart Thermostat:
      1) BAS- or BMS-linked programmable thermostat; see Section **<< 251400>>**.

2.02 HORIZONTAL / VERTICAL WATER-SOURCE HEAT PUMP

A. Manufacturers:
   1. Bosch Thermotechnology Corp. - Florida Heat Pump
   2. Carrier Corporation.
   3. Climate Master, Inc.
   4. Daikin Applied Americas, Inc.
   5. Trane Technologies, PLC.

B. Compressor: Hermetically sealed, single stage or two stage **<< rotary; scroll; swing; or ____>>** type as scheduled.

C. Water-to-Refrigerant Heat Exchanger: **<< Coaxial; Brazed-plate; or _____>>** type**<< with factory-installed water economizer; with factory-supplied water economizer; _____; or None - N/A>>**.

D. Blower Section: Provide **<< high-static, permanent split capacitor (PSC) motor; low-static, permanent split capacitor (PSC) motor; permanent split capacitor (PSC) motor; 5-speed, electrically commutated motor (ECM); variable-speed, electrically commutated motor (ECM); or _____>>** fan type.

E. Filter Section: Include **<< MERV 4; MERV 13; or MERV 10>>** rated air filter**<< and secondary MERV-13 rated filter; and secondary MERV- __ rated filter; and secondary MERV- __ rated filter with filter box; _____; or None - N/A>>**. Side access filter housing shall accommodate required quantity of 2-inch flat filters. Housing shall be factory-assembled, with one hinged access door with quick access latches, and be constructed of 18 gauge minimum aluminized steel.
   1. Horizontal units above ceilings shall have MERV 10 filters in return filter grilles in lieu of filters located at unit return air connection.

F. Accessories:
   1. Provide **<< ball valves; automatic balancing-valve; manual balancing-valve; hoses; Y-strainer; and _____>>**. Provide 2 foot long metal braided hoses with swivel connectors on one end, rated per UL 94 and 300 psi working pressure.
   2. Provide RectorSeal EZ-trap condensate drain with high water cutoff switch.

G. Unit Controls: **<< Factory-installed DDC with thermostat; see Section 251400; Factory-supplied DDC with thermostat; Factory-supplied DDC with wireless thermostat; Factory-supplied DDC with blind-face thermostat; Factory-supplied programmable thermostat; Factory-supplied nonprogrammable thermostat; Smart thermostat; or _____>>**.
   1. BAS Integrated Automation Link: **<< BACnet IP in accordance with ASHRAE Std 135; BACnet MS/TP in accordance with ASHRAE Std 135; BACnet SC in accordance with ASHRAE Std 135; Modbus IP in accordance with Modbus (PS); Modbus RTU in accordance with Modbus (PS); LonWorks in accordance with LonMark Interoperability Guide; Wireless (Bluetooth) in accordance with Bluetooth CS;**

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Wireless (Wi-Fi) in accordance with IEEE 802.11; Wireless (Zig-bee) in accordance with IEEE 802.15.4; or _____>>.

2. Control Valve: Return-installed, **<< 2-position; modulating; position-adjusted; or _____>>**, **<< ball; globe; pressure independent; pressure-independent ball; or _____>>** type; **<< manufacturer provided; see Section 253519; or _____>>**.

H. Sound Package: Provide with sound attenuating compressor blankets, casings, and sound asborbing material within the heat pump.

2.03 ROOFTOP-MOUNTED WATER-SOURCE HEAT PUMP

A. Manufacturers:
1. Carrier Corporation.
2. ClimateMaster, Inc.
3. Daikin Applied Americas, Inc.
4. Trane Technologies, PLC.

B. Discharge Configuration: Roof-curb-mounted unit with bottom-end duct openings field convertible on supply and return sides to tie-in side-mounted ductwork.

C. Casing Assembly:
1. Construct of zinc-coated, heavy-gauge, galvanized steel.
2. Finish: Factory apply weather-resistant **<< baked enamel; electrostatic powder paint; or _____>>** finish. Coordinate with **<<Architect>>** for specific color finish requirements of console units or other units installed within occupied spaces.
3. Unit Surface: Test for 100 hours in salt spray in accordance with **<<ASTM B117>>**.
4. Cabinet construction allows for maintenance on one side of unit.
5. Hinged Access Doors: Factory install sheet metal hinges on indoor fan section, supply fan, and compressor control access doors.
6. Service Panels: Provide with lifting handles and water/air tight seal.
7. Indoor Air Section: Insulate exposed vertical and top covers with cleanable, foil-faced, fire-retardant, permanent, and odorless glass fiber material.
8. Base of Unit:
   a. Insulate with minimum **<< 3/8 inch; or ___ inch>>**, **<< 1 lb per cu ft ; or ___ lb per cu ft>>** density foil-faced, closed-cell material.
   b. Provisions for forklift and crane lifting.
9. Insulation Edges: Captured or sealed.
10. Base Pan: No penetrations within curb perimeter other than raised down flow discharge and return openings for protection against condensate drain back-up when required.

D. Compressor Section:
1. Hermetically sealed, direct-driven **<< single-stage scroll; dual-stage scroll; or _____>>** type with centrifugal type oil pumps.
2. Motor: Suction gas-cooled with voltage utilization range of plus/minus 10 percent of unit nameplate voltage.
3. Internal spring isolation and sound muffling to minimize vibration transmission and noise.
4. External high-and low-pressure switches.

E. Evaporator Section: Internally finned, 5/16 inch **<< aluminum; copper; cupro-nickel; or _____>>** tubes mechanically bonded to aluminum plate fins.

F. Drain Pan Section:

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1. Construct of **<< nonferrous; stainless steel; or _____>>**, corrosion-resistant material.
2. Reversible, double sloped with provisions for through-the-base condensate drain.
3. Units with Sizes **<< 5 Tons>>** or Lower: Plastic, removable, dual-sloped drain pan, easy to clean, and reversible to allow installation of drain trap on either side of the unit.
4. Units with Sizes Above **<< 5 Tons>>**: Sloped, prepainted for corrosion resistance.

G. Water-to-Refrigerant Heat Exchanger: **<< Coaxial; Brazed-plate; or _____>>** type**<< with factory-installed water economizer; with factory-supplied water economizer; _____; or None - N/A>>**.

H. Refrigerant Load Control: Provide **<< hot-gas bypass; hot-gas reheat coil; and _____>>**.

I. Blower Section: Provide direct or plenum mounted **<< 5-speed, ECM; variable-speed, ECM; backward-inclined, belt-driven; forward-inclined, belt-driven; or _____>>** fan motors.

J. Filter Section: Include **<< MERV 8; MERV 13; or _____ >>** rated air filter**<< and secondary MERV-13 rated filter; and secondary MERV- __ rated filter; and secondary MERV- __ rated filter with filter box; _____; or None - N/A>>**.

K. Outside Air Damper with Rain Hood and Screen:
1. Damper(s) to modulate when unit is on economizer, space pressurization, or CO2 control.

L. Return Air Damper:
1. Damper(s) to modulate when unit is on economizer, space pressurization, or CO2 control.

M. Relief Damper:
1. Motorized: Coordinate motorized control to maintain flow balance during economizer control mode.

N. **<< Wet-Bulb; Dry-Bulb; or _____>>** Economizer Control:
1. Provide enthalpy sensor kit and wire into unit controller for coordinated control of outside air, return air, and relief dampers.
2. Enthalpy sensors to be either wet bulb type or temperature and humidity combination sensor for outdoor air, return air, and mixed air sides. Use temperature-only for dry bulb economizer.
3. Enthalpy sensors to apply differential enthalpy control to compare total heat content of indoor air verses outdoor air for most efficient air source.

O. Electrical:
1. **<< 208 to 230 VAC, 3-phase; 208 to 230 VAC, 1-phase; 460 VAC, 3-phase; or _____>>**, 60 Hz**<< with field-installed disconnect switch; with factory-provided disconnect switch; _____; or None - N/A>>**.
2. Through-Base Electrical with Disconnect Switch:
   a. Factory install 3-pole, molded-case, disconnect switch, installed in watertight enclosure with swinging door access, and provisions for through-base electrical connections.
   b. Provide factory wiring from switch to high-voltage terminal block.
   c. Size disconnect switch in accordance with **<<UL 1995>>**.
   d. Switch not to be used for overcurrent protection.

P. Unit Controls: **<< Factory-installed DDC with thermostat; see Section 251400; Factory-supplied DDC with thermostat; Factory-supplied DDC with wireless thermostat;**

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Factory-supplied DDC with blind-face thermostat; Factory-supplied DDC, return-air-controlled; Factory-supplied programmable thermostat; Factory-supplied nonprogrammable thermostat; Smart thermostat; or _____>>.

1. BAS Integrated Automation Link: **<< BACnet IP in accordance with ASHRAE Std 135; BACnet MS/TP in accordance with ASHRAE Std 135; BACnet SC in accordance with ASHRAE Std 135; Modbus IP in accordance with Modbus (PS); Modbus RTU in accordance with Modbus (PS); LonWorks in accordance with LonMark Interoperability Guide; Wireless (Bluetooth) in accordance with Bluetooth CS; Wireless (Wi-Fi) in accordance with IEEE 802.11; Wireless (Zig-bee) in accordance with IEEE 802.15.4; or _____>>**.
2. Control Valve: Return-installed, **<< 2-position; modulating; position-adjusted; or _____>>**, **<< ball; globe; pressure-independent; pressure-independent ball; or _____>>** type with position tracking; **<< manufacturer provided; see Section 253519; or _____>>**.

Q. Accessories:
1. Roof Curb with Nailer Strips:
   a. Factory designed to mate with the down flow supply and return air openings, providing unit support and water tight installation.
   b. Design to allow field-fabricated rectangular supply/return ductwork to be connected directly to field assembled roof curb.
   c. Comply with NRCA requirements.

2.04 WATER-TO-WATER SOURCE HEAT PUMP

A. Manufacturers:
1. Bosch Thermotechnology**<< ; _____; or None - N/A>>**: www.bosch-thermotechnology.us/#sle.
2. **<< _____>>**.
3. **<< _____>>**.

B. General:
1. Factory assemble, pipe, internally wire, test, and fully charge with **<< R-454B; R-410A; or _____>>** refrigerant.
2. Comply with **<<ASHRAE Std 13256-1>>** and **<<UL 1995>>**.
3. Provide with filters, factory-installed safety controls, and thermostat field interface strip.
4. System Water Inlet/Outlet Connections: Female NPT copper.
5. Securely affix service and caution labels on unit in appropriate locations.

C. Cabinet:
1. Construct casing from zinc coated, heavy-gauge, galvanized steel.
2. Provide access panel(s) for inspection and servicing of refrigerant, controls, condensate drain pan, and coils.
3. Insulation:
   a. Factory insulate all panels with minimum **<< 1/2 inch; or __ inch>>** thick, dual density, bonded glass fiber.
   b. Exposed Side of Insulation: High-density, erosion-proof material suitable for use in air streams up to **<< 3,600 fpm; or ____ fpm>>**, complying with erosion requirements of **<<UL 181>>**.
   c. Provide flame spread of less than 25, and smoke developed classification of less than 50 in accordance with **<<ASTM E84>>** and **<<UL 723>>**.

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4. Include electrical box for entrance of line voltage with separate knockout for control wiring.

D. Water-To-Refrigerant Heat Exchanger:
1. Construction: Co-axial coil for maximum heat transfer.
2. Coil Material: Deeply fluted **<< copper; cupro-nickel; or _____>>** to enhance heat transfer and minimize fouling and scaling.
3. Factory insulate heat exchanger, water lines, and refrigerant suction lines for prevention of condensation at temperatures below **<< 60 degrees F; or ___ degrees F>>**.
4. Provide rubber isolation to heat exchanging device for enhanced sound attenuation.
5. Working Pressure:
   a. Water Side: Minimum **<< 400 psi; or ___ psi>>**.
   b. Refrigerant Side: Minimum **<< 600 psi; or ___ psi>>**.

E. Compressor:
1. High efficiency **<< rotary; scroll; or ____>>** compressor.
2. External Vibration Isolation: Provide rubber mounting devices located underneath compressor mounting base.
3. Safety Devices:
   a. Internal thermal overload protection.
   b. High pressure switch for protection against excessive discharge pressure.
   c. Low pressure safety for protection against loss of refrigerant charge.

F. Refrigerant Circuits:
1. Thermal expansion device.
2. Service pressure ports on high and low pressure sides.
3. Filter driers.

G. Refrigerant Tubing:
1. Material: **<< Copper; or _____>>**.
2. Free from contaminants and conditions such as drilling fragments, dirt, and oil.
3. Insulation:
   a. Water Lines Located in Indoor Air Stream: Minimum **<< 3/8 inch; or ___ inch>>** thick elastomeric insulation.
   b. Refrigerant Lines Located in Indoor Air Stream Not Over Drain Pan: Minimum **<< 3/8 inch; or __ inch>>** thick elastomeric insulation.

H. Ball Valves: Provide for field installation between unit and supply/return lines of loop to stop water flow to unit in maintenance or service situation.

2.05 HOSE KITS, VALVES, FITTINGS, AND ACCESORIES

A. Control valves for water-source heat pumps shall be provided by the BAS provider under Section 230923.

B. **<< Automatic ; Manual ; or None - N/A>>**Balancing Valves:
1. Brass body for shutoff and hydronic balancing.

C. Ball Valves:
1. Brass body for shutoff and hydronic balancing.
2. Provide pressure/temperature ports.
3. Provide with balancing valves.

D. Y Strainers:

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1. Bronze body.
2. "Y" type configuration with brass cap.
3. Maximum Operating Pressure: Minimum **<< 450 psi; or ___ psi>>**.
4. Screen: Stainless steel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Floor Mounted Unit(s):
   1. Support on neoprene pads with **<< 0.125 inch; or ____ inch>>** minimum static deflection.
   2. Secure unit(s) to anchor bolts installed in concrete bases.
   3. Secure vertical units on a metal stand using 1.5-inch angle, welded with a full metal plate installed on top of stand.
   4. Provide Rubberlite, Inc. Model SCE41B neoprene/EPDM/SBR vibration isolation pad under heat pump and above sheet steel top of stand.

C. Suspended Units: Suspend from structure with threaded steel rods and **<< 0.25 inch; or ___ inch>>** minimum **<< static deflection rubber-in-shear vibration isolators; seismic restraints; and _____>>**.

D. Roof Mounted Units:
   1. Mount units on factory-built, roof mounting curb providing watertight enclosure to protect ductwork and utility services.
   2. Install roof mounting curb level.

E. Coordinate installation of units with architectural,**<< mechanical,; _____ ,; or None - N/A>>** and electrical work.

F. On water coils, provide shut-off valve on supply line and **<< balancing valve; flow control and shut-off valve; or _____>>** on return line. Provide **<< manual; float operated automatic; or _____>>** air vents at high points complete with stop valve.

G. Install wall-mounted thermostats, humidistats, and switch controls in electrical outlet boxes at heights to match lighting controls. Provide thermal break barrier for outdoor walls.

3.02 CONNECTIONS

A. Connect supply/return piping from heat pump to appropriate water source piping; see Section **<< 232113>>**. Complete end connections with **<< unions and shut-off valves; see Section 232114; hose kits; or _____>>**.

B. Connect condensate drain pan to indirect waste connection with P-trap of adequate depth to seal against fan pressure; see Section **<< 221005>>**.

C. Install cleanouts at each directional change in piping.

D. Connect supply/return air ducts with flexible connectors; see Section **<< 233300>>**.

E. Installation of piping adjacent to heat pump to allow for maintenance and service.

F. Field Install all electrical devices provided by the heat pump manufacturer not specified to be factory-installed.

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3.03 SYSTEM STARTUP

A. Provide manufacturer's field representative to **<< perform; observe and approve; instruct; or _____>>** systems startup; see Section **<< 230593>>**.

B. Adjust for proper operation within manufacturer's published tolerances.

3.04 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

B. Provide manufacturer's field representative to **<< test; inspect; instruct; observe; and _____>>**.

C. Inspect for and remove blocks, shipping bolts, and tie-down straps.

D. Test the heat pumps for performance compliance upon completion of the installation and energization of all electrical circuitry.

E. Operational Test: Start units to confirm unit operation and motor rotation.

F. Controls and Safety Switches: Test, adjust, and replace damaged/malfunctioning controls and equipment.

G. Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s) and remote **<< front-end interface; see Section 251500; software app or terminal; see Section 253500; or _____>>**.

H. Malfunctioning Units: Remove, replace, and retest as specified above.

3.05 CLOSEOUT ACTIVITIES

A. See Section **<< 017800 - Closeout Submittals>>** for closeout submittals.

B. See Section **<< 017900 - Demonstration and Training>>** for additional requirements.

C. Demonstration: Demonstrate operation of system to **<<Owner>>** personnel.
   1. Use operation and maintenance data as reference during demonstration.
   2. Briefly describe function, operation, and maintenance of each component.

D. Training: Train **<<Owner>>**'s personnel on operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of **<< two hours; one day; or _____>>** of training.
   3. Instructor: Manufacturer's training personnel.
   4. Location: At project site.

END OF SECTION 238146

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SECTION 238149
GROUND-SOURCE UNITARY HEAT PUMPS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section **<< 223000 - Plumbing Equipment>>**: Domestic water heater or storage tanks.

B. Section **<< 251400 - Integrated Automation Local Control Units>>**.

1.02 REFERENCE STANDARDS

A. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

B. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

D. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

E. UL 1995 - Heating and Cooling Equipment.

1.03 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Product Data: Manufacturer's data sheets for each product furnished, including:

1. Electrical and performance data showing compliance with specifications.
2. Required water flow rates and temperatures for inflow and outflow.
3. Detailed electrical wiring diagrams.
4. Storage and handling requirements and recommendations.
5. Installation instructions.
6. Start-up, troubleshooting, and TAB instructions.
7. Specimen warranty.

C. Shop Drawings: Indicate piping connections and interface to supply and return ductwork, source-side water piping to buried loop, circulator pumps, and condensate drains. Include control wiring diagrams prepared specifically for this project including unit controls interface.

D. Field Test Reports.

E. Operation and Maintenance Data: Include replaceable parts lists, parts sources, and troubleshooting guide.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than **<< three; or _____>>** years of**<< documented; _____; or None - N/A>>** experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Verify upon delivery that equipment nameplate data, including electrical data, matches specified and ordered equipment. Verify that refrigerant charge has been retained during shipping.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Store products under cover and elevated above grade.

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1.06 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Provide **<< two; or _____>>** year manufacturer warranty for compressors and motors, expansion devices, heat exchangers, and reversing valves.

PART 2 PRODUCTS

2.01 GENERAL UNITARY HEAT PUMP FABRICATION REQUIREMENTS

A. Energy Efficiency: **<<ASHRAE Std 90.1 I-P>>** EER and COP ratings, minimum.

B. Factory assemble internal components, safety controls, accessories, filters, piping, cable, and wires, then charge with **<< R-454B; R-410A; or _____>>** refrigerant prior to testing.

C. Include marked terminal strip to interface field-mounted components, accessories, and thermostat.

D. Comply with **<<UL 1995>>**, place service and caution labels on unit.

E. Cabinet Assembly:

1. Construct of zinc-coated, heavy-gauge, galvanized steel with exposed edges rounded.
2. Finish: Factory apply **<< electrostatic powder paint; baked enamel; or _____>>** finish. Coordinate with **<<Architect>>** for specific color finish requirements of console units or other units installed within occupied spaces.
3. Provide access panels for inspection, cleaning, and servicing of refrigerant, controls, condensate drain pan, coil, and blower.
4. Furnish **<< 1-inch; 3-inch; or _-inch>>** duct flange on open-discharge selections.
5. Interior Insulation: Minimum **<< 1/2 inch; or __ inch>>** thick, dual-density, bonded glass fiber.
6. Provide flame spread of less than 25, and smoke developed classification of less than 50 in accordance with **<<ASTM E84>>** and **<<UL 723>>**.
7. Sound and Noise Suppression:
   a. Mechanical Rooms: **<< 18 gauge, 0.05 inch; or ___ gauge, ___ inch>>**, minimum.
   b. Occupied Spaces: **<< 16 gauge, 0.06 inch; or __ gauge, __ inch>>**, minimum.
   c. Compressor enclosure lined with **<< 1/2 inch; or __ inch>>** thick insulation.
   d. Include vibration isolation between compressor and heat exchanger.
   e. Include length-wise unit base stiffeners.
   f. Foam gasket sealant around compressor and end panel perimeter.

F. Blower Section:

1. Draw-through, forward-curved fan, constructed of corrosion-resistant, galvanized material and designed for efficient, quiet operation.
2. Factory program for both soft start and constant flow output over static pressure range.
3. Provide preinstalled neutral-wire protection when required to support specified fan type.
4. Motor to include thermal overload protection, quick-disconnect plug, and permanently lubricated bearings.
5. Belt-Driven Motor Requirements: Provide adjustable blower-motor/sheave combination device based on indicated flow performance requirements.
6. Variable Speed Control: Configure controller to maintain adjustable flow setpoint for modulating or speed-switched units.

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7. Fan Turndown: Design control features to allow fan-speed reduction to adjustable **<< 50; or __>>** percent of its capacity when zone set point temperature is satisfied or when unit runs in fan-only mode.

G. Evaporator Section:
1. Internally finned, aluminum or copper tubes mechanically bonded to configured aluminum plate fin, corrosion-inhibitor coated as indicated.
2. Refrigerant Coil Distributor Assembly: Orifice style with round copper distributor tubes.
3. Thermostatic Expansion Valve: Factory select and install for wide control range.
4. Factory leak test to minimum **<< 450 psi; or ___ psi>>** and pressure test to minimum **<< 600 psi; or ___ psi>>**.
5. Tubes: Size tubes consistent with coil capacity. Fabricate suction header from rounded copper pipe.
6. Completely evacuate air and charge with proper column of refrigerant prior to shipment.

H. Compressor Section:
1. Provide rubber mounting devices located underneath compressor mounting base.
2. Safety Interlocked Devices:
   a. Thermal overload protection.
   b. High-pressure switch for protection against excessive discharge pressure.
   c. Low-pressure safety for protection against loss of refrigerant charge.

I. Refrigerant Tubing Lines:
1. Tubing made of **<< aluminum; copper; or _____>>** with service pressure ports on high- and low-pressure sides.
2. Free from contaminants and conditions such as drilling fragments, dirt, and oil.
3. Include drier, thermal expansion valve, and other related components.
4. Freeze Protection: **<< 15 degrees F; 30 degrees F; or __ degrees F>>**, thermistor based.

J. Refrigerant Load Control:
1. Hot-Gas Bypass: Provide to increase heat transfer efficiency at low temperatures.
2. Hot-Gas Reheat Coil:
   a. Humidity Control: Upgrade thermostat to include humidity sensor tied to unit controller for integral dehumidification control.
   b. Coil Assembly: Aluminum or copper tubes mechanically expanded into evenly spaced aluminum fins.
   c. Coil Testing: Proof test at minimum of **<< 1.5; or __>>** times maximum operating pressure, then leak test at maximum operating pressure.
3. Hot-Water Generator:
   a. Secondary coil or heat exchanger**<< with load-matched, field-installed pump; _____; or None - N/A>>**, reversing valve, and accessories.
   b. Storage: **<< Interconnect to existing water heater or external storage tanks; See Section 223000 for domestic water heaters or storage tanks; or _____>>**.

K. Water-to-Refrigerant Heat Exchanger:
1. Coaxial Type: Provide **<< aluminum; copper; cupro-nickel; or _____>>** tube and fins**<< , corrosion-inhibitor coated; , corrosion-inhibitor coated, and insulated; , insulated; , _____; or None - N/A>>**.

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2. Brazed-Plate Type: Stainless steel, with bidirectional liquid line filter drier.
3. Insulate heat exchanger, water lines, and refrigerant suction lines for prevention of condensation at temperatures below **<< 60 degrees F; or ___ degrees F>>**.
4. Provide rubber isolation to heat exchanging device for enhanced sound attenuation.
5. Freeze Protection: **<< 35 degrees F; 20 degrees F; or __ degrees F>>** by thermistor sensing.
6. Minimum Working Pressure: **<< 400 psi; or ___ psi>>** waterside, **<< 600 psi; or ___ psi>>** DX side.
7. End Connections: Copper NPT. Provide flow shut-off ball valves.
8. Accessories:
   a. Strainer, PT test plug, and flow regulator.
   b. Unit-controlled, return-waterside solenoid valve**<< ; see Section 253619; ; _____; or None - N/A>>**.

L. Waterside Economizer Section:
1. Thermostat-controlled, metered, prepiped return air coil with 3-way valve assembly tied and coordinated by unit controller.
2. Provide assembly factory installed or shipped loose for field installation as indicated.
3. Performance Requirements:**<< As indicated on drawings.; _____ .; or None - N/A>>**
4. Air-to-Water Hydronic Coil:
   a. Aluminum or copper tubes and aluminum plate fin combination.
   b. Accessible, cleanable, dual-sloped, noncorrosive drain pan.
   c. Leak test at maximum operating pressure.
   d. Factory proof test at minimum **<< 1.5; or ___>>** times maximum operating pressure.
5. Modulating or position-adjusted control valve to engage and control coil at listed EWT.

M. Filter Section:
1. **<<ASHRAE Std 52.2>>**, minimum efficiency reported value or MERV listing.
2. Filter Box: Provide field-installed, return-duct-mounted filter housing with side access.

N. Electrical:
1. Provide factory-installed phase loss safety device for 3-phase units.
2. Configure unit for single-point connection, include terminal for field-installed components.
3. Include separate holes and knockouts with plastic ferrules for respective electrical and controls wiring.

O. Unit Controls:
1. DDC:
   a. Tested to monitor and handle sequencing functions and other operational modes using field-mounted thermostat and other sensors.
   b. Coordination and Sequencing:
      1) Internal Devices: Include compressors, blower, sensors, switches, valves, safeties, other components.
      2) Field-Installed Devices: Solenoid valves, thermostat, EWT sensors, LWT sensors, load-pump contact, source-pump contact, and other devices required for operation.

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3) Safeties: At minimum include anti-short-cycle compressor protection, condensate overflow, refrigerant high pressure, refrigerant low pressure, loss-of-charge, refrigerant freeze protection, and freezestat.

2. Thermostat:
   a. Field mounted and wired, tied into prewired control-interface terminals.
   b. Smart Thermostat:
      1) BAS or BMS linked programmable thermostat; see Section **<< 251400>>**.
   c. Programmable Thermostat:
      1) Electro-mechanical type with **<< key or pushbutton operated display; touchscreen; or _____>>**.
      2) Programmable occupied/unoccupied weekly and holiday schedule.
   d. Non-Programmable Thermostat:
      1) Electro-mechanical type with **<< key- or pushbutton-operated display; touchscreen; or _____>>**.
      2) User configurable precoded options aligned with equipment functions.
   e. Thermostat: Single-gang-box-mounted platinum or thermistor.
      1) Local Interface to Include:
         (a) Filter maintenance indicating status.

END OF SECTION 238149

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SECTION 238200
CONVECTION HEATING AND COOLING UNITS

PART 2 PRODUCTS

END OF SECTION 238200

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SECTION 238241
WATER-TO-WATER HEAT PUMPS

PART 2 PRODUCTS

1.01 GENERAL WATER-TO-WATER HEAT PUMP FABRICATION REQUIREMENTS

A. Energy Efficiency: **<<ASHRAE Std 90.1 I-P>>** EER and COP ratings, minimum.

B. Factory assemble internal components, safety-controls, accessories, filters, piping, cable, and wires, then charge with **<< R-454B; R-410A; or _____>>** refrigerant prior to testing.

C. Include marked terminal strip to interface field mounted components and accessories.

D. Comply with **<<UL 1995>>**, place service and caution labels on unit in appropriate locations.

E. Cabinet Assembly:
   1. Construct of zinc-coated, heavy-gauge, galvanized steel with exposed edges rounded.
   2. Finish: Factory apply **<< electrostatic powder paint; baked enamel; or _____>>** finish. Coordinate with **<<Architect>>** for specific color finish requirements of console units or other units installed within occupied spaces.
   3. Provide access panels for inspection, cleaning, and servicing of refrigerant, controls, and heat exchangers.
   4. Interior Insulation: Minimum **<< 1/2 inch; or __ inch>>** thick, dual density, bonded glass fiber.
   5. Provide flame spread of less than 25, and smoke developed classification of less than 50 when tested in accordance with **<<ASTM E84>>** and **<<UL 723>>**.
   6. Sound and Noise Suppression:
      a. Mechanical Rooms: **<< 18 gauge, 0.05 inch; or ___ gauge, ___ inch>>**, minimum.
      b. Occupied Spaces: **<< 16 gauge, 0.06 inch; or __ gauge, __ inch>>**, minimum.
      c. Compressor enclosure lined with **<< 1/2 inch; or __ inch>>** thick insulation.
      d. Include vibration isolation between compressor and heat exchanger.
      e. Include length-wise unit base stiffeners.
      f. Foam gasket sealant around compressor and end panel perimeter.

F. Compressor Section:
   1. Provide rubber mounting vibration isolation devices underneath mounting base.
   2. Safety Interlocked Devices:
      a. Thermal overload protection.
      b. High pressure switch for protection against excessive discharge pressure.
      c. Low pressure safety for protection against loss of refrigerant charge.

G. Refrigerant Tubing Lines:
   1. Tubing made of **<< aluminum; copper; or _____>>** with service pressure ports on high and low pressure sides.
   2. Free from contaminants and conditions such as drilling fragments, dirt, and oil.
   3. Include drier, thermal expansion valve, and other related components.
   4. Freeze Protection: **<< 15 degrees F; 30 degrees F; or __ degrees F>>**, thermistor based.

H. Water-to-Refrigerant Heat Exchanger:

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1. Coaxial Type: Provide **<< aluminum; copper; cupro-nickel; or _____>>** tube and fins**<< , corrossion-inhibitor coated; , corrossion-inhibitor coated, and insulated; , insulated; , _____; or None - N/A>>**.
2. Brazed-Plate Type: Stainless steel, with bidirectional liquid line filter drier.
3. Insulate heat exchanger, water lines, and refrigerant suction lines for prevention of condensation at temperatures below **<< 60 degrees F; or ___ degrees F>>**.
4. Provide rubber isolation to the heat exchanging device for enhanced sound attenuation.
5. Freeze Protection: **<< 35 degrees F; 20 degrees F; or __ degrees F>>** by thermistor sensing.
6. Minimum Working Pressure: **<< 400 psi; or ___ psi>>** water side, **<< 600 psi; or ___ psi>>** DX side.
7. End Connections: Copper NPT. Provide flow shut-off ball valves.
8. Accessories:
   a. Strainer, PT test plug, and flow regulator.
   b. Unit-controlled, return-water-side solenoid valve**<< ; see Section 253619; ; _____; or None - N/A>>**.

I. Electrical:
1. Provide factory-installed phase loss safety device for 3-phase units.
2. Configure unit for single point connection, include terminal for field-installed components.

J. Unit Controls: DDC.
1. Application Specific Controller; see Section **<< 251400>>** unless factory-provided.
2. Tested to monitor and handle sequencing functions and other operational modes using supplied field mounted sensors and switches.
3. Controller Interface:
   a. **<< Wall; Unit; or _____>>** mounted device with monitoring display.
   b. Pushbutton or key operated for local control and configuration.
4. Coordination and Sequencing:
   a. Internal Devices: Include compressors, sensors, switches, valves, safeties, other components.
   b. Field-Installed Devices: Solenoid valves, EWT sensors, LWT sensors, load-pump contact, source pump contact, and other devices required for operation.
   c. Safeties: At minimum include anti-short-cycle compressor protection, condensate overflow, refrigerant high-pressure, refrigerant low-pressure, loss-of-charge, and refrigerant freeze protection.
5. Power:
   a. Factory-mounted and internally-wired into nonfused electrical disconnect.
   b. Configure safety-lockout circuits to be reset either using reset switch or power cycling.
   c. 24 VAC/VDC, include minimum of 10 VA spare load capacity for potential field use.

END OF SECTION 238241

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SECTION 260505
SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical demolition.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify field measurements and circuiting arrangements are as indicated.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation**<< and existing record documents; _____; or None - N/A>>**.

D. Report discrepancies to **<<Architect>>** before disturbing existing installation.

E. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

B. Coordinate utility service outages with utility company.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.

E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Minimize outage duration.

1. Notify **<<Owner>>** before partially or completely disabling system.
2. Make temporary connections to maintain service in areas adjacent to work area as required.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with**<< Section 028400 and; _____; or None - N/A>>** applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:

1. PCB- and DEHP-containing lighting ballasts.

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2. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring to source of supply.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

G. Repair adjacent construction and finishes damaged during demolition and extension work.

H. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

I. Extend existing installations using materials and methods**<< compatible with existing electrical installations, or; _____; or None - N/A>>** as specified.

3.04 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment that remain or that are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

C. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps**<< , ballasts; , _____; or None - N/A>>** and broken electrical parts.

END OF SECTION 260505

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SECTION 260519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wire and cable rated 600-volts and less.

B. Type AC-HCF and Type NM cables are not permitted.

C. Wiring connectors.

D. Electrical tape.

E. Heat shrink tubing.

F. Oxide inhibiting compound.

G. Wire pulling lubricant.

H. Cable ties.

I. Firestop sleeves.

1.02 RELATED REQUIREMENTS

A. Section **<< 078400 - Firestopping>>**.

B. Section **<< 260505 - Selective Demolition for Electrical>>**: Disconnection, removal, and/or extension of existing electrical conductors and cables.

C. Section **<< 260526 - Grounding and Bonding for Electrical Systems>>**: Additional requirements for grounding conductors and grounding connectors.

D. Section **<< 260553 - Identification for Electrical Systems>>**: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire.

B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes.

D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation.

E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape.

F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes.

G. NECA 1 - Standard for Good Workmanship in Electrical Construction.

H. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.

I. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems.

J. NFPA 70 - National Electrical Code.

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K. UL 44 - Thermoset-Insulated Wires and Cables.

L. UL 83 - Thermoplastic-Insulated Wires and Cables.

M. UL 267 - Outline of Investigation for Wire-Pulling Compounds.

N. UL 486A-486B - Wire Connectors.

O. UL 486C - Splicing Wire Connectors.

P. UL 486D - Sealed Wire Connector Systems.

Q. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables.

R. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.

S. UL 719 - Nonmetallic-Sheathed Cables.

T. UL 854 - Service-Entrance Cables.

U. UL 1569 - Metal-Clad Cables.

V. UL 4703 - Standard for Photovoltaic Wire.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
3. Notify **<<Architect>>** of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>**, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

1. Each type of wire and cable, including accessories.
2. Include copies of UL certifications showing compliance with requirements in "Quality Assurance" below.

C. Product schedule: Provie schedule or detailed statement on use of wires and cables. Indicate wire or cable type, product use, and representative location(s).

1. Identify proposed use of wire or cable types in locations not specifically listed in contract documents.

1.06 QUALITY ASSURANCE

A. Comply with requirements of **<<NFPA 70>>**.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

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1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.
   1. Wire and cable shall be packaged in a manner that protects them during ordinary handling and shipping. Ship from manufacturer with ends temporarily sealed against moisture.
   2. Protect wire and cable during storage (both onsite and offsite).
      a. Store in a clean and dry location. Elevate from surfaces where water can accumulate, and cover cable rolls to protect against weather.
   3. Damaged wire and cable shall be removed from the project site.

1.08 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than **<< 14 degrees F>>**, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify **<<Architect>>** and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 COPPER BUILDING WIRE (600-VOLTS MAX.)

A. Conductors: UL listed and NEMA WC 70 compliant; Copper, 98 percent conductivity, suitable for 600-volt duty; rated 90-degree Celsius temperature for wet/dry applications; solid bare annealed copper for No. 10 and smaller complying with ASTM B3, and stranded for No. 8 and larger complying with ASTM B8.

B. Conductor Insulation:
   1. Type THHN/THWN-2: Comply with UL 83; PVC insulation, nylon jacket.
   2. Type RHH/RHW-2: Comply with UL 44; stranded conductors, XLPE insulation.
   3. Type XHHW-2: Comply with UL 44; stranded conductors XLPE insulation.

C. Conductor identification: Markings along outer braid denoting conductor size, voltage classification, type of insulation, and manufacturer's trade name, and color code. Identification shall extend to branch circuits and outlets. Use the color coding system indicated below throughout the building's network of feeders and circuits, unless otherwise required by the authority having jurisdiction.
   1. Colors on conductors No. 10 and smaller, or No. 6 and smaller for grounded and grounding conductors: Solid colored insulation.
   2. Colors on conductors No. 8 and larger, or No. 4 and larger grounded and grounding conductors: Colored tape wrapped a minimum of 6 inches on either end of conductor.
      a. 480Y/277 V, 3-phase, 4-wire System:
         1) Phase A: Brown.
         2) Phase B: Orange.
         3) Phase C: Yellow.
         4) Neutral/Grounded: Gray.
      b. 208Y/120 V, 3-phase, 4-wire System:
         1) Phase A: Black.
         2) Phase B: Red.
         3) Phase C: Blue.
         4) Neutral/Grounded: White.

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D. Wires used solely for grounding purposes shall be green, where insulated.

E. Control wiring shall be coded with colors different from those used to designate phase wires.

2.02 ALUMINUM CONDUCTORS

A. Aluminum conductors: UL 44 listed and NEMA WC 70 compliant; suitable for 600-volt duty; rated 90-degree Celsius temperature for wet/dry applications; complying with ASTM B800 and ASTM B801. Compact, stranded Aluminum Association 8000 series electrical conductor alloy material, equal to Alcan Cable "Stabiloy".
   1. Sizes No. 2 through 750 kmils only.

B. Conductor insulation:
   1. Type THHN/THWN-2: Comply with UL 83; PVC insulation, nylon jacket.
   2. Type XHHW-2: Comply with UL 44; stranded conductors XLPE insulation.

2.03 WIRING ACCESSORIES

A. Factory-fabricated connectors and splices of size, ampacity rating, material type, and class for application and service where installed.

B. Twist-on wire connectors (dry locations): Color-keyed, Ideal Industries, Inc., Wingnut, 3M Company "Scotchlok", or approved equal by King Innovation.

C. Twist-on wire connectors (damp and wet locations): Ideal Industries, Inc., UnderGround, models 60, 64 or 66 as appropriate; King Innovation DryConn; or approved equal by 3M Company. Connectors shall be listed under UL 486D.

D. Compression connectors

2.04 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by **<<NFPA 70>>** and product listing.

B. Wiring methods and locations: Wires and cables shall be installed based on the following requirements, unless noted otherwise.
   1. Feeders, exposed: Type THHN/THWN-2, single conductors in raceway.
   2. Feeders, concealed in ceilings, walls, partitions, and crawlspaces: Type THHN/THWN-2, single conductors in raceway.
   3. Feeders, concealed in concrete and below slab-on-grade: Type XHHW-2, single conductors in raceway.
   4. Feeders, underground: Type RHW-2, single conductors in raceway.
   5. Feeders, concealed in raised flooring or partitions: Type THHN/THWN-2, single conductors in raceway.
   6. Branch circuits, concealed in ceilings, walls and partitions:
      a. Type THHN/THWN-2, single conductors in raceway.
      b. Metal-clad cable, Type MC cable and MC luminary cable.
   7. Branch circuits, exposed: Type THHN/THWN-2, single conductors in raceway.
   8. Branch circuits, concealed in concrete and below slab-on-grade: Type THHN/THWN-2, single conductors in raceway.
   9. Branch circuits, underground: Type RHW-2, single conductors in raceway.
   10. Feeders serving fire pump controller equipment: Mineral-insulated cable, Type MI.
   11. Feeders serving vertical risers: Type XHHW-2, single conductors in raceway.

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12. All other applications: Provide Type THHN/THWN-2, single conductors in raceway or wire and cable type as indicated.

2.05 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of **<<NFPA 70>>**.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

D. Comply with **<<NEMA WC 70>>**.

E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with **<<UL 83>>**.

F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with **<<UL 44>>**.

G. Conductors for Grounding and Bonding: Also comply with Section **<< 260526>>**.

H. Conductor Material:
   1. For feeders, provide copper conductors for feeders smaller than No. 4 AWG. Provide copper or aluminum for feeders No. 4 AWG and larger. Conductor sizes indicated are based on copper.
   2. For branch circuits, provide copper conductors only. Provide solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
      a. For VFC cable, extra flexible stranded is allowable.
   3. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with **<<ASTM B3>>**, **<<ASTM B8>>**, or **<<ASTM B787/B787M>>** unless otherwise indicated.
   4. Tinned Copper Conductors: Comply with **<<ASTM B33>>**.

I. Minimum Conductor Size: Minimum sizes shall be as follows, unless a larger size is indicated on the drawings.
   1. 120-volt branch circuits:
      a. Homerun from first outlet/device to panel: No. 12 AWG when the run is 50 feet or less; No. 10 AWG when the run is between 50 feet and 100 feet; No. 8 AWG when the run is more than 100 feet.
      b. First outlet/device to the other outlets/devices: No. 12 AWG.
   2. Control Circuits:
      a. Provide No. 14 AWG.

J. Where conductor size is not indicated, size to comply with **<<NFPA 70>>** but not less than applicable minimum size requirements specified.

K. Conductor Color Coding:
   1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
   2. Color Coding Method: Integrally colored insulation.

2.06 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:
   1. Copper Building Wire:
      a. Encore Wire Corporation**<< ; _____; or None - N/A>>**: www.encorewire.com/#sle.

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b. General Cable Technologies Corporation**<< ; _____; or None - N/A>>**: www.generalcable.com/#sle.
c. Service Wire Co**<< ; _____; or None - N/A>>**: www.servicewire.com/#sle.
d. Southwire Company**<< ; _____; or None - N/A>>**: www.southwire.com/#sle.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:
1. Feeders and Branch Circuits:**<< Stranded.; _____ .; or None - N/A>>**
a. Size 10 AWG and Smaller: Solid.
b. Size 8 AWG and Larger: Stranded.
2. Control Circuits: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:
1. Copper Building Wire: Type **<< THHN/THWN; THHN/THWN-2; XHHW-2; RHH/RHW-2; or _____>><< , except as indicated below; , _____; or None - N/A>>**.

2.07 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with **<<UL 486A-486B>>** or **<<UL 486C>>** as applicable.

B. Connectors for Grounding and Bonding: Comply with Section **<< 260526>>**.

C. Splicing shall be done in outlet boxes and junction boxes, and not in conduit.
1. Conductors No. 8 and larger: Termianted, spliced and taped, wherever practical, with connectors as indicated below. Use tools recommended by the manufacturer.
2. Splices in conductors No. 10 and smaller, including lighting fixtures: Made with wire connectors.
3. Taps in conductors No. 6 and larger: Made with compression taps or power distribution blocks.

D. Wiring Connectors for Terminations:
1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.

E. Wiring in high ambient temperature areas shall be of types required by NFPA 70 including over boilers and breechings, in fixture channels, in kitchen hoods, and on rooftops.

F. Wires shall be neatly shaped in panels, wireways, boxes and appurtenances.

G. Twist-on Insulated Spring Connectors: Rated 600 V, **<< 221 degrees F>>** for standard applications and **<< 302 degrees F>>** for high temperature applications; pre-filled with sealant and listed as complying with **<<UL 486D>>** for damp and wet locations.

H. Mechanical Connectors: Provide set-screw type for all interior applications. ***** MCPS Standard *****

I. Compression Connectors: Provide compression type for all exterior applications. ***** MCPS Standard *****

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J. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

2.08 ACCESSORIES

A. Electrical Tape:
   1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with **<<UL 510>>**; minimum thickness of **<< 7 mil>>**; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to **<< 221 degrees F>>**.
   2. Vinyl Insulating Electrical Tape: Complying with **<<ASTM D3005>>** and listed as complying with **<<UL 510>>**; minimum thickness of **<< 7 mil; 8.5 mil; or _____>>**; resistant to abrasion, corrosion, and sunlight; conformable for application down to **<< 0 degrees F>>** and suitable for continuous temperature environment up to **<< 221 degrees F>>**.
   3. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with **<<ASTM D4388>>**; minimum thickness of **<< 30 mil>>**; suitable for continuous temperature environment up to **<< 194 degrees F>>** and short-term **<< 266 degrees F>>** overload service.
   4. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of **<< 125 mil>>**; suitable for continuous temperature environment up to **<< 176 degrees F>>**.
   5. Varnished Cambric Electrical Tape: Cotton cambric fabric tape**<< , with or without adhesive; , with adhesive; , without adhesive; , _____; or None - N/A>>**, oil-primed and coated with high-grade insulating varnish; minimum thickness of **<< 7 mil>>**; suitable for continuous temperature environment up to **<< 221 degrees F>>**.
   6. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of **<< 90 mil>>**.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with **<<UL 486D>>**.

C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.

D. Wire Pulling Lubricant:
   1. Listed and labeled as complying with **<<UL 267>>**.
   2. Suitable for use with conductors/cables and associated insulation/jackets to be installed**<< , when tested in accordance with IEEE 1210; , _____; or None - N/A>><< ; approved by conductor/cable manufacturer; ; _____; or None - N/A>>**.
   3. Suitable for use at installation temperature.

E. Cable Ties: Material and tensile strength rating suitable for application.

F. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for cables and roofing system to be installed; designed to accommodate existing penetrations where applicable.

G. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

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B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with **<<NFPA 70>>**.

D. Verify that field measurements are as indicated.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

A. General:
   1. Provide wire and cable indicated in accordance with national, state and local electrical codes.
   2. Conceal wire and cable in new construction and in locations with finished walls, ceilings and floors, unless noted otherwise.
   3. Wire and cable serving systems over 100-volts shall be installed in raceways, except where noted otherwise.

B. Interior Wiring
   1. Exit light and emergency lighting circuits: Do not install in raceways, outlet boxes, or other locations with non-emergency wiring systems.
   2. Other systems (over 100-volts): Minimum No. 12 AWG unless specified or shown on drawings to be smaller.

C. Exterior Wiring
   1. Minimum sizes shall be as follows, unless a larger size is indicated on the drawings:
      a. 600-volt branch circuits: Copper, No. 10 AWG minimum.
      b. Exterior lighting circuits: Copper, No. 10 AWG minimum, with an extra No. 10 AWG (minimum) bare copper ground conductors.

D. Cable Rated Below 100-volts
   1. Install in raceway, unless otherwise indicated in contract documents.
   2. Where individual specification sections allow cable to installed either in raceway, on cable trays, or on J-hooks, install as follows:
      a. Wiring in walls, above inaccessible ceilings, where exposed in finished spaces, exposed on walls, and wherever it may not be accessible or may be subject to physical damage: Install cables in raceway.
      b. Wiring exposed in ceilings of unfinished spaces: Install cables in raceway or on cable trays.
      c. Wiring concealed above accessible suspended ceilings: Install cables on cable trays.
      d. Wiring within enclosures, consoles, cabinets, desks, and counters: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and/or distribution spools.
   3. Conceal raceway and cables, except in unfinished spaces and in open ceiling spaces.
   4. Cable not in raceways or on cable tray:
      a. Do not install in hangers used for pipes, electrical conduits, or ceiling hangers, nor support in any way by attachments to pipes, conduits, or ceiling hangers.

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b. Install without damaging conductors, shield or jacket. Cables shall not run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
c. Install away from potential EMI sources, including electrical power lines and equipment.
d. Install parallel and perpendicular to surfaces or exposed structural members adn follow surface contours where possible.

5. Cable support with J-hooks:
   a. Install J-hooks at intervals not exceeding 60 inches.
   b. Secure cables on J-hooks with Velcro cable straps. Avoid cinching cables.
6. Each cable run shall contain a 'S' loop or other means to accommodate expansion or contraction.
7. Where ceiling plenums are used for passage of air by heating and air conditioning system, install cable in conduit or use UL listed plenum cable.

E. For cable installed in conduit, comply with requirements for raceways and boxes specified in Section 260533, Conduits, and Section 260534, Boxes.
   1. Provide separate conduit systems for each low-voltage system.
   2. Pull cables without exceed cable manufacturer's recommended pulling tensions.
      a. Pull cables simultaneously if more than one is being installed in the same raceway.
      b. Use pulling compound or lubricant. Use compounds that will not damage conductor or insulation.
      c. Use pulling means, including fish tape, cable, rope, and basket-weave wire or cable grips, that will not damage cables or raceway.

F. Avoid installing near hot utilities, which might adversely affect system performance or result in damage to the cables. If cable must be placed close to such utilities, keep it separate and protect with insulation.

G. Cable bends shall have a radius not less than the value recommended by the cable manufacturer.

H. Tage cables connected to electronic equipment, to show funtion and the location of other end. Securely fasten labels to the cable.

I. Circuiting Requirements:
   1. Unless dimensioned, circuit routing indicated is diagrammatic.
   2. When circuit destination is indicated without specific routing, determine exact routing required.
   3. Arrange circuiting to minimize splices.
   4. Include circuit lengths required to install connected devices within **<< 10 ft; or ____ ft>>** of location indicated.
   5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with **<<NFPA 70>>**.
   6. Maintain separation of wiring for emergency systems in accordance with **<<NFPA 70>>**.
   7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is **<< not permitted.; permitted, under the following conditions:; or _____>>**
   8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among**<< up to three; _____; or None - N/A>>** single phase branch circuits of different phases installed in the same raceway is **<< not permitted. Provide dedicated**

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neutral/grounded conductor for each individual branch circuit.; permitted where not otherwise prohibited, except for the following:; or _____ .>>

J. Install products in accordance with manufacturer's instructions.

K. Perform work in accordance with **<<NECA 1>>** (general workmanship).

L. Installation in Raceway:
   1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
   2. Pull all conductors and cables together into raceway at same time.
   3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
   4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

M. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

N. Secure and support conductors and cables in accordance with **<<NFPA 70>>** using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
   1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
   2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.

O. Install conductors with a minimum of **<< 12 inches; or _____ inches>>** of slack at each outlet.

P. Where conductors are installed in enclosures for future termination by others, provide a minimum of **<< 5 feet; or _____ feet>>** of slack.

Q. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

R. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with **<<NFPA 70>>**.

S. Make wiring connections using specified wiring connectors.
   1. Make splices and taps only in **<< accessible boxes; or _____>>**. Do not pull splices into raceways or make splices in **<< conduit bodies; wiring gutters; or _____>>**.
   2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
   3. Do not remove conductor strands to facilitate insertion into connector.
   4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
   5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

T. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.

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1. Dry Locations: Use **<< insulating covers specifically designed for the connectors; electrical tape; heat shrink tubing; or _____>>**.
   a. For taped connections, first apply adequate amount of **<< rubber splicing electrical tape; electrical filler tape; or _____>>**, followed by outer covering of vinyl insulating electrical tape.
   b. For taped connections likely to require re-entering**<< , including motor leads.; , _____; , including _____; or None - N/A>>** first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
2. Damp Locations: Use **<< insulating covers specifically designed for the connectors; electrical tape; heat shrink tubing; or _____>>**.
   a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
   b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
3. Wet Locations: Use **<< heat shrink tubing; or _____>>**.

U. Insulate ends of spare conductors using **<< vinyl insulating electrical tape; or _____>>**.

V. Identify conductors and cables in accordance with Section **<< 260553>>**.

W. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section **<< 078400; or _____>>**.

X. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.04 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Inspect and test in accordance with **<<NETA ATS>>**, except Section 4.

C. Perform inspections and tests listed in **<<NETA ATS>>**, Section 7.3.2. The insulation resistance test is **<< required for all conductors; only required for conductors larger than _____; only required for services and feeders; not required; or _____>>**. The resistance test for parallel conductors listed as optional is **<< not required; required; or _____>>**.
   1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION 260519

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SECTION 260526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding electrical systems and equipment.

B. Ground system test.

1.02 RELATED REQUIREMENTS

A. Section **<< 260519 - Low-Voltage Electrical Power Conductors and Cables>>**: Additional requirements for conductors for grounding and bonding, including conductor color coding.

B. Section **<< 270536 - Cable Trays for Communication Systems>>**: Additional grounding and bonding requirements for cable tray systems.

C. Section **<< 260553 - Identification for Electrical Systems>>**: Identification products and requirements.

D. Section 264100 - Facility Lightning Protection.

E. Section 231123 - Facility Natural-Gas Piping

1.03 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings.

D. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems.

E. NFPA 70 - National Electrical Code.

F. NFPA 780 - Standard for the Installation of Lightning Protection Systems.

G. UL 467 - Grounding and Bonding Equipment.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Verify exact locations of underground metal water service pipe entrances to building.
2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
3. Notify **<<Architect>>** of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittals procedures.

B. Product Data: Ground rods and connections.

C. Certifications: System test.

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D. Field quality control test reports.

E. Project Record Documents: Record actual locations of **<< grounding electrode system components and connections; or _____>>**.

1.06 QUALITY ASSURANCE

A. Comply with requirements of **<<NFPA 70>>**.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

A. Do not use products for applications other than as permitted by **<<NFPA 70>>** and product listing.

B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

C. Where conductor size is not indicated, size to comply with **<<NFPA 70>>** but not less than applicable minimum size requirements specified.

D. Grounding System Resistance:

1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by **<<Architect>>**. Precipitation within the previous 48 hours does not constitute normally dry conditions.
2. Grounding Electrode System: Not greater than **<< 5 ohms; 25 ohms; or _____>>** to ground, when tested according to **<<IEEE 81>>** using "fall-of-potential" method**<< or alternate test described in IEEE 81; _____; or None - N/A>>**.

E. Grounding Electrode System:

1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
   a. Provide continuous grounding electrode conductors without splice or joint.
   b. Install grounding electrode conductors in raceway**<< where exposed to physical damage; _____; or None - N/A>>**. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
2. Metal Underground Water Pipe(s):
   a. Provide connection to underground metal**<< domestic and fire protection (where present); _____; or None - N/A>>** water service pipe(s) that are in direct contact with earth for at least **<< 10 feet>>** at an accessible location not more than **<< 5 feet>>** from the point of entrance to the building.
   b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
   c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
3. Concrete-Encased Electrode:
   a. Provide connection to concrete-encased electrode consisting of not less than **<< 20 feet; or _____>>** of **<< either steel reinforcing bars or bare copper conductor not smaller than 4 AWG; bare copper conductor not smaller than 4**

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AWG; steel reinforcing bars; or _____>> embedded within concrete foundation or footing that is in direct contact with earth in accordance with **<<NFPA 70>>**.

4. Ground Ring:
   a. Provide a ground ring encircling the building or structure consisting of bare copper conductor not less than **<< 2 AWG; or _____>>** in direct contact with earth, installed at a depth of not less than **<< 30 inches; _____ inches; or _____>>**.
5. **<< Ground Rod; Chemically-Enhanced Ground; Ground Plate; or _____>>** Electrode(s):
   a. Provide **<< three electrodes in an equilateral triangle configuration; two electrodes; single electrode; or _____>>** unless otherwise indicated or required.
   b. Space electrodes not less than **<< 10 feet; _____ feet; or _____>>** from each other and any other ground electrode.
6. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
7. Ground Riser: Provide common grounding electrode conductor not less than **<< 3/0 AWG; or _____>>** for tap connections to multiple separately derived systems as permitted in **<<NFPA 70>>**.

F. Service-Supplied System Grounding:
   1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection **<< at neutral (grounded) bus in service disconnect enclosure; or _____>>**.
   2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.

G. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:
   1. Provide grounding electrode system for each separate building or structure.
   2. Provide equipment grounding conductor routed with supply conductors.
   3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
   4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.

H. Separately Derived System Grounding:
   1. Separately derived systems include, but are not limited to:
      a. Transformers (except autotransformers such as buck-boost transformers).
      b. Uninterruptible power supplies (UPS), when configured as separately derived systems.
      c. Generators, when neutral is switched in the transfer switch.
   2. Provide grounding electrode conductor to connect derived system grounded conductor to **<< nearest effectively grounded metal building frame; nearest effectively grounded metal water pipe; common grounding electrode conductor ground riser; or _____>>**. Unless otherwise indicated, make connection at **<< neutral (grounded) bus in source enclosure; neutral (grounded) bus in first disconnecting means; or _____>>**.

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3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
4. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
5. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

I. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with **<<NFPA 70>>**.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with **<<NFPA 70>>**.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.

J. Lightning Protection Systems:
1. Do not use grounding electrode dedicated for lightning protection system for component of building grounding electrode system provided under this section.
2. Provide bonding of building grounding electrode system provided under this section and lightning protection grounding electrode system in accordance with **<<NFPA 70>>** and **<<NFPA 780>>**.

K. Cable Tray Systems: Also comply with Section **<< 270536>>**.

2.02 MANUFACTURED UNITS

A. Ground conductor, unless specifically noted otherwise, shall be copper, 98 percent conductivity, solid for No. 10 AWG and smaller, and stranded for No. 8 AWG and larger.
1. Isolated equipment grounding conductors shall have green insulation with a yellow stripe, or shall be identified as specified in Part 3.

B. Grounding busbar: Predrilled rectangular bars of electro-tin plated copper, 0.25 inches thick, 12 inch long, unless otherwise indicated on the drawings, with 0.3125 inch or 0.4375 inch diameter holes horizontally spaced 1 to 1.125 inches apart.
1. Intersystem bonding termination grounding busbar (IBGB) and telecommunications main grounding busbbar (TMGB) shall be 4 inches wide, with four rows of holes. Telecommunications main grounding busbar shall comply with ANSI/TIA/EIE-J-STD-607.
2. Other grounding busbars shall be 2 inches wide with two rows of holes. Each telecommunication ground busbar (TGB) shall comply with ANSI/IA/EIA J-STD-607.

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3. Stand-off insulators for busbar shall be flame-resistant fiberglass-reinforced thermoset polyester, UL recognized per UL Standard 891.

C. Ground Rods: Copper bonded steel, 0.75 inch diameter by 10 feet long, one end pointed and the other end tinned.

D. Mechanical type ground connectors:
1. Connectors: IEEE 837 and UL 467 compliant, listed for specific types, sizes and combinations of conductors and connected items.
2. Nuts, bolts and washers: Silicon bronze alloy type B per ASTM F467 and F468.

E. Exothermic type ground connections: Exothermic welding systems shall be equal to "Cadweld", manufacturered by Erico International Corporation.

F. Lugs: Lugs shall be two-hole or four-hole, equal to Burndy Hylug series.

2.03 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with **<<UL 467>>** where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section **<< 260526>>**:
1. Use insulated copper conductors unless otherwise indicated.
a. Exceptions:
1) Use **<< bare copper conductors; bare tinned copper conductors; or _____>>** where installed underground in direct contact with earth.
2) Use **<< bare copper conductors; bare tinned copper conductors; or _____>>** where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with **<<UL 467>>**.
2. Unless otherwise indicated, use **<< exothermic welded connections; compression connectors; or _____>>** for underground, concealed and other inaccessible connections.
3. Unless otherwise indicated, use **<< mechanical connectors; compression connectors; exothermic welded connections; or _____>>** for accessible connections.

D. Ground Bars:
1. Description: Copper rectangular ground bars with mounting brackets and insulators.
2. Size: **<< As indicated; _____ unless otherwise indicated or required; or _____>>**.
3. Holes for Connections: **<< As indicated or as required for connections to be made; or _____>>**.

E. Ground Rod Electrodes:
1. Comply with **<<NEMA GR 1>>**.
2. Material: **<< Copper-bonded (copper-clad) steel; Zinc-coated (galvanized) steel; Stainless steel; or _____>>**.
3. Size: **<< 3/4 inch; 5/8 inch; or _____>>** diameter by **<< 10 feet; 8 feet; or _____>>** length, unless otherwise indicated.

F. Chemically-Enhanced Ground Electrodes:

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1. Description: Copper tube factory-filled with electrolytic salts designed to provide a low-impedance ground in locations with high soil resistivity**<< ; straight (for vertical installations) or L-shaped (for horizontal installations) as indicated or as required; ; straight (for vertical installations); ; L-shaped (for horizontal installations); ; _____; or None - N/A>>**.
2. Length: **<< 10 feet; 20 feet; or _____>>**.
3. Integral Pigtail: Factory-attached, **<< sized not less than grounding electrode conductor to be attached; #4/0 AWG; #2/0 AWG; #2 AWG; or _____>>**.
4. Backfill Material: Grounding enhancement material recommended by electrode manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as indicated.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with **<<NECA 1>>** (general workmanship).

C. Provide the complete grounding of conduit systems, electrical equipment, conductor and equipment enclosures, motors, transformers, and neutral conductors in accordance with applicable codes. Grounded phase and neutral conductors shall be continuously identified. Continuity of metal racways shall be insured by double locknuts.

D. Furnish and install main ground for secondardy electrical service to cold water main accordance with NEC requirements. IN addition to the cold water ground, provide ground rods as indicated or as required by NEC and applicable codes.

1.

E. Grounding busbar: Busbars shall stand off the wall a minimum of 2 inches. Mount 6 inches above finished floor, unless otherwise indicated. Insulate the busbar from its supports.

1. Conductors connecting busbar to other busbars, and to the grounding electrode system shall be attached to busbar with exothermic welds.
2. Connect other conductors to busbar using lugs.

F. Install copper grounding jumpers of 3/0 copper cable around each main water valve in the building. Install copper grounding jumpers around conduit expansion fittings. Jumpers shall be of adequate current carrying capacity corresponding to size of conduit.

G. Ground system connections which are beneath the floor and in a concealed or inaccessible location shall be brazed or welded. Brazing and welding shall be "CADWELD".

H. Separately-derived 120/208-volt three phase wye electrical systems originating in transformers shall be grounded at the transformer neutral terminal:

1. The grounding electrode for the system shall be whichever oneof the following that is closest to the transformer:
   a. Building's grounding electrode.

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b. Steel structural member of the building conforming to NEC requirements for grounding electrodes.
c. First five feet of the water service piping to the building.

I. Separately-derived three phase why electrical systems originating in generators shall be grounded at the generator neutral terminal:
1. The grounding electrode
2. The grounding electrode for the indoor generator shall be whichever one of the following that is closest to the generator:
a. Building's grounding electrode.
b. Steel structural member of the building conforming to NEC requirements for grounding electrodes.
c. First five feet of the water service piping to the building.

J. Bonding separately-derived systems:
1. Each metal water piping system, not used as the electrical system's grounding electrode, in the area served by the electrical system, shall be bonded fo the electrical system's neutral by a system bonding jumper.
2. If exposed structural metal is not used as the grounding electrode for the system, bond exposed structural metal in the arear served by the electrical system to the system's neutral by a system bonding jumper.
3. If a metal water piping system in the area served by the electrical system is bonded to exposed structural metal by a NEC-compliant bonding jumper, then only one of the two (piping or structural metal) need to be bonded to the electrical system's neutral.

K. Bonding straps and jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to equipment mounted on vibration isolation hangers and supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connections to outdoor locations; if a disconnect-type connection is required, use a bolted clamp secured with a minimum of two bolts and lock washers.

L. Identify grounding and bonding system components in accordance with Section **<< 260553>>**.

3.03 EQUIPMENT GROUNDING AND BONDING

A. Provide insulated equipment grounding conductors to all feeders and branch circuits.

B. Air-duct equipment circuits: Install insulated equpment grounding conductor to duct-mounted electrical devices operating at 120V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water heater, heat tracing, and anti-frost heating cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat tracing cable. Bond conductor to heater untis, piping, connected equipment and components.

D. Isolated grounding receptacle circuit shall be provided with an additional equipment grounding conductor insulated from the normal equipment grounding conductor.

E. Signal adn communication equipment: In addition to grounding and bonding required by NFPA 70, provide grounding systems complying with requirements in ANSI/TIA/EIA J-STD-607-A.
1. Telephone and data equipment may share a common grounding system.

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a. Provide a No. 4 AWG minimum conductor from the IBGB to a TMGB, located in the telecommunicaitons entrance facility.
b. Provide a TGB in each telephone and data wiring closet. Where a telephone and data terminal cabinet is not in a wiring closet, provide a TGB next to it.
c. Provide No. 4 AWG minimum conductors to bond the TMGB to each TGB.
d. Where a TMGB or TGB is in a room with a panelbaord providing circuits to the telephone or data equipment in the room, locate the busbar as cloas as is practical to the panelboard, and bond the panelboard's equipment ground or enclosure to the busbar.

2. For other communication equipment, such as fire alarm, intercom, CATV, and security panels, when located in a room other than where the IBGB, TMGB, or TGB is, provide a grounding busbar in teh same room as the equipment. Bond the grounding busbar to the IBGB, TMGB, or TGB with a No. 4 AWG minimum conductor.

F. Gas piping:
1. Comply with NFPA 54.
2. Provide bonding jumpers for each length of corrugated stainless-steel tubing (CSST).
a. Jumpers shall be No. 6 AWG or the same size as the equipment grounding conductor serving the equipment served by the CSST, whichever is larger.
b. Install in accordance with CSST manufacturer's instructions and NFPA 54.

3.04 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Grounding manholes and handholes: Install a driving ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from rod into manhole through a waterproof sleeve in a manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink groute. Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shileds within each manhole or handhole, to ground rod or grounding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shield according to written instructions by manufacturer of splicing and termination kits.

3.05 APPLICATIONS

A. Underground grounding conductors: Install bare copper conductor, No. 2/0 AWG minimum.
1. Bury at least 24 inches below grade.

3.06 IDENTIFICATION

A. Comply with requirements in Section260553, Identification for Electrical Systems, for instruction signs. The label or its text shall be green.

B. Install labels at the ends of telecommunications bonding conductors and the grounding electrode conductor where exposed.
1. Label text: "If this connector or cable is loose, or must be removed for any reason, please cal the building telecommunications manager."

3.07 GROUNDING SYSTEM TEST

A. Inspect and test each component of the grounding system in accordance with **<<NETA ATS>>** except Section 4.

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B. Perform inspections and tests listed in **<<NETA ATS>>**, Section 7.13.

C. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

D. Ensure the grounding system is continuous and that resistance to earth is not more than 10 ohms.

E. Test each ground rod for resistance to earth before making connections to rod; tie grounding system together and test for resistance to earth.

F. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

G. Submit detailed reports indicating inspection and testing results, including locations of rods as well as resistance and soil conditions at the time measurements were made, and corrective actions taken.

END OF SECTION 260526

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SECTION 260529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section **<< 033000 - Cast-in-Place Concrete>>**: Concrete equipment pads.

B. Section **<< 260548 - Vibration and Seismic Controls for Electrical Systems>>**.

1.02 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

D. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

F. MFMA-4 - Metal Framing Standards Publication.

G. NECA 1 - Standard for Good Workmanship in Electrical Construction.

H. NFPA 70 - National Electrical Code.

I. NFPA 101 - Life Safety Code.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Comply with the following. Where requirements differ, comply with most stringent.
   a. **<<NFPA 70>>**.
2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported**<< with minimum safety factor of _____; _____; or None - N/A>>**. Include consideration for vibration, equipment operation, and shock loads where applicable.
5. Do not use products for applications other than as permitted by **<<NFPA 70>>** and product listing.
6. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
   a. Zinc-Plated Steel: Electroplated in accordance with **<<ASTM B633>>**.
   b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with **<<ASTM A123/A123M>>** or **<<ASTM A153/A153M>>**.

B. Components for Vibration Isolation and/or Seismic Controls: See Section **<< 260548>>**.

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C. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
   1. Conduit Straps: One-hole or two-hole type; **<< steel; malleable iron; or _____>>**.
   2. Conduit Clamps: Bolted type unless otherwise indicated.

D. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.

E. Metal Channel/Strut Framing Systems:
   1. Manufacturers:
      a. ABB**<< ; _____; or None - N/A>>**: www.electrification.us.abb.com/#sle.
      b. Atkore International Inc; Unistrut**<< ; _____; or None - N/A>>**: www.unistrut.us/#sle.
      c. Eaton Corporation**<< ; _____; or None - N/A>>**: www.eaton.com/#sle.
      d. Elgen Manufacturing Company, Inc**<< ; _____; or None - N/A>>**: www.elgenmfg.com/#sle.
      e. **<< Thomas & Betts Corporation>>**.
   2. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
   3. Comply with **<<MFMA-4>>**.
   4. Channel Material:
      a. Indoor Dry Locations: Use **<< painted steel; zinc-plated steel; galvanized steel; or _____>>**.
      b. Outdoor and Damp or Wet Indoor Locations: Use **<< galvanized steel; or _____>>**.

F. Fiberglass Channel/Strut Framing Systems:
   1. Manufacturers:
      a. Atkore International Inc; Unistrut**<< ; _____; or None - N/A>>**: www.unistrut.us/#sle.
      b. Champion Fiberglass**<< ; _____; or None - N/A>>**: www.championfiberglass.com/#sle.
      c. Eaton Corporation**<< ; _____; or None - N/A>>**: www.eaton.com/#sle.
      d. Enduro Composites**<< ; _____; or None - N/A>>**: www.endurocomposites.com/#sle.
   2. Description: Factory-fabricated, continuous-slot, fiberglass channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
   3. Flammability: Fire retardant with **<<NFPA 101>>**, Class A flame spread index, maximum of 25, when tested in accordance with **<<ASTM E84>>**; self extinguishing in accordance with **<<ASTM D635>>**.

G. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.

H. Anchors and Fasteners:
   1. Manufacturers - Mechanical Anchors:
      a. Hilti, Inc**<< ; _____; or None - N/A>>**: www.hilti.com/#sle.
      b. MKT Fastening, LLC.
      c. Cooper B-Line, Inc:, a division of Cooper Industries
   2. Manufacturers - Powder-Actuated Fastening Systems:
      a. Hilti, Inc**<< ; _____; or None - N/A>>**: www.hilti.com/#sle.
      b. MKT Fastening, LLC.

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c. Cooper B-Line, Inc:, a division of Cooper Industries

3. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
4. New Concrete: Use **<< preset concrete inserts; expansion anchors; screw anchors; or _____>>**.
5. Existing Concrete: Use expansion anchors
6. Solid or Grout-Filled Masonry: Use **<< expansion anchors; screw anchors; or _____>>**.
7. Hollow Masonry: Use **<< toggle bolts; or _____>>**.
8. Hollow Stud Walls: Use **<< toggle bolts; or _____>>**.
9. Steel: Use **<< beam clamps; machine bolts; welded threaded studs; or _____>>**.
10. Wood: Use **<< wood screws; or _____>>**.
11. **<< Plastic and lead; or _____>>** anchors are **<< not permitted.; permitted only as follows:; or _____ .>>**
12. Powder-actuated fasteners are **<< not permitted.; permitted only as follows:; or _____ .>>**
    a. **<< In standard-weight concrete 4 inches thick or greater for a supported weight of less than 50lbs>>**.
13. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    a. Manufacturer: Same as manufacturer of metal channel/strut framing system.
    b. Comply with **<<MFMA-4>>**.
    c. Channel Material: Use **<< galvanized steel; or _____>>**.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install hangers and supports in accordance with **<<NECA 1>>** and NECA 101.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D. Maximum support spaceing and minimum hanger rod size for raceway: Space supports for conduits and raceways as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in the future without exceed specified design load limits.
    1. Secure raceways and cables to supports with two-bolt conduit clamps.

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F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings for fastening raceways to trapeze supports.

G. Unless specifically indicated or approved by **<<Architect>>**, do not provide support from suspended ceiling support system or ceiling grid.

H. Unless specifically indicated or approved by **<<Architect>>**, do not provide support from roof deck.

I. Do not penetrate or otherwise notch or cut structural members without approval of **<< Structural Engineer; Architect; or _____>>**.

J. Equipment Support and Attachment:

1. Use **<< metal, fabricated supports; supports assembled from metal channel/strut; or _____>>** to support equipment as required.
2. Use **<< metal channel/strut secured to studs; or _____>>** to support equipment surface mounted on hollow stud walls**<< when wall strength is not sufficient to resist pull-out; _____; or None - N/A>>**.
3. Use **<< metal channel/strut; or _____>>** to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Unless otherwise indicated, mount floor-mounted equipment on properly sized concrete pad **<< 3 inches; 4 inches; or _____>>** in height; see Section **<< 033000; or _____>>**.
5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

K. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

L. Secure fasteners in accordance with manufacturer's recommended torque settings.

M. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 260529

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SECTION 260533
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal conduits, tubing, and fittings.

B. Nonmetal condutis, tubing, and fittings.

C. Metal wireways and auxiliary gutters.

D. Surface raceways.

E. Boxes, enclosures, and cabinets.

F. Handholes and boxes for exterior underground cabl

1.02 RELATED REQUIREMENTS

A. Section **<< 078400 - Firestopping>>**.

B. Section **<< 260526 - Grounding and Bonding for Electrical Systems>>**.

C. Section **<< 260529 - Hangers and Supports for Electrical Systems>>**.

1.03 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC).

B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S).

C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction.

E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT).

F. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC).

G. NECA 130 - Standard for Installing and Maintaining Wiring Devices.

H. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.

I. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit.

J. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.

K. NFPA 70 - National Electrical Code.

L. UL 1 - Flexible Metal Conduit.

M. UL 5 - Surface Metal Raceways and Fittings.

N. UL 6 - Electrical Rigid Metal Conduit-Steel.

O. UL 6A - Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel.

P. UL 360 - Liquid-Tight Flexible Metal Conduit.

Q. UL 514B - Conduit, Tubing, and Cable Fittings.

R. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.

S. UL 797 - Electrical Metallic Tubing-Steel.

T. UL 1242 - Electrical Intermediate Metal Conduit-Steel.

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1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
   3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
   4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
   5. Notify **<<Architect>>** of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
   6. Coordinate the placement of raceways with millwork, furniture, equipment, etc. installed under other sections or by others.
   7.

B. Sequencing:
   1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

1.05 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product type provided.
   1. Surfac Raceway Systems: Include information on fill capacities for conductors and cables.

B. Sustainable Design Submittals:
   1. Product Data for Sustainable Design credits: For solvent cements and adhesive primers, documentation including printed statement of VOC content.

C. Shop Drawings:
   1. For custom enclosures and cabinets. Include plans, elevations, sections and attachment details.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

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PART 2 PRODUCTS

2.01 METAL CONDUITS, TUBING, AND FITTINGS

A. Do not use conduit and associated fittings for applications other than as permitted by **<<NFPA 70>>**, manufacturer's instructions, and product listing.

B. Galvanized Rigid Steel Conduit (GRC, RMC): Comply with **<<ANSI C80.1>>** and listed and labeled as complying with **<<UL 6>>**.

C. Galvanized Steel Intermediate Metal Conduit (IMC): Comply with **<<ANSI C80.6>>** and listed and labeled as complying with **<<UL 1242>>**.

D. Galvanized Steel Electrical Metallic Tubing (EMT): Comply with **<<ANSI C80.3>>** and listed and labeled as complying with **<<UL 797>>**.

E. Flexible Metal Conduit (FMC): Comply with **<<UL 1>>**, and listed for use in classified firestop systems.

F. Liquidtight Flexible Metal Conduit (LFMC): Comply with **<<UL 360>>**.

G. Fittings for Metal Conduit:
   1. Nonhazardous Locations: Use fittings complying with **<<NEMA FB 1>>** and listed and labeled as complying with **<<UL 514B>>** or **<<UL 6>>**.
   2. Material: Use steel.
      a. Use threaded type fittings only. Provide compression type connectors for exterior use. Provide set screw type connectors for interior use.

H.

2.02 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Rigid Polyvinyl Chloride Conduit (PVC): **<<NFPA 70>>**, Type PVC rigid polyvinyl chloride conduit complying with **<<NEMA TC 2>>** and listed and labeled as complying with **<<UL 651>>**; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

B. Fittings for PVC:
   1. Description: Fittings complying with **<<NEMA TC 3>>** and listed and labeled as complying with **<<UL 651>>**; material to match conduit.
   2. Provide solvent cement made by manufacturer of the conduit and fittings.

2.03 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Steel, with hinge cover, complying with UL 870 and NEMA 250, Type 1, unless otherwise indicated and sized according to NFPA 70.
   1. Cover: Screw type. Opening complete width and lenght of trough.
   2. Finish: Manufactuer's standard baked enamel.

B. Fittings:
   1. Made with removable covers and sides to permit installation of a complete system with access to wires throughout system. UL listed with the troughs.
   2. Provide threaded screws at every connector.

2.04 SURFACE RACEWAYS

A. General Requirements:
   1. Provide all components, fittings, supports, and acceessories required for a complete raceway system.
   2. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Surface Metal Raceways: Galvanized steel with snap-on covers. Listed and labeled as complying with **<<UL 5>>**.
   1. One-piece type, equal to Wiremold No. 700 as a minimum size, steel 0.04 inch thick, complete with fittings, connectors and appurtenances.
   2. Two-piece type, equal to Wiremold 2000, steel, base 0.04 inch thick and cover 0.025 inch thick, complete with receptacles, fittings, connectors, conductors, and appurtenances.
   3. Elbows: "FiberReady" full-capacity elbows.
   4. Two-piece, two-channel type, equal to Wiremold 4000, galvanized steel, no less than 4.75 inches wide, base 0.05 inch thick and cover 0.04 inch thick, complete with divider, fittings, connectors, devices, and appurtenances.
      a. Cover 4000C, precut or field cut.
      b. Divider 4000D, galvanized steel with one painted side, with divider clip every 2.5 feet.

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c. Device mounting bracket and trim plate: At each location indicated on drawings, 4050, high-impact plastic. Trim plate overlaps raceway cover and seam between mounting bracket and adjacent cover plate.

d. Face plates: 5507 Series, types for types of locations indicated on drawings.

1) Location indicated for duplex receptacle: Duplex receptacle type.

2) Location indicated for data and telephone: Dual RJ11/RJ45 type.

3) Location indicated for future system: Blank.

e. End cap at vertical termination of raceway: Entrance end fitting 4010 with removable divider, capable of allowing connection with minimum 1.25-inch conduit.

f. V4011FO "FiberReady" full-capacity corner elbows and T fittings which maintain a controlled 2-inch minimum cable bend radius.

5. Multi-outlet plug-in strips: Wired assemblies, equal to Wiremold No. 2000 Series, of lengths indicated.

6. Finish Color: Ivory.

2.05 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements:

1. Do not use boxes and associated accessories for applications other than as permitted by **<<NFPA 70>>** and product listing.

2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.

3. Provide products listed, classified, and labeled as suitable for the purpose intended.

4. Where box size is not indicated, size to comply with **<<NFPA 70>>** but not less than applicable minimum size requirements specified.

5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Outlet boxes in concrete construction: Octagonal, two-piece type, of sufficient depth to keep conduits not closer than 1 inch to surface.

E. Switch and receptacle boxes in masonry partitions and walls: Square cornered tile wall boxes 3.5 inches deep, or 4-11/16 inches square boxes with raised tile wall device covers. The device covers shall be of extra depths required to suit the block or brick construction in which they are placed.

F. Switch and receptacle boxes in metal stud partitions: 4-11/16 inches square by 2.125 inches deep square boxes with 0.75-inch raised tile wall device covers finishing flush with finished wall surface.

G. Wall and partition mounted outlets for low-voltage systems: Same as specified above for switches and receptacles.

H. Junction and Pull Boxes:

1. Junction and pull boxes in feeder conduit runs: Galvanized, of size required for conduit arrangement and not less than the size required by NFPA 70, and furnished with screwed covers.

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2.06 FLOOR BOXES AND SERVICE FITTINGS

A. Floor box for power and communications: equal to Wiremold EFB Evolution Series.
   1. Complete in-floor multi-service box consisting of floor box housing, removable cover, wiring devices and device plates, as detail on drawings.

2.07 POKE-THROUGH DEVICES

A. Poke Through service fittings for power and communications: equal to Wiremold 8-inch Evolution Series.
   1. Listed by UL and classified for fire resistance up to and including two-hour fire rating. Provide units with wiring devices and device plates as detail on the drawings.

2.08 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

2.09 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by **<<NFPA 70>>**, manufacturer's instructions, and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, **<< comply with most restrictive requirements; or _____>>**. Where conduit type for particular application is not specified, **<< use galvanized steel rigid metal conduit; or _____>>**.

C. Underground:
   1. Under Slab on Grade: Use **<< galvanized steel rigid metal conduit (RMC); stainless steel rigid metal conduit (RMC); aluminum rigid metal conduit (RMC); galvanized steel intermediate metal conduit (IMC); stainless steel intermediate metal conduit (IMC); PVC-coated galvanized steel rigid metal conduit (RMC); galvanized steel electrical metallic tubing (EMT); stainless steel electrical metallic tubing (EMT); aluminum electrical metallic tubing (EMT); rigid PVC conduit; reinforced thermosetting resin conduit (RTRC); high-density polyethylene (HDPE) conduit; or _____>>**.
   2. Exterior, Direct-Buried: Use **<< galvanized steel rigid metal conduit (RMC); stainless steel rigid metal conduit (RMC); aluminum rigid metal conduit (RMC); galvanized steel intermediate metal conduit (IMC); stainless steel intermediate metal conduit (IMC); PVC-coated galvanized steel rigid metal conduit; galvanized steel electrical metallic tubing (EMT); stainless steel electrical metallic tubing (EMT); aluminum electrical metallic tubing (EMT); rigid PVC conduit; reinforced thermosetting resin conduit (RTRC); high-density polyethylene (HDPE) conduit; or _____>>**.
   3. Exterior, Embedded Within Concrete: Use **<< galvanized steel rigid metal conduit (RMC); stainless steel rigid metal conduit (RMC); aluminum rigid metal conduit (RMC); galvanized steel intermediate metal conduit (IMC); stainless steel intermediate metal conduit (IMC); PVC-coated galvanized steel rigid metal conduit (RMC); galvanized steel electrical metallic tubing (EMT); stainless steel electrical metallic tubing (EMT); aluminum electrical metallic tubing (EMT); rigid PVC conduit; reinforced thermosetting resin conduit (RTRC); high-density polyethylene (HDPE) conduit; or _____>>**.
   4. Where **<< rigid polyvinyl chloride (PVC) conduit; high-density polyethylene (HDPE) conduit; or _____>>** is provided, transition to **<< galvanized steel rigid metal conduit (RMC); stainless steel rigid metal conduit (RMC); aluminum rigid metal conduit (RMC); galvanized steel intermediate metal conduit (IMC); stainless steel intermediate metal conduit (IMC); PVC-coated galvanized steel rigid metal conduit (RMC); galvanized steel electrical metallic tubing (EMT); aluminum electrical**

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metallic tubing (EMT); schedule 80 rigid PVC conduit; Type XW reinforced thermosetting resin conduit (RTRC); or _____>> where emerging from underground.

D. Embedded Within Concrete:
   1. Within Slab on Grade: Not permitted.
   2. Within Slab Above Ground: Not permitted.
   3. Within Concrete Walls Above Ground: Use **<< galvanized steel rigid metal conduit (RMC); stainless steel rigid metal conduit (RMC); aluminum rigid metal conduit (RMC); galvanized steel intermediate metal conduit (IMC); stainless steel intermediate metal conduit (IMC); PVC-coated galvanized steel rigid metal conduit (RMC); galvanized steel electrical metallic tubing (EMT); aluminum electrical metallic tubing (EMT); rigid PVC conduit; electrical nonmetallic tubing (ENT); reinforced thermosetting resin conduit (RTRC); or _____>>**.
   4. Where rigid polyvinyl (PVC) conduit is provided, transition to **<< galvanized steel rigid metal conduit (RMC); stainless steel rigid metal conduit (RMC); aluminum rigid metal conduit (RMC); galvanized steel intermediate metal conduit (IMC); stainless steel intermediate metal conduit (IMC); PVC-coated galvanized steel rigid metal conduit (RMC); galvanized steel electrical metallic tubing (EMT); aluminum electrical metallic tubing (EMT); reinforced thermosetting resin conduit (RTRC); or _____>>** where emerging from concrete.

E. Concealed Within Masonry Walls: Use **<< galvanized steel rigid metal conduit (RMC); stainless steel rigid metal conduit (RMC); aluminum rigid metal conduit (RMC); galvanized steel intermediate metal conduit (IMC); stainless steel intermediate metal conduit (IMC); galvanized steel electrical metallic tubing (EMT); stainless steel electrical metallic tubing (EMT); aluminum electrical metallic tubing (EMT); reinforced thermosetting resin conduit (RTRC); or _____>>**.

F. Concealed Within Hollow Stud Walls: Use **<< galvanized steel rigid metal conduit (RMC); stainless steel rigid metal conduit (RMC); aluminum rigid metal conduit (RMC); galvanized steel intermediate metal conduit (IMC); stainless steel intermediate metal conduit (IMC); galvanized steel electrical metallic tubing (EMT); stainless steel electrical metallic tubing (EMT); aluminum electrical metallic tubing (EMT); reinforced thermosetting resin conduit (RTRC); or _____>>**.

G. Concealed Above Accessible Ceilings: Use **<< galvanized steel rigid metal conduit (RMC); stainless steel rigid metal conduit (RMC); aluminum rigid metal conduit (RMC); galvanized steel intermediate metal conduit (IMC); stainless steel intermediate metal conduit (IMC); galvanized steel electrical metallic tubing (EMT); stainless steel electrical metallic tubing (EMT); aluminum electrical metallic tubing (EMT); reinforced thermosetting resin conduit (RTRC); or _____>>**.

H. Interior, Damp or Wet Locations: Use **<< galvanized steel rigid metal conduit (RMC); stainless steel rigid metal conduit (RMC); aluminum rigid metal conduit (RMC); galvanized steel intermediate metal conduit (IMC); stainless steel intermediate metal conduit (IMC); PVC-coated galvanized steel rigid metal conduit (RMC); galvanized steel electrical metallic tubing (EMT); stainless steel electrical metallic tubing (EMT); aluminum electrical metallic tubing (EMT); reinforced thermosetting resin conduit (RTRC); or _____>>**.

I. Exposed, Interior, Not Subject to Physical Damage: Use **<< galvanized steel rigid metal conduit (RMC); stainless steel rigid metal conduit (RMC); aluminum rigid metal conduit (RMC); galvanized steel intermediate metal conduit (IMC); stainless steel intermediate metal conduit (IMC); galvanized steel electrical metallic tubing (EMT); stainless steel**

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electrical metallic tubing (EMT); aluminum electrical metallic tubing (EMT); rigid PVC conduit; reinforced thermosetting resin conduit (RTRC); or _____>>.

J. Exposed, Interior, Subject to Physical Damage: Use **<< galvanized steel rigid metal conduit (RMC); stainless steel rigid metal conduit (RMC); aluminum rigid metal conduit (RMC); galvanized steel intermediate metal conduit (IMC); stainless steel intermediate metal conduit (IMC); galvanized steel electrical metallic tubing (EMT); stainless steel electrical metallic tubing (EMT); schedule 80 rigid PVC conduit; Type XW reinforced thermosetting resin conduit (RTRC); or _____>>**.

K. Exposed, Interior, Subject to Severe Physical Damage: Use **<< galvanized steel rigid metal conduit (RMC); stainless steel rigid metal conduit (RMC); aluminum rigid metal conduit (RMC); galvanized steel intermediate metal conduit (IMC); stainless steel intermediate metal conduit (IMC); or _____>>**.

1. Locations subject to severe physical damage include, but are not limited to:
   a. High traffic industrial and warehouse areas where exposed below **<< 8 feet; _____ feet; or _____>><< , except within electrical and communication rooms or closets; , _____; or None - N/A>>**.
   b. Mechanical Rooms.
   c. Loading Dock.
   d. Gymnasiums.
   e. Cooridors used for traffic of forklifts or similar vehicles.

L. Exposed, Exterior: Use **<< galvanized steel rigid metal conduit (RMC); stainless steel rigid metal conduit (RMC); aluminum rigid metal conduit (RMC); galvanized steel intermediate metal conduit (IMC); stainless steel intermediate metal conduit (IMC); PVC-coated galvanized steel rigid metal conduit (RMC); galvanized steel electrical metallic tubing (EMT); stainless steel electrical metallic tubing (EMT); reinforced thermosetting resin conduit (RTRC), type XW; or _____>>**.

M. Flexible Connections to Luminaires Above Accessible Ceilings: Use **<< flexible metal conduit (FMC); or _____>>**.

1. Maximum Length: **<< 6 feet; _____ feet; or _____>>**.

N. Flexible Connections to Vibrating Equipment:

1. Dry Locations: Use **<< flexible metal conduit (FMC); or _____>>**.
2. Damp, Wet, or Corrosive Locations: Use **<< liquidtight flexible metal conduit (LFMC); or _____>>**.
3. Maximum Length: **<< 6 feet; _____ feet; or _____>>** unless otherwise indicated.
4. Vibrating equipment includes, but is not limited to:
   a. Transformers.
   b. Motors.

O. Class 2 & 3 Wiring shall be installed in conduit subject to application requirements above in 2.01.

2.10 CONDUIT - GENERAL REQUIREMENTS

A. Comply with **<<NFPA 70>>**.

B. Provide conduit, fittings, supports, and accessories required for complete raceway system.

C. Provide products listed, classified, and labeled as suitable for purpose intended.

D. Where conduit size is not indicated, size to comply with **<<NFPA 70>>** but not less than applicable minimum size requirements specified.

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2.11 GALVANIZED STEEL RIGID METAL CONDUIT (GRC)

A. Description: **<<NFPA 70>>**, Type RMC galvanized steel rigid metal conduit complying with **<<ANSI C80.1>>** and listed and labeled as complying with **<<UL 6>>**.

B. Fittings:

1. Nonhazardous Locations: Use fittings complying with **<<NEMA FB 1>>** and listed and labeled as complying with **<<UL 514B>>** or **<<UL 6>>**.
2. Material: Use **<< steel; malleable iron; die cast zinc; or _____>>**.
3. Connectors and Couplings: Use **<< threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted; threaded or threadless type fittings; or _____>>**.

2.12 STAINLESS STEEL RIGID METAL CONDUIT (RMC)

A. Description: **<<NFPA 70>>**, Type RMC stainless steel rigid metal conduit complying with **<<ANSI C80.1>>** and listed and labeled as complying with **<<UL 6A>>**.

B. Fittings:

1. Nonhazardous Locations: Use fittings complying with **<<NEMA FB 1>>** and listed and labeled as complying with **<<UL 514B>>** or **<<UL 6A>>**.
2. Material: Use stainless steel with corrosion resistance equivalent to conduit.
3. Connectors and Couplings: Use **<< threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted; threaded or threadless type fittings; or _____>>**.

2.13 FLEXIBLE METAL CONDUIT (FMC)

A. Description: **<<NFPA 70>>**, Type FMC **<< standard-wall steel; reduced-wall steel; standard-wall aluminum; reduced-wall aluminum; or _____>>** flexible metal conduit listed and labeled as complying with **<<UL 1>>**, and listed for use in classified firestop systems.

B. Fittings:

1. Description: Fittings complying with **<<NEMA FB 1>>** and listed and labeled as complying with **<<UL 514B>>**.
2. Material: Use **<< steel; malleable iron; aluminum; die cast zinc; or _____>>**.

2.14 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Description: **<<NFPA 70>>**, Type LFMC polyvinyl chloride (PVC) jacketed **<< steel; aluminum; or _____>>** flexible metal conduit listed and labeled as complying with **<<UL 360>>**.

B. Fittings:

1. Description: Fittings complying with **<<NEMA FB 1>>** and listed and labeled as complying with **<<UL 514B>>**.
2. Material: Use **<< steel; malleable iron; aluminum; die cast zinc; or _____>>**.

2.15 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Description: **<<NFPA 70>>**, Type EMT galvanized steel electrical metallic tubing complying with **<<ANSI C80.3>>** and listed and labeled as complying with **<<UL 797>>**.

B. Fittings:

1. Description: Fittings complying with **<<NEMA FB 1>>** and listed and labeled as complying with **<<UL 514B>>**.
2. Material: Use **<< steel; malleable iron; die cast zinc; or _____>>**.

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3. Connectors and Couplings: Use **<< compression/gland; set-screw; or _____>>** type.
    a. Do not use indenter type connectors and couplings.

2.16 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Description: **<<NFPA 70>>**, Type PVC rigid polyvinyl chloride conduit complying with **<<NEMA TC 2>>** and listed and labeled as complying with **<<UL 651>><< ; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; ; Schedule 40 or Schedule 80 as indicated; ; Schedule 80 unless otherwise indicated; ; _____; or None - N/A>>**; rated for use with conductors rated 90 degrees C.

B. Fittings:
1. Manufacturer: Same as manufacturer of conduit to be connected.
2. Description: Fittings complying with **<<NEMA TC 3>>** and listed and labeled as complying with **<<UL 651>>**; material to match conduit.

PART 3 EXECUTION

3.01 RACEWAY APPLICATION

A. Minimum raceway size for interior applications is 3/4 inch. Minimum raceway size for exterior applications is 1 inch.
1. Provide GRC for the following applications:
    a. Conduit buried in earth, except where noted to be plastic.
    b. Conduit in concrete slab, except where noted to be plastic.
    c. First five feet of conduit extending outside building.
    d. Under roads and paved areas where existing pavement is not to be disturbed, extending at least five feet beyond edges of pavement.
    e. Elbows penetrating floor slabs, exterior walls, or bearing walls.
    f. In exterior walls.
2. Provide IMC for the following applications:
    a. Wiring to exterior equipment.
    b. In exterior walls.
3. Provide EMT for the following applications:
    a. Sizes 4 inches and smaller, except as noted above.
4. Provide FMC for the followign applications:
    a. For connection to vibrating equipment indoors.
5. Provide LFMC for the following applications:
    a. For connection to vibrating equipment outdoors.
6. Provide PVC for the following applications:
    a. For exterior circuits, directly buried, except first five feet from building.
    b. Where noted under concrete slab, concrete encased.
    c. Where noted under concrete slab, directly buried.
    d. For concrete encased ductbanks.

B.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

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B. Install conduit in accordance with **<<NECA 1>>**.

C. Surface Raceways:
   1. Where field cutting is required, make each cut with the manufacturer's tool specifically designed for cutting their product.
   2. Make raceway runs plumb, level, true and parrallel with building and casework lines.
   3. Except as otherwise shown on drawings, locate raceways in corners, beneath chalkboard and tackboard frames, adjacent to door trims, and in other ways to be inconspicuous, even when this requires additional lengths.
   4.

D. Boxes
   1. Install boxes in accordance with **<<NECA 1>>** (general workmanship) and, where applicable, **<<NECA 130>><< , including mounting heights specified in those standards where mounting heights are not indicated; , except for mounting heights specified in those standards; , _____; or None - N/A>>**.
   2. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and **<<NFPA 70>>**.
   3. Provide separate boxes for emergency power and normal power systems.
   4. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
   5. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
   6. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
   7. Provide box at each outlet, switch, and appurtenance. Each box shall be of a type suitable for the duty intended and shall be installed in accordance with the manufacturer's instructions.
      a. Where conduit is exposed, provide cast-steel or aluminum boxes.
   8. Coordinate locations of boxes with installation of conduit as specified in Section ######.
   9. "Through-wall" boxes: Not permitted in partitions.
   10. Firmly secure boxes in place, plumb, level and with front device cover even with finished wall surface.
   11. Boxes in metal wall stud partitions shall be securely supported by metal channels spanning between two studs and attached to the same.
   12. Outlet boxes used for supporting lighting fixtures: Furnish with malleable iron fixture studs of "No-Bolt" type, secured by locknut. Provide structural channel supports for boxes occurring in ceilings. Outlets in ceilings directly on bottom of joists shall be supported independent of ceiling construction. Outlets in suspended ceilings shall not be supported from ceiling construction. Special supports for boxes shall be as directed and approved by the Architect.
   13. Where service fittings will not permit ganging of boxes for floor outlets, outlets shall be as close as practiable.
   14. Provide a single cover plate where two or more devices are grouped together in one box.
   15. Provide poke-through service fittings where indicated.
      a. Install more than 2 feet apart, and not to exceed an average of one every 65 sq. ft.
      b. Core drill holes 8 inches in diameter.
   16. Verify door swings with door fame installed before locating switch outlets.
   17. Outlet boxes in fire-rated assembly:
      a. Clearance between boxes and wallboard shall not exceed 0.125 inch.

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b. Surface area of individual outlet box does not exceed 16 square inches.
c. Entire surface area of boxes shall not exceed 100 square inches per 100 square feet of wall surface.

18. Interior of boxes for thermostats shall be painted maroon. ***** MCPS STANDARD *****

E. Galvanized Steel Rigid Metal Conduit (RMC): Install in accordance with **<<NECA 101>>**.

F. Rigid Polyvinyl Chloride (PVC) Conduit: Install in accordance with **<<NECA 111>>**.

G. Conduit Support:
1. Secure and support conduits in accordance with **<<NFPA 70>>** using suitable supports and methods approved by authorities having jurisdiction; see Section **<< 260529>>**.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

H. Connections and Terminations:
1. Use approved **<< zinc-rich paint; conduit joint compound; or _____>>** on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use **<< three-piece couplings; split couplings; or _____>>**. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using **<< threaded hubs; double lock nuts; or _____>>** for dry locations and **<< raintight hubs; or _____>>** for wet locations.
6. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
7. Secure joints and connections to provide mechanical strength and electrical continuity.

I. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Provide suitable **<< sealing system; or _____>>** where conduits penetrate exterior wall below grade.
6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
8. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section **<< 078400; or _____>>**.

J. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings**<< or approved flexible connections; _____; or None - N/A>>** to prevent damage to enclosed conductors or connected equipment.**<< This includes, but is not limited to:; _____ .; or None - N/A>>**

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1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where calculated in accordance with **<<NFPA 70>>** for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
3. Where conduits are subject to earth movement by settlement or frost.

K. Conduit Sealing:
1. Use **<< foam conduit sealant; or _____>>** to prevent entry of moisture and gases.**<< This includes, but is not limited to:; _____ .; or None - N/A>>**
   a. Where conduits enter building from outside.
   b. Where service conduits enter building from underground distribution system.
   c. Where conduits enter building from underground.
   d. Where conduits may transport moisture to contact live parts.
2. Where conduits cross barriers between areas of potential substantial temperature differential, use **<< foam conduit sealant; or _____>>** at accessible point near penetration to prevent condensation.**<< This includes, but is not limited to:; _____ .; or None - N/A>>**
   a. Where conduits pass from outdoors into conditioned interior spaces.
   b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

L. Provide grounding and bonding; see Section **<< 260526>>**.

3.03 IDENTIFICATION

A. Identification on outside covers of pull and junction boxes in ceiling space or exposed on walls: Paint with color enamel or mark with permanent, waterproof black marker, or both as specified.
1. Fire alarm system: Red.
2. Other special systems: Mark with system type, such as Data or Public Address.
3. Power and lighting: Panelboard designation and circuit number(s).

B. Identification on inside boxes for recess-mounted or concealed in walls and partitions: Plasticized card stock tags marked with permanent, waterproof black markers.
1. Fire alarm system: Red.
2. Other special systems: Mark with system type, such as Data or Public Address.
3. Power and lighting: Panelboard designation and circuit number(s).

3.04 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Correct deficiencies and replace damaged or defective conduits.

3.05 CLEANING

A. Clean interior of conduits, boxes, enclosures, and cabinets to remove moisture and foreign matter.

3.06 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

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B. Protect installed raceways from subsequent construction operations.

C. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION 260533

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SECTION 260543
UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Direct-buried conduit, ducts, and duct accessories.
   2. Concrete-encased conduit, ducts, and duct accessories.
   3. Handholes and boxes.

1.02 DEFINITIONS

A. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.03 REFERENCE STANDARDS

A. AASHTO HB - Standard Specifications for Highway Bridges.

B. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC).

C. ASTM C858 - Standard Specification for Underground Precast Concrete Utility Structures.

D. ASTM C891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures.

E. ASTM F512 - Standard Specification for Smooth-Wall Poly(Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation.

F. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit.

G. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.

H. SCTE 77 - Specifications for Underground Enclosure Integrity.

I. UL 514B - Conduit, Tubing, and Cable Fittings.

J. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include ductbank materials, including separators and miscellaneous components.
   2. Include ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
   3. Include accessories for manholes, handholes, boxes.
   4. Include warning tape.

B. Shop Drawings:
   1. Precast or Factory-Fabricated Underground Utility Structures:
      a. Include plans, elevations, sections, details, attachments to other work, and accessories.
      b. Include duct entry provisions, including locations and duct sizes.
      c. Include reinforcement details.
      d. Include frame and cover design and manhole frame support rings.
      e. Include Ladder details.
      f. Include grounding details.

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g. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
h. Include joint details.

2. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:
a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
b. Include duct entry provisions, including locations and duct sizes.
c. Include cover design.
d. Include grounding details.
e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

C. Ductbank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
2. Drawings shall be signed and sealed by a qualified professional engineer.

D. Field quality-control reports.

1.05 FIELD CONDITIONS

A. Ground Water: Assume ground-water level is 36 inches below ground surface unless a higher water table is noted on Drawings.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FOR DUCTS AND RACEWAYS

A. Comply with ANSI C2.

B. Install underground conduits and ductbanks per the table below. Locate a minimum of 3 feet from other utility systems (steam, chilled water, sewer, storm, etc.).
1. Install not less than 4- #4 reinforcing bars tied to a square cage at 8 foot centers for conduits in ductbank under roadways.
2. Concrete encased with a minimum envelope of 3 inches around each conduit where encasement is required.
3. Concrete shall be red dyed utilizing red dye mixed into the concrete for a minimum of 5 minutes prior to pouring. Minimum of 1 bag of dye per 1 yard of concrete.

	Above 600V	600V and Below	Other Systems
Below Building Slabs	PVC Schedule 40 or GRS, 36" deep, red concrete encasement, 3000 psi	PVC Schedule 40 or GRS, 18" deep, no concrete encasement required	PVC Schedule 40 or GRS, 24" deep, no concrete encasement required
Outside of Building Footprint	PVC or GRS, 36" deep, red concrete encasement, 3000 psi	GRS, 36" deep, no encasement, or PVC, 24" deep with 2000 psi concrete encasement, no dye	GRS, 36" deep, no encasement, or PVC, 24" deep with 2000 psi concrete encasement, no dye (PVC Schedule 80 below auto traffic areas)

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2.02 CONDUIT

A. Rigid Steel Conduit: Galvanized. Comply with **<<ANSI C80.1>>**.

B. RNC: **<<NEMA TC 2>>**, Type EPC-40-PVC, **<<UL 651>>**, with matching fittings by same manufacturer as the conduit, complying with **<<NEMA TC 3>>** and **<<UL 514B>>**.

2.03 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. ARNCO Corp.
   2. Electri-Flex Company.
   3. Lamson & Sessions.
   4. Spiraduct/AFC Cable Systems, Inc.

B. Underground Plastic Utilities Duct: **<<NEMA TC 2>>**, **<<UL 651>>**, **<<ASTM F512>>**, Type EPC-40, with matching fittings complying with **<<NEMA TC 3>>** by same manufacturer as the duct.

C. Duct Accessories:
   1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and size of ducts with which used, and selected to provide minimum duct spacing indicated while supporting ducts during concreting or backfilling.
   2. Warning Tape: Underground-line warning tape specified in Divisio 26 Section "Identification for Electrical Systems."

2.04 PRECAST CONCRETE HANDHOLES AND BOXES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Christy Concrete Products.
   2. Oldcastle Precast, Inc.
   3. Utility Concrete Products, LLC.

B. Comply with **<<ASTM C858>>** for design and manufacturing processes.

C. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
   1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
   2. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   3. Cover Legend: Molded lettering, As indicated for each service.
   4. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
   5. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
      a. Extension shall provide increased depth of 12 inches **<< 12 inches>>**.
      b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
   6. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

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7. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks, plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
    a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
    b. Window opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
    c. Window openings shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
8. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
    a. Type and size shall match fittings to duct or conduit to be terminated.
    b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.
9. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

C. Clear and grub vegetation to be removed, remove and stockpile topsoil for reapplication, and protect vegetation to remain according to Division 31 requirements and Civil Drawings.

3.02 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Cables More than 600 V: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank unless otherwise indicated.

B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank unless otherwise indicated.

C. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank unless otherwise indicated.

D. Underground Ducts Crossing Paved Paths and Roadways: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

3.03 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less:
    1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. **<<AASHTO HB>>** 17, H-10 structural load rating.

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2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, **<<AASHTO HB>>** 17, H-20 structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, **<<AASHTO HB>>** 17, H-10 structural load rating.
4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to **<<SCTE 77>>** with 3000-lbf vertical loading.
5. Cover design load shall not exceed the design load of the handhole or box.

3.04 EARTHWORK

A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 requirements and Civil Drawings as applicable.

D. Cut and patch existing pavement in the path of underground ducts and utility structures according to the "Cutting and Patching" Article in Division 1.

3.05 DUCT INSTALLATION

A. Install ducts according to NEMA TCB 2.

B. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes, to drain in both directions.

C. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 60 inches, both horizontally and vertically, at other locations unless otherwise indicated.

D. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

E. Installation Adjacent to High-Temperature Steam Lines: Where duct banks are installed parallel to underground steam lines, perform calculations showing the duct bank will not be subject to environmental temperatures above 104 degrees F. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct bank crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.

F. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line direct-buried duct banks with calculated expansion of more than 3/4-inch.
3. Grout end bells into structure walls from both sides to provide watertight entrances.

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G. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall, without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

H. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

I. Pulling Cord: Install 100-lbf-test nylon cord in empty ducts.

J. Concrete-Encased Ducts: Support ducts on duct separators.
   1. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division 31 for pipes less than 6 inches in nominal diameter.
   2. Width: Excavate trench 12 inches wider than duct bank on each side.
   3. Depth: Install top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
   4. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
   5. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than five spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
   6. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.
   7. Elbows: Use manufactured duct elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run unless otherwise indicated. Extend concrete encasement throughout length of elbow.
   8. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
   9. Concrete Cover: Install a minimum of 3 inches of concrete cover at top and bottom, and a minimum of 2 inches on each side of duct bank.
   10. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
      a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
      b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing-rod dowels extending a minimum of 18 inches into concrete on both sides of joint near corners of envelope.
   11. Pouring Concrete: Comply with requirements in Division 3 Concrete specification. Place concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.

K. Direct-Buried Duct Banks:

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1. Excavate trench bottom to provide firm and uniform support for duct bank. Comply with requirements in Division 31 for preparation of trench bottoms for pipes less than 6 inches in nominal diameter.
2. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
3. Space separators close enough to prevent sagging and deforming of ducts, with not less than five spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.
4. Depth: Install top of ductbank at least 36 inches below finished grade unless otherwise indicated.
5. Set elevation of bottom of ductbank below frost line.
6. Install ducts with a minimum of 3 inches between ducts for like services and 6 inches between power and signal ducts.
7. Elbows: Install manufactured duct elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
8. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run.
    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
9. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Division 31 for installation of backfill materials.
    a. Place minimum 3 inches of sand as a bed for duct bank. Place sand to a minimum of 6 inches above top level of duct bank.
    b. Place minimum 6 inches of engineered fill above concrete encasement of duct bank.

L. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within **<< 3 inches>>** of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal **<< 18 inches>>**. Space additional tapes 12 inches apart, horizontally.

3.06 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Cast-in-Place Manhole Installation:
    1. Finish interior surfaces with a smooth-troweled finish.
    2. Windows for Future Duct Connections: Form and pour concrete knockout panels 1-1/2 to 2 inches thick, arranged as indicated.
    3. Comply with requirements in Division 3 concrete section for cast-in-place concrete, formwork, and reinforcement.

B. Precast Concrete Handhole and Manhole Installation:

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1. Comply with **<<ASTM C891>>** unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts, to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevations:
1. Manhole Roof: Install with rooftop at least 15 inches below finished grade.
2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
3. Install handholes with bottom below frost line, below grade.
4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
5. Where indicated, cast handhole cover frame integrally with handhole structure.

D. Manhole Access: Circular opening in manhole roof; sized to match cover size.
1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
2. Install chimney, constructed of precast concrete collars and rings, to support cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for frame to chimney.

E. Waterproofing: Apply waterproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. After ducts have been connected and grouted, and before backfilling, waterproof joints and connections, and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.

F. Dampproofing: Apply dampproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Refer to Division 7 for Bituminous Dampproofing. After ducts are connected and grouted, and before backfilling, dampproof joints and connections, and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.

G. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

H. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.

I. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

3.07 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

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C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch above finished grade.

D. Install handholes and boxes with bottom below frost line, below grade.

E. Field cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

F. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.
   1. Concrete: 3000 psi, 28-day strength, complying with Division 3 concrete specification, with a troweled finish.
   2. Dimensions: 10 inches wide by 12 inches deep.

3.08 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 "Grounding and Bonding for Electrical Systems."

3.09 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:
   1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
   2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 6-inch-long mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
   3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.10 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 260543

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SECTION 260553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Electrical identification materials and devices required to comply with ANSI, NFPA, and OSHA standards.

B. Identification of electrical equipment, raceways, boxes, conductors, and other related electrical system components.

1.02 SECTION INCLUDES

A. Identification of power conductors and control cables.

B. Identification of equipment and instructions.

C. Miscellaneous identification products.

1.03 RELATED REQUIREMENTS

A. Sections in Divisions 26, 27, and 28.

1.04 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs.

B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels.

C. NFPA 70 - National Electrical Code.

D. NFPA 70E - Standard for Electrical Safety in the Workplace.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.

B. Sequencing:

1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
2. Do not install identification products until final surface finishes and painting are complete.

1.06 SUBMITTALS

A. Product Data: For each type of electrical identification product.

1.07 QUALITY ASSURANCE

A. Comply with requirements of **<<NFPA 70>>**.

B. Comply with ANSI A13.1 and IEEE C2.

C. Comply with OSHA standards.

D. Comply with ANSI Z535.4 for safety signs and labels.

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1.08 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

1.09 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other sections requiring identification applications, drawings, shop drawings, manufacturer's wiring diagrams, and the operation and maintenance manual; and with those required by codes, standards, and safety regulations. Use consisten designations throughout Project.

B. Coordinate installation of identification materials and devices with completion of covering and painting surfaces where devices are to be applied.

C. Coordinate installation of identification materials and devices with location of access panels and doors.

D. Install identifying materials and devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following manufacturers, or approved equal:

1. Brady USA, Inc.
2. Carlton Industries
3. Graphic Products, Inc.
4. Ideal Industries
5. Panduit Corporation
6. Presco
7. Seton Identification Products
8. Thomas and Betts Company
9. Utility Safeguard

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2.02 GENERAL PRODUCT REQUIREMENTS

A. Except where otherwise indicated, provide manufacturer's standard identification products of category and type suitable for each application. Where more than one identification method is specified for an application, the installer shall select and utilize each material in a consistent manner.

2.03 CONDUCTOR AND CABLING IDENTIFICATION

A. Adhesive labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a clear weather and chemical resistant coating and matching wraparound adhesive tape for securing ends of legend label.

B. Color-coded, adhesive tape: Self-adhesive, vinyl tape, in appropriate colors for system voltage and phase.

C. Marker tapes: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

2.04 EQUIPMENT IDENTIFICATION

A. Engraved plastic nameplates: Laminated plastic, engraved, white letters on black background, excepter where other schemes are noted or specified:
   1. Size: Minimum 0.75-inch by 2.5-inches.
   2. Letter size: Minimum height of 0.375-inch.
   3. Mechanically fastened, except adhesive mounted where necessary due to substrate.
      a. Mechanical fastener: Punched or drilled, vandalproof stainless steel or brass screws or rivets.

B. Baked-enamel signs: Preprinted, aluminum signs, punched or drilled for fasteners with corner grommets; with colors, legend, and size required for application.

C. Exterior, metal-backed signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate (CAB) signs with galvanized steel backing; punched or drilled for fasteners with corner grommets; with colors, legend, and sized required for application.

D. Adhesive film label: Machine-printed, black letters on white background, through thermal transfer or equivalent process, with clear weatherproof and UV-resistant covering. Minimum letter size height of 0.375-inch.

2.05 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Underground warning tape: Permanent, bright-colored, continuous-printed, vinyl tape for use with underground cables, conduits, and ductbanks. Comply with ANSI Z535.
   1. Not less than 6-inches wide by 4 mils thick.
   2. Tape Material:
      a. Made of metal detectable polyester or vinyl.
      b. Compounded for permanent direct-burial service. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to destructive substances commonly found in soils.

B. Printed legend with black lettering, indicating type of underground line.
   1. Provide inscriptions for power cabling with red-colored tape: Example - "CAUTION - BURIED ELECTRIC LINE BELOW".
   2. Provide inscriptions for low-voltage system cabling with orange-colored tape: Example - "CAUTION - TELECOMMUNICATIONS LINE BELOW".

C. Wiring device tape labels:
   1. Adhesive film label: Machine-printed, black letters on clear background, through thermal transfer or equivalent process. Minimum letter size height of 0.25-inch.

D. Labeling for electrical devices and components suck as receptcles, switches, control device stations, manual motor starters, network and phone jacks, junction and pull boxes, etc.

E. Warning labels and signs:
   1. Self-adhesive warning labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configures for display on front cover, door, or other access to equipment unless otherwise noted.
   2. Baked-enamel warning signs: Preprinted, aluminum signs, punched or drilled for fasteners with corner grommets; with colors, legend, and size required for application.
   3. Fasteners: Self-tapping, stainless-steel screws or, stainless-steel machine screws with nuts, flat and lock washers.

F. Cable ties: Fungus-inert, self-extinguishing, one-piece, self-lock, color-coded, nylon cable ties suitable for application (general purpose, UV-stablized outdoor, or plenum rated).

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G. Paint: Formulated for the type of surface, location, and intended use.

H. Stencling: Nonfading, waterproof, ink or paint. Black or color-coded.

I. Adhesive: Heavy-duty, thermo-resistant, industrial grade adhesive, for adhesion to any surface without identification curling, peeling, or falling off.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Verify identity of each item before installing identification products.

C. Location: Install identification products at locations for most conveient viewing without interference with operation and maintenance of equipment.

1. For finished public spaces, coordinated identification product mounting locations with Architect.

D. Apply identification products to surfaces after equipment finish work has been completed.

E. Attache signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. System identification color-coding bands for cables: Each color-coding band shall completely encircle cable.

G. Underground-line warning tape: During backfilling of trenches, install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16-inches overall.

H. Painted identification: Comply with requirements of Division 09 for surface preparation and paint application.

I. Install identification products centered, level, and parallel with lines of item being identified.

J. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

3.03 APPLICATION

A. Miscellaneous:

1. Access doors and panels: Apply engraved nameplate labels at access doors identifying concealed electrical item. Do not locate labels in finished, public spaces.

B. Junction and pull boxes:

1. Label each junction box and pull box, identifying circuit designation or type of system.
   a. Exposed boxes: Place label on coverplate, externally visible.
   b. Concealed boxes: Place label or tag on inside of cover of box.
   c. Junction boxes concealed above suspended ceilings or exposed in non-occupied spaces may be marked with permanent ink marker in lieu of printed labels.
2. Fire alarm system boxes shall have red finish. Boxes shall be prefinished prior to installation.

C. Wiring and cabling identification:

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1. Power circuit conductor identification, 600 V or less: Apply color-coded identification for cables, feeders, and power circuit conductors exposed in accessible vaults, junction and pull boxes, utility structures, and equipment enclosures. Apply color-coding schemes as indicated in below throughout the building's network of feeders and circuits, unless otherwise required by the authority having jurisdiction.
    a. Colors on conductors No. 10 and smaller, or No. 6 and smaller for grounded and grounding conductors: Solid colored insullation.
    b. Colors on conductors No. 8 and larger, No. 4 and larger for grounded and grounding conductors: Apply colored tape wrapped a minimum of 6 inches on either end of conductor and in boxes where splices or taps are made.
    c. Conductors used solely for grounding purposes shall be green, if insulated.
    d. Where multi-conductor cables are used, use same color coding system for identification of wiring in Section 260519.
2. Conductors for future use: Attach tags with circuit designations for conductors to be extended for future use.
3. Control and low-voltage system wiring shall be coded with colors and markings different from those used to designate phase wires.

D. Wiring device labels: For wiring devices such as receptacles, devices installed in surface raceway assemblies, and other wiring devices operating at or greater than 120V.
1. Apply adhesive film labels on inside of wiring device identifying circuit designation serving device.

E. Equipment identification: Install unique designation label consistent with contract documents and shop drawings.
1. Labeling instructions:
    a. Engraved plastic laminate nameplates, unless otherwise indicated.
    b. Unless otherwise required, provide a single line of text with 0.5-inch high lettering on 1.5-inch high label. Where two or more liens are required, use single label with increased height.
    c. For multi-section or multi-compartment equipment, apply labels identifying each compartment or section.
    d. For fusible equipment, identify fuse type and size on the front cover.
    e. For enclosed circuit breaker equipment, identify device trip rating where rating is not visible.
    f. Where equipment has more than one source of power (i.e., transfer switch, separate control power soruce), the location and circuit designation of each power source shall be clearly identified at the equipment location.
2. Apply nameplates and labels to equipment according to the below identification schemes:
    a. Identify equipment designation; voltage rating; phase and number of wires; and designatino and location of load served. Apply products to the following equipment:
        1) Panelboards
        2) Switchboards
        3) Dimming system equipment
        4) Lighting control system equipment
    b. Identify equipment designation; primary and secondary voltage ratings; phase and number of wires; circuit designation and location of primary source; and designation and location of load served. Apply products to the following equipment:
        1) Disconnect switches

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2) Enclosed circuit breakers
3) Contactors
4) Motor starters and combination motor starter-disconnect switches
5) Variable frequency drives
6) Transformers

c. Identify equipment designation; voltage rating; phase and number of wires; and capacity rating. Apply products to the following equipment:
1) Generator: Capacity rating kilo-watts (kW).
2) Transfer switches: Capcity rating in amperes; identify the location and circuit designation of each power source at the equipment location.

d. Identify equipment designation; and circuit designation and location of primary source. Apply products to the following equipment:
1) Monitoring and control equipment
2) Control stations
3) Fire alarm control panels and auxiliary equipment

3. Nameplates shall incorporate white lettering on colored background based on the following color-coding scheme:
a. Normal Power System: Black background.
b. Emergency Power System (Life-Safety Branch): Red background.
c. Emergency Power System (Equipment Branch): Blue background.

F. Warning and caution labels and signs:
1. Apply warning and caution lables on equipment in accordance with NFPA 70 and 70E, ANSI, and OSHA requirements, inculding arc-flash hazard warning lables and special clearance requirements.
2. Apply warning and caution labels and signs at locations where safe operation and maintenance of electrical system equipment is of concern.
3. Apply warning signs on electrical room doors in accordance with NFPA 70 and 70E, ANSI , and OSHA requirements. Where doors are located in finished, public areas, locate sign on the inside of the door. Coordinate mounting requirements with door type.

G. Service-entrance equipment: Provide field marking of service entrance equipment maximum available fault current values in accordance with NFPA 70 requirements.

H. Underground Warning Tape: Apply underground warnign tabpe above underground ductbanks, conduit, or direct-buried cable.

3.04 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

C. Coordinate names, abbreviations, colors, and other designations with construction documents, submittals, and applicable code and standards requirements. Utilize consistent designations and identification techniques throughout projects.

D. Install identification products at locations that are clearly visible at normal viewing angles and without interference with operation and maintenance of the equipment.

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E. Install identification products in a neat and clean, workmanship-like manner where products are securely attached and orientated parallel to equipment edges.

END OF SECTION 260553

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SECTION 260573
POWER SYSTEM STUDIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical system fault-current and protective device study:
   1. Fault-current analysis.
   2. Coordination study and device settings.
   3. Arc flash hazard analysis and shock risk assessment.

1.02 RELATED REQUIREMENTS

A. Section **<< 260553 - Identification for Electrical Systems>>**: Additional requirements for arc flash hazard warning labels.

B. Section **<< 262413 - Switchboards>>**.

C. Section **<< 262416 - Panelboards>>**.

1.03 REFERENCE STANDARDS

A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels.

B. IEEE 141 - IEEE Recommended Practice for Electric Power Distribution for Industrial Plants.

C. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

D. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis.

E. IEEE 551 - IEEE Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems.

F. IEEE 1584 - IEEE Guide for Performing Arc-Flash Hazard Calculations.

G. NEMA MG 00001 - Motors and Generators.

H. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems.

I. NFPA 70 - National Electrical Code.

J. NFPA 70E - Standard for Electrical Safety in the Workplace.

K. IEEE 241 - IEEE Recommended Practice for Electric Power Systems in Commercial Buildings.

L. IEEE 1015 - IEEE Recommended Practice for Apply Low-Voltage Circuit Breakers Used in Industrical and Commercial Power Systems.

M. OSHA 29 Code of Federal Regulations (CFR) Part 1910, Subpart S.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
   2. Notify **<<Architect>>** of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

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1. Submit study reports prior to or concurrent with product submittals.
2. Do not order equipment until matching study reports and product submittals have both been approved by **<<Architect>>**.

1.05 SUBMITTALS

A. Product data: For computer software to be used to perform studies.

B. Produt certificates: For power system study computer software programs, certifying compliance with IEEE 399.

C. Qualifications:
   1. Submit evidence indicating individual and organization compliance with requirements indicated in "Quality Assurance" below.

D. Delegated Design Report: Stamped or sealed and signed by study preparer.

E. Preliminary electrical system study: Submit for review before distribution equipment shop drawings have been submitted, and before equipment order has been released to manufacturer.
   1. If formal completion of the study may delay the project schedule, Architect/Engineer may approve use of the preliminary draft for ordering equipment.
   2. If approved for use in ordering equipment, preliminary draft shall include sufficient study data to ensure that the selection of device ratings and characteristics will be satisfactory.
   3. Use of the preliminary study to order equipment shall be the full responsibility of the contractor. Any changes made to the electrical distribution system resulting from the review of the final electrical system study shall be incorporated at no additional cost to the owner and shall be the sole responsibility of the general contractor.

F. Final electrical system study:
   1. Submit final report for review and record.
   2. Incorporate changes resulting from deficiencies and corrections of preliminar

G. Reports:
   1. Electrical system study report: Submit reports required above including the following items:
      a. General report information: Scope, definitions, descriptions, assumptions, and other information necessary to properly interpret results of the report.
      b. Tabulated summary comparing protective device ratings and calculated available fault-current levels.
      c. Tabulated summary of protective device settings including circuit braker, fuse and relay
      d. Fault-current analysis calculations.
      e. Selective coordination study overlay, plots of device time-current curves and relationship to other distribution system components.
      f. Arc flash hazard calculations including details of the incident energy and flash protection boundary calculations.
      g. Tabulated summary of values associated with load flow study.
      h. Tabulated summary of values associated with voltage drop analysis.
      i. Recommendations for system improvements.
      j. System one-line diagram.
      k. Input and output data used for each component and for study calculations.
   2. Submit final reports as electronic files in portable document format (.pdf) to Owner.

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a. Study shall reflect as-built conditions.
b. Include computer software files used to prepare studies with file name(s) cross-referenced to specific pieces of equipment and systems.

1.06 POWER SYSTEM STUDIES

A. Scope of Studies:
1. Except where study descriptions below indicate exclusions, analyze system at each bus **<< from primary protective devices of utility source down to each piece of equipment involved; or _____>>**, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).
2. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.

B. General Study Requirements:
1. Comply with **<<NFPA 70>>**.
2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.

C. Data Collection:
1. Collect and compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
1) Obtain up-to-date information from **<< Utility Company; Owner; or _____>>**.
b. Generators: Include manufacturer/model, kW and voltage ratings, and impedance.
c. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or **<<NEMA MG 00001>>** code letter designation.
d. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
e. Protective Devices:
1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
f. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.
g. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.

D. Short-Circuit Study:
1. Comply with **<<IEEE 551>>** and applicable portions of **<<IEEE 141>>**, **<<IEEE 242>>**, and **<<IEEE 399>>**.
2. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:

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a. Maximum utility fault currents.
b. Maximum motor contribution.
c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).

3. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.

E. Protective Device Coordination Study:
1. Comply with applicable portions of **<<IEEE 242>>** and **<<IEEE 399>>**.
2. Analyze alternate scenarios considering known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
3. Analyze protective devices and associated settings for suitable margins between time-current curves to provide adequate protection for equipment and conductors while achieving **<< full selective coordination.; best possible coordination.; selective coordination for fault durations extending beyond 0.1 seconds.; selective coordination for fault durations extending beyond the following thresholds:; or _____ .>>**

F. Arc Flash and Shock Risk Assessment:
1. Comply with **<<NFPA 70E>>**.
2. Perform incident energy and arc flash boundary calculations in accordance with **<<IEEE 1584>>** (as referenced in **<<NFPA 70E>>** Annex D), where applicable.
3. For equipment with main devices mounted in separate compartmentalized sections, perform calculations on both the line and load side of the main device.
4. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
a. Maximum and minimum utility fault currents.
b. Maximum and minimum motor contribution.
c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).

G. Study Reports:
1. General Requirements:
a. Identify date of study and study preparer.
b. Identify study methodology and software product(s) used.
c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
d. Identify base used for per unit values.
e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
f. Include conclusions and recommendations.
2. Short-Circuit Study:
a. For each scenario, identify at each bus location:
1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
2) Fault point X/R ratio.
3) Associated equipment short circuit current ratings.

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b. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.

3. Protective Device Coordination Study:
   a. For each scenario, include time-current coordination curves plotted on log-log scale graphs.
   b. For each graph include (where applicable):
      1) Partial single-line diagram identifying the portion of the system illustrated.
      2) Protective Devices: Time-current curves with applicable tolerance bands for each protective device in series back to the source, plotted up to the maximum available fault current at the associated bus.
      3) Conductors: Damage curves.
      4) Transformers: Inrush points and damage curves.
      5) Generators: Full load current, overload curves, decrement curves, and short circuit withstand points.
      6) Motors: Full load current, starting curves, and damage curves.
      7) Capacitors: Full load current and damage curves.
   c. For each protective device, identify fixed and adjustable characteristics with available ranges and recommended settings.
      1) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
      2) Include ground fault pickup and delay.
      3) Include fuse ratings.
      4) Protective Relays: Include current/potential transformer ratios, tap, time dial, and instantaneous pickup.
   d. Identify cases where either full selective coordination or adequate protection is not achieved, along with recommendations.
4. Arc Flash and Shock Risk Assessment:
   a. For the worst case for each scenario, identify at each bus location:
      1) Calculated incident energy and associated working distance.
      2) Calculated arc flash boundary.
      3) Bolted fault current.
      4) Arcing fault current.
      5) Clearing time.
      6) Arc gap distance.
   b. For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.

1.07 QUALITY ASSURANCE

A. Electrical system study shall be performed by one or more independent qualified organizations, and under the supervision and approval of a Registered Professional Engineer skill in peforming and interpreting the power system studies.

B. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum five years experience in preparation of power system studies of similar type and complexity using specified computer software.
   1. Study preparer may be employed by manufacturer of electrical distribution equipment.

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C. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
   1. Products:
      a. EasyPower LLC: www.easypower.com/#sle.
      b. ETAP/Operation Technology, Inc: www.etap.com/#sle.
      c. Power Analytics Corporation: www.poweranalytics.com/#sle.
      d. SKM Systems Analysis, Inc: www.skm.com/#sle.
      e. EDSA Micro Corporation.

PART 2 PRODUCTS

2.01 COMPUTER SOFTWARE REQUIREMENTS

A. Comply with IEEE 399.

B. Computer software program shall be capable of performing fault-current analysis of project electrical distribution system.

C. Computer software program shall be capable of plotting and diagramming time-current characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

D. Computer software program shall be capable of performing arc fault hazard analysis using equations as established by IEEE 1584 and requirements presented in NFPA 70E, Annex D.

E. Software shall include comprehensive equipment library of manufacturer-based and IEEE/ANSI based equipment to accurately model the electrical distribution system.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine project submittals for compliance with electrical distribution system requirements outlined in the contract documents.

3.02 SYSTEM DATA COLLECTION

A. The Contractor shall furnish all data required to perform the power system studies. The Engineer peforming the power system studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to ensure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

B. If applicable, include fault contribution of existing motors and equipment in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

C. The Engineer peforming the studies shall gather and tabulate input data necessary to support each study including the following:
   1. Product data for each component of the electrical distribution system.
   2. Utility available fault contribution and impedance values.
   3. Drawings, one-line, and riser diagrams showing system configuration, equipment designations, feeder lengths, and other applicable system characteristics.

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3.03 SYSTEM FAULT CURRENT ANALYSIS

A. Calculate the maximum available short-circuit momentary current and interrupting duties in amperes rms symmetrical for electricla power distribution system components. The calculatino shall be peformed for current immediately after initiation and for a three-phase bolted fault at each of the following locations:
   1. Electric utility's support termination.
   2. Switchboards.
   3. Distribution panelboards.
   4. Branch circuit panelboards.
   5. Generator output terminals.
   6. Automatic transfer switch terminals.
   7. Variable frequency drives serving motors equal to and greater than 25 hores

B. Study the project's electrical distribution system from normal and alternate power sources throuhout electrical distribution system.

C. For grounded systems, provide line-to-ground fault current values for areas as defined above for the three-phase, bolted fault, short-circuit study.

D. Calculations to verify interrupting ratings of overcurent protective devices shall comply with IEEE 141, IEEE 241 and IEEE 242.

E. Study Report:
   1. Input data: Gather and provide the following input data, in tabular or graphic form, used to perform fault calculations and other studies in this section.
      a. Utility three-phase and line-to-ground available contribution with associated X/R ratios.
      b. Short-circuit reactance of rotating machines with associated X/R ratios.
      c. Cable type, construction, size, quantity per phase, length, impedance and conduit type.
      d. Transformer primary & secondary voltages, winding configurations, kVA rating, impedance, and X/R ratio.
      e. Circuit breaker types and sizes.
   2. Methods and assumptions: Indicate calculation methods and assumptions that may have been used to peform analysis.
   3. Results: Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram. Provide the following in a table format:
      a. Source fault impedance and generator contributions.
      b. X/R ratios.
      c. Asymmetry factors.
      d. Motor contributions
      e. Short circuit KVA.
      f. Symmetrical and asymmetrical fault currents.
   4. Equipment evaluation and conclusions:
      a. Verify interrupting ratings and withstand ratings are equal to or higher than calculated fault current levels.
      b. Verify adequacy of phase conductors at maximum three-phase, botled fault currents.

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5. Recommendations: List recommendations for equipment with inadequate ratings. Notify Architect, in writing of existing equipment improperly rated for the calculated available fault current of the system.

3.04 SYSTEM COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written and graphical report using results of fault current study and proposed protective devices and system distribution components. Comply with IEEE 399.

B. Coordination curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series using time-current curves plotted on log-log scale graphs.

C. Prepare separate sets of curves to demonstrate full system coordination. Include the following equipment on plotted coordination curves:
   1. Low-voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.
   2. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
   3. Conductor damage curves.
   4. Ground-fault protective devices.
   5. Signficant motor starting characteristics and motor damage points.
   6. Significant generator short-circuit decrement curve and generator damage point.
   7. Largest feeder circuit breaker for distribution panelboards.
   8. Largest feeder circuit breaker for 208-volt panelboards on secondary side of 480V-120/208V step-down transformer.

D. Recommended device settings: Prepare a tabulated summary of recommended device settings for system adjustable protective devices. Include the following information:
   1. Device tags.
   2. Phase and Ground Relays:
      a. Current transformer ratios.
      b. Current settings.
      c. Time settings.
      d. Instantaneous settings.
      e. Specialty non-overcurrent device settings.
      f. Recommendations for improved system coordination.
   3. Circuit Breakers:
      a. Sensor and plug ratings, where applicable.
      b. Adjustable pickups and time delays (long time, short time, ground).
      c. Adjustable time-current characteristic
      d. Adjustable instantaneous pickup.
      e. Recommendations for improved system coordination.
   4. Fuses:
      a. Current rating
      b. Type.

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3.05 SYSTEM ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA 70E, Annex D.

B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (such as switchboards and panelboards) where work could be performed on energized parts.

C. The arc flash hazard analysis shall include electrical equipment locations where work such as examination, adjustment, service, or maintenacne could be performed on energized parts.

D. Safe working distances shall be based upon the calculated arc flash boundary considering incident energy of 1.2 cal/cm2.

E. When appropriate, the short circuit calculations and the clearing times of the phase ovecurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurent relays should not be take into consideration when determining the clearing time when peforming incident energy calculations.

F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assum a minimum motor contributino (all motors off).

   1. Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

G. The incident energy calculations must consider the accumulation of energy over time when peforming arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interruped or decremented with time. Fault contribution from motors and generators shoudl be decremented as follows:

   1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
   2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closesly as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

K. Arc flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584. Where it is not phsyically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

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L. Incident energy and flash protection boundary calculations:
   1. Arcing fault magnitude.
   2. Device clearing time.
   3. Duration of arc.
   4. Arc flash boundary.
   5. Working distance.
   6. Incident energy.
   7. Hazard Risk Category.
   8. Recommendations for arc flash energy reduction.

3.06 ARC FLASH HAZARD WARNING LABELS

A. Provide warning labels complying with **<<ANSI Z535.4>>** to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
   1. Materials: Comply with Section **<< 260553>>**.
   2. Minimum Size: 4 by 6 inches.
   3. Legend: Provide custom legend in accordance with **<<NFPA 70E>>** and OSHA standards based on equipment-specific data as determined by arc flash and shock risk assessment.
      a. Include the text "Arc Flash and Shock Hazard, Appropriate PPE Required".
      b. Include the following information:
         1) Available incident energy and corresponding working distance.
         2) Site-specific PPE (personnel protective equipment) requirements.
         3) Nominal system voltage.
         4) Limited approach boundary.
         5) Restricted approach boundary.
         6) Equipment identification.
         7) Study preparer, report reference, and date calculations were performed.

B. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
   1. For each 600V, 480V, and applicable 208V panelboard, one arc flash label shall be provided.
   2. For each motor control center, one arc flash label shall be provided.
   3. For each low-voltage switchboard, one arc flash label shall be provided.
   4. For each switchgear, one flash label shall be provided.
   5. For medium voltage switches, one arc flash label shall be provided.

3.07 ARC FLASH TRAINING

A. The equipment vendor shall train personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). Maintenance procedures in accordance with the requirements of NFPA 70e, shall be provided in the equipment manuals.

3.08 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Inspect and test in accordance with **<<NETA ATS>>**, except Section 4.

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C. Adjust equipment and protective devices for compliance with studies and recommended settings at no additional cost to the owner. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

D. Make modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

E. Notify **<<Architect>>** of any conflicts with or deviations from studies. Obtain direction before proceeding.

END OF SECTION 260573

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SECTION 260923
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Occupancy sensors.

B. Time switches.

C. In-wall time switches.

D. Outdoor photo controls.

E. Lighting contactors.

1.02 RELATED REQUIREMENTS

A. Section **<< 260519 - Low-Voltage Electrical Power Conductors and Cables>>**.

B. Section **<< 260526 - Grounding and Bonding for Electrical Systems>>**.

C. Section **<< 260529 - Hangers and Supports for Electrical Systems>>**

D. Section **<< 260534 - Boxes for Electrical Systems>>**.

E. Section **<< 260553 - Identification for Electrical Systems>>**: Identification products and requirements.

F. Section **<< 260573 - Power System Studies>>**.

G. Section **<< 262726 - Wiring Devices>>**: Devices for manual control of lighting, including **<< wall switches; wall dimmers; fan speed controllers; and _____>>**.

H. Section **<< 265100 - Interior Lighting>>**.

I. Section **<< 265600 - Exterior Lighting>>**.

1.03 REFERENCE STANDARDS

A. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing.

B. ANSI C136.24 - American National Standard for Roadway and Area Lighting Equipment - Nonlocking (Button) Type Photocontrols.

C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts.

E. NEMA IA 10030 - Industrial Control and Systems: Enclosures.

F. NFPA 70 - National Electrical Code.

G. UL 773 - Plug-in, Locking Type Photocontrols for Use with Area Lighting.

H. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control.

I. UL 916 - Energy Management Equipment.

J. UL 917 - Clock-Operated Switches.

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1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate placement of lighting control devices with millwork, furniture, equipment and other potential conflicts.
   2. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.
   3. Coordinate placement of occupancy sensors with millwork, furniture, equipment and other potential obstructions to motion detection coverage.
   4. Coordinate placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement.
   5. Coordinate lighting control device product selections with luminaire characteristics; see Section **<< 265100>>** and lighting fixture schedule.
   6. Notify **<<Architect>>** of conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>**, for submittal procedures.

B. Product Data: Include ratings, configurations, standard wiring diagrams for power/signal/control wiring, dimensions, colors, service condition requirements, and installed features.

C. Shop Drawings:
   1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
   2. Digital Load Controllers: Provide dimensioned plan views indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing factory and field connections. Include manufacturer product characteristics and application instructions for wired and wireless applications, including start-up and commissioning.
   3. Daylighting Controls: Provide lighting plan indicating location, model number, and orientation of each photo sensor and associated system component.

D. Field quality control reports.

E. Operation and Maintenance Data: For each type of device, include detailed information on device programming and setup as well as emergency, operation and maintenance manuals..

F. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.
   1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
   2. Extra Locking Receptacle-Mounted Outdoor Photo Controls: **<< Five; or _____>>** percent of total quantity installed for each type, but not less than **<< two; or _____>>** of each type.
   3. Occupancy Sensors, Daylight Sensors, Wall Switch Controls, Load Control Relays: **<< one; and _____>>** percent of total quantity installed for each type but not less than **<< two; and _____>>**.

1.06 QUALITY ASSURANCE

A. Comply with **<<NFPA 70>>**.

B. Devices shall be UL listed and labeled for their intended application.

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C. Provide services from factory certified field service engineer to perform functional testing.
   1. Qualifications for factory certified fiel service engineer:
      a. Minimum experience of two years training in the electrical field.
      b. Certified by the equipment manufacturer on the system installed.

D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

E. Product Evaluation and Listing Organization Qualifications: Organization engaged in evaluation of products and services, including those recognized by OSHA as Nationally Recognized Testing Laboratories (NRTL), and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store products in clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.08 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship or from transient voltage surges, and the Contractor agrees to provide associated electrical work to make good within the specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure equipment to operate, or to operate reliably.
      b. Damage of electronic components due to transient voltage surges.
   2. Warranty Period: Five years from date of Final Acceptance for material and labor.
   3. Extended Material Warranty Period Failure Due to Transient Voltage Surges: 10 years from date of Final Acceptance.

C. Provide necessary materials, laptop, programs, and service tools for training(s). The owner shall have access to TechSupport for the life of the materials.

PART 2 PRODUCTS

2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for purpose intended.

B. Unless specifically indicated as excluded, provide components necessary for complete operating system including, but not limited to, conduit, wiring, connectors, hardware, and accessories.

C. Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in **<<NEMA 410>>**.

D. Open protocol systems are only to be considered. Non-proprietary systems shall not be used. An example of open protocol systems is Bacnet IP protocols.

2.02 OCCUPANCY SENSORS

A. Acceptable Manufacturers:
   1. Sensorworx
   2. Hubbell Incorporated: www.hubbell.com/#sle.
   3. Cooper Lighting Solutions

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4. Sensor Switch Inc: www.sensorswitch.com/#sle.
5. Acuity Brands, Inc.

B. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.

C. General Requirements:
1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
2. Sensor Technology:
a. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.
b. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using combination of both passive infrared and ultrasonic technologies.
3. Provide LED to visually indicate motion detection**<< with separate color LEDs for each sensor type in dual technology units; _____; or None - N/A>>**.
4. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
5. Turn-Off Delay: Field adjustable**<< , with time delay settings up to 30 minutes; , _____; or None - N/A>>**.
6. Sensitivity: Field adjustable.
7. Integral Photocell: Optional integral photocell for light level sensing and adjustment.
8. Where wired sensors are indicated, **<< wireless sensors are acceptable provided that all components and wiring modifications necessary for proper operation are included; wireless sensors are not acceptable without prior approval of Architect; or _____>>**.

D. Wall Switch/Dimmer Occupancy Sensors:
1. All Wall Switch/Dimmer Occupancy Sensors:
a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees**<< , integrated manual control capability,; , automatic control only (no integrated manual control capability),; , _____ ,; or None - N/A>>** integrated dimming control where indicated, and no leakage current to load in off mode.
b. Unless otherwise indicated or required to control load indicated on drawings, provide **<< line voltage units with self-contained relay; low voltage units, for use with separate compatible accessory power packs; or _____>>**.
c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.
d. Operation: **<< Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off); Operates only as vacancy sensor (manual-on/automatic-off) in accordance with California Title 24 requirements; or _____>>**.
e. Finish: White, unless otherwise indicated.
f. Sensor unit shall be available with the following powered methods:
1) Line voltage, 120VAC or 277VAC, supplied by utility through a local circuit.

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g. Sensor unit accommodates neutral (3-wire) and no neutral (2-wire) installation, as well as multi-way switching installation. Unit shall meet NEC 404.2 & 404.22 guidelines regarding power over ground & current leakage.

h. Ambient light override: Option of an integrated photocell for ambient light sensing. The functional mode of this photo sensor shall be initial inhibit only; i.e. if enough ambient light is sensed for a duration of five (5) minutes, unit will prevent the lights from automatically turning on. Sensor unit shall have an auto-setpoint option or a manual setpoint from 10fc to 99fc.

i. Sensor unit shall have an operating temperature from 32 degrees to 122 degrees.

j. Dimmer shall be solid state with continuous full-range even control following square law dimming curve, integral radio freqnency filtering, power failure present memory, air gap switch, and listed as complying with UL 1472; type and rating suitable for load controlled.

k. Provide field adjustable dimming present for occupied state.

l. Provide fade-to-off operation to notify occupant of impending load turn-off.

2. Passive Infrared/Ultrasonic/Acou Dual Technology Wall Switch Occupancy Sensors: Capable of detecting major motion within an area of **<< 900 square feet; or _____>>** and minor motion within an area of 300 square feet.

E. Ceiling/Wall Mounted Occupancy Sensors:

1. General Requirements:

a. Unless otherwise indicated or required to control load indicated on drawings, provide **<< low voltage units, for use with separate compatible accessory power packs; line voltage units with self-contained relay; or _____>>**.

b. Provide field selectable setting for disabling LED motion detector visual indicator.

c. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.

d. Finish: **<< White unless otherwise indicated; or _____>>**.

2. Passive Infrared/Ultrasonic/Acoustic Dual Technology Occupancy Sensors:

a. Capable of detecting minor motion within a minimum area of 900 square feet at a mounting height of **<< 8-12 feet; 9 feet; or _____>>**, with a field of view of **<< 360 degrees; 180 degrees; 360 or 180 degrees as indicated on the drawings; or _____>>** for ceiling-mounted sensors, 90 degrees minimum for wall mounted sensors.

b. Sensors shall be available with the following powered methods:

1) Low voltage, 12-24VDC, supplied by power supply or power pack.

c. Sensors shall have an optional integral photocell with three different modes of operation available. Where daylighting is indicated on drawings, provide integral photocell, adjustable from 10-100fc, to turn lights off when selected lighting level is present.

1) Daylight Harvesting (0-10V dimming to maintain the target light level).

2) ON/OFF photocell control (lights switched OFF if ambient level surpasses the threshold and back ON if level drops).

3) Inhibit only photocell control (lighting is held OFF if sufficient ambient light level is present upon initial occupancy).

d. Sensor housing shall be impact resistant plastic.

e. Sensors shall have adjustable time delay increment settings from 30 seconds to 30 minutes (default 15 minutes), that is easily accessible to the use

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f. Sensors shall be designed to fail to the ON condition for predictable internal failure conditions.

g. Sensors shall have the ability to be wired in parallel to provide detection coverage of large areas beyond the range of a single unit. All joined sensors must time out (i.e. register unoccupied) before lights will turn OFF.

h. Sensor shall be available with an isolated low voltage relay for providing interfaces. Relay shall communicate occupancy status to BAS, HVAC system or any other system requiring contact closure style status signal. Relay logic shall be programmable.

i. Sensor unit shall have an operating temperature from 32 degrees to 122 degrees.

3. High Bay Sensors: Capable of detecting motion within a distance of **<< 50 feet; or _____>>** at a mounting height of **<< 30 feet; or _____>><< None - N/A; , with a field of view of _____ degrees; or , _____>>**.

4. Passive Infrared/Ultrasonic/Acoustic Dual Technology Long-range Occupancy Sensors: Capable of detecting motion within a distance of **<< 40 feet; 80 feet; or _____>>** at a mounting height of **<< 10 feet; or _____>><< None - N/A; , with a field of view of _____; or , _____>>** with a field of view of 45 degrees.

5. Outdoor Motion Sensors:

a. Description: Factory-assembled wet location listed device suitable for wall or ceiling/eave mounting, with integral swivel for field adjustment of coverage, capable of detecting motion for automatic control of load indicated.

b. Sensor Technology: Passive Infrared (PIR) designed to detect occupancy by sensing movement of thermal energy between zones.

c. Operation: Unless otherwise indicated, motion sensor to turn load on when motion is detected and to turn load off when no motion is detected during an adjustable turn-off delay time interval.

d. Turn-Off Delay: Field adjustable, with time delay settings available up to 15 minutes.

e. Integral Photocell: For dusk to dawn operation.

f. Coverage: Capable of detecting motion within a distance of **<< 40 feet; 50 feet; or _____>>** at a mounting height of **<< 20 feet; 8 feet; or _____>>**, with a field of view of **<< 270 degrees; or _____>>**.

2.03 AUXILIARY COMPONENTS

A. Power pack: Universal 120/277V, switched input, controlled through a high-current 20A relay. Low voltage output, less than or equal to 24VDC, for powering low voltage occupancy sensors. Enclosrue shall be plenum rated.

B. Override switch: Low-voltage switch shall operate on voltage less than or equal to 24VDC and shall have a momentary contact actuator to send a signal to the associated power pack to change the current lighting state. Color shall match switch device color specified above.

C. Provide quantity and configuration of power and slave packs with associated wiring and accessories as required to control load indicated on drawings.

D. Input Supply Voltage: **<< Dual rated for 120/277 V ac; As indicated on the drawings; 120 V ac unless otherwise indicated; 277 V ac unless otherwise indicated; or _____>>**.

2.04 DAYLIGHT SENSORS

A. General: Provide a complete and operable daylight sensor system in areas shown on the drawings.

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B. System Components: Daylight sensor lighting control shall include, but not be limited to, all required sensors, relays, power supplies, and low-voltage or line voltage wiring.

C. Sensor Requirements:
   1. Sensors shall be self-contained, solid-state, photo-electric detectors which shall provide detection of ambient light level in a given area.
   2. Sensors shall be available with the following powered methods:
      a. Low voltage, 12-24VDC, supplied by power supply or power pack.
   3. Sensor housing shall be impact resistant plastic.
   4. Setpoint: The minimum overall light level that shall be maintained in a space by the sensor is referred to as the setpoint:
      a. Sensor shall have manually adjustable setpoint from 5fc to 100fc.
      b. Sensor shall have an auto-setpoint method which shall automatically determine setpoint in a given area based on the controlled and uncontrolled light sources.
   5. Sensor shall have the following operational modes:
      a. Daylight harvesting to low trim
      b. Daylight harvesting to OFF (requires power pack)
      c. Photocell override (ON/OFF)
      d. Initial inhibit only (Hold OFF)
   6. Sensor with daylight harvesting option restricts the manual dimming range by a wall dimmer station to a maximum level that equals the setpoint down to the low-trim and/or off position. Sensor will ignore any attempt to raise the lighting above the setpoint with any wall dimmer station.
   7. Sensor shall have an operating temperature from 32 degrees to 122 degrees.

2.05 LOW VOLTAGE WALL STATIONS

A. General: Provide low voltage wall stations as required in areas shown on Drawings. These devices are to function seamlessly with other control devices.

B. System Components: Low Voltage Wall Station shall include, but not be limited to, all required sensors, relays, power supplies, and low-voltage wiring.

C. Wall Station Requirements:
   1. Station shall be capable of switching and/or dimming the lighting load with a momentary pulse length of 250msec.
   2. Station shall have multiple colors of LED indicator light for the following:
      a. Location of switch when lighting load is Off
      b. Relay status
      c. Response to programming push button
      d. Indication of function current setting when queried
      e. Current dimming level with five (5) stacked LEDs displayed to the user (dimming station only)
   3. Station shall be capable of Multiway Switching with all connected stations indicate the same state. Manual dimming control shall be available at one (1) location.
   4. Station shall have an operating temperature from 32°F to 122°F (0°C to 50°C) standard, and down to -40°F/C with an optional conformal coating.
   5. Station shall be UL Listed, RoHS Compliant, and BAA Compliant.
   6. Full electronic and mechanical assembly of sensors shall be in the USA.
   7. Dimming Station:

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a. Station shall have High-End and Low-End Trim settings:
   1) High End Trim enables energy saving task tuning by setting a maximum level (100%-50%) to which users are allowed to raise lights.
   2) Low-End Trim enables minimum user level of dimmer to be customized.
b. Station shall have Turn On/Turn Off Dimming Operation (when used with a load controller and an occupancy sensor):
   1) Turns On lighting to last user level or can be programmed to a pre-set level (100%, 50%, or custom).
   2) Lighting can turn Off lighting by switching Off power (by opening relay) or dimming below electronic Off Level.
   3) Lighting can also be held at low-end trim level during unoccupied/off state.
c. Station shall have adjustable Fade On and Fade Off Times;
   1) Adjustable time interval for level to ramp up to Turn On Level is 0.75 sec, 1.5 sec, 3 sec, 5 sec, or 15 sec.
   2) Adjustable time interval for level to ramp down to Off is 0.75 sec, 1.5 sec, 3 sec, 5 sec, or 15 sec.

2.06 LOAD CONTROL RELAYS

A. General: Provide a complete and operable load control relay system to be used in conjunction with occupancy sensors, daylight sensors, and wall stations in areas shown on drawings.

B. Provide quantity and configuration of power and slave packs with associated wiring and accessories as required to control load indicated on drawings.

C. System Components: Load Control Relays shall include, but not be limited to, all required sensors, wall stations, power supplies, and low-voltage or line-voltage wiring.

D. System Requirements:
   1. Load Control Relay shall have an operating voltage of 120VAC or 277VAC.
   2. Load Control Relay shall have a Class 2 Output Rating of at least 18VDC, 150mA with 80mA dedicated to powering connected devices. Voltage will be higher when a reduced low voltage load is connected.
   3. Load Control Relay shall be capable of switching the following loads:
      a. 20A @ 120VAC – General Purpose Plug Load
      b. 20A @120/277 VAC – General Purpose, Tungsten, Magnetic Ballast
      c. 16A @ 120/277 VAC – Electronic Ballast, LED Driver
   4. Load Control Relay shall have the following options to be ordered:
      a. PowerPack with Single Relay with 150mA Supply
      b. PowerPack as Secondary Relay
      c. Power Supply (No Relay) with 150mA Supply
   5. Load Control Relay shall be plenum rated.
   6. Load Control Relay housing shall be impact-resistant plastic.
   7. Load Control Relay shall be mounted inside a junction box or shall be provided with separate junction box for concealing low voltage wiring and connecting low voltage conduit.
   8. Load Control Relay shall have optional 0-10 Volt Stepped Dimming for Partial Off or Partial On Operation.
   9. Load Control Relay shall have optional Auxiliary Switch Input wires for Manual On, Hold On, or Hold Off Operation.

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10. Load Control Relay shall have a relay status output signal to keep all connected wall station indicator LEDs operating in unison.
11. Load Control Relay shall have the following operational modes:
    a. Auto On / Auto Off (Occupancy Mode)
    b. Manual On / Auto Off (Vacancy Mode) – requires Low Voltage Wall Station(s)
    c. Override On for Logic High or Logic Low
    d. Override Off for Logic High or Logic Low
12. Load Control Relay shall have an operating temperature from 32°F to 122°F

2.07 TIME SWITCHES

A. Manufacturers:
    1. Cooper Industries, Inc.
    2. Intermatic, Inc.
    3. Leviton Manufacturing Co., Inc.
    4. NSi Industries LLC.

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
    1. Listed and labeled as defined in NFPA 70, and marked for intended location and application.
    2. Contact Configuration: DPDT
    3. Contact Rating: 30A inductive or resistive, 240VAC.
    4. Programs: Each channel is individually programmable with two on-off set points on a 24-hour schedule, allowing different set points for each day of the week.
    5. Astronomic Time: All channels.
    6. Automatic daylight savings time changeover.
    7. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.08 IN-WALL TIME SWITCHES

A. Manufacturers:
    1. Intermatic, Inc**<< ; _____; or None - N/A>>**: www.intermatic.com/#sle.
    2. Wattstoper
    3. Leviton
    4. Acuity
    5. Current
    6. Cooper
    7. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
    8. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.

B. Digital Electronic In-Wall Time Switches:
    1. Description: Factory-assembled solid state programmable controller with LCD display, suitable for mounting in standard wall box, and listed and labeled as complying with **<<UL 916>>** or **<<UL 917>>**.
    2. Program Capability:
        a. 7-Day Time Switches: Capable of different schedule for each day of week.

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b. Astronomic Time Switches: Capable of different schedule for each day of week and field-configurable astronomic feature to automatically adjust for seasonal changes in sunrise and sunset times.

3. Provide automatic daylight savings time compensation.
4. Provide power outage backup to retain programming and maintain clock.
5. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
6. Switch Configuration: Suitable for use in either SPST or 3-way application.
7. Contact Ratings: As required to control load indicated on drawings.
8. Program Capability: Designed to turn load off at end of preset time interval.

C. Digital Electronic In-Wall Interval Timers

1. Description: Factory-assembled solid state programmable controller with LCD display, suitable for mounting in standard wall box, and listed and labeled as complying with **<<UL 916>>** or **<<UL 917>>**.
2. Program Capability: Designed to turn load off at end of preset time interval.
   a. Damp location rated where required by NFPA.
3. Input Supply Voltage: Dual rated for 120/277VAC unless otherwise indicated.
4. Cabling Terminations:
   a. Provide manufacturer supplied and factory tested control wiring.
   b. Include two RJ45 wiring connections.
5. Compatibility:
   a. Compatible with luminaires specified with integral sensors; include auxiliary contact closure accessory components for controls indicated.
   b. Compatible with wired sensors and communication protocols for controlling lin-voltage loads.
      1) Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.
   c. Configurable for single room control as indicated from single digital load controller.
6. Provide UL 2043 plenum rated control unit with self-contained relay(s) and low-voltage class 2 transformer, compatible with specified wired and wireless sensors, components, and ballasts/drivers.
   a. Comply with NFPA 70 for use in plenum spaces.
   b. Provide UL 2043 plenum rating for associated system control components for control indicated.
7. Surface Mounting: Manufacturer approved box
8. Provide one auxiliary contact closure output where indicated.
9. Minimum Load Rating: As required to control load indicated on drawings.
10. Control Inputs:
    a. Digital: Two
    b. Include 24VDC device power input and coordinate maximum current draw as required.
    c. Include automatic-on and manual-on occupancy control wiring inputs.
    d. Include wiring inputs for manual overrides as indicated.
11. Output Control Capability:
    a. Single Zone Switching Modules: One programmable channel.
    b. Multi-Zone Switching Modules: Three separately programmable channels.

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c. Channel Dimming as Indicated:
   1) Range: From 1% to 100% allowing for precise control of light levels.
   2) Method: 0-10VDC protocol: coordinate maximum current draw as reuired.
d. Provide integral load protection from external faults (e.g. power surges and short circuits).

12. Emergency Branch Circuit Loads:
    a. Comply with NFPA 70 for controlling or bypassing emergency branch circuits as indicated.
    b. Provide control devices listed for interfacing with fire alarm system for override operations.
       1) Refer to section **<< 284600>>**.
    c. Provide UL 924 listed components.

D. Additional Integrated Requirements for Digital Load Controllers:
   1. Central monitoring and Management: Include programmable user interface for lighting system controllable features; control access locally by plugging into devices with settings retained in nonvolatile memory.
   2. Provide additional auxiliary contact closure outputs where required for functions and operating modes indicated.
   3. Occupancy Controls:
      a. Scene Control: Occupant selections by lighting control devices for controls as indicated.
      b. Bi-level Switching: Multi-level lighting for controls as indicated.
      c. Dimming: Occupancy controlled dimming, including blink warning; 50% light-level after programmed delay time.
      d. Shade Control: Interfacing capability.
   4. Energy Monitoring:
      a. Include capability for integration with power monitoring system via BACnet/IP communications.
      b. Include reporting and expor
   5. Daylight Harvesting:
      a. System Description:
         1) Control system with compatible control modules, power packs, contactors, or relays as required for automatic control of load indicated according to available natural light.
         2) System control responds to changes in measured light levels according to selected settings.
         3) Capable of integrating with daylighting sensors, occupancy sensors, and manual override controls.
      b. Daylighting Control Photo Sensors: Low-voltage class 2 photo sensor units with output signal proportional to measured light level and provision for zero or offset based signal.
         1) Sensor Range: 5 to 100 footcandles.
      c. Finish: White unless otherwise indicated.
      d. Where sensors are indicated, wireless sensors are not acceptable without prior approval of Architect and owner.
      e. Dimming Photo Sensors: Photo sensor units with integral controller compatible with specified dimming drivers, for direct continuous dimming of up to 50 drivers.

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f. Input delay: To prevent unwanted cycling due to intermittent light level fluctuations.
g. Daylight Control Switching Modules: Unless otherwise indicated, load to be turned on when light level is below selected low set point and load to be turned off when light level is above selected high set point, with no-switching dead band between set points to prevent unwanted cycling.
h. Daylight Control Dimming Module Operations:
1) Unless otherwise indicated, specified load to be continuously brightened as not enough daylight becomes available and continuously dimmed as enough daylight becomes available.
2) Load to be turned off when available daylight is sufficient to fully dim load after selected time delay.
3) Dimming and Fade Rates: Adjustable from 5 to 60 seconds.
4) Cut-Off Delay: Selectable and adjustable from 0 to 20 minutes.
5) Output Voltage: Compatible with specified dimming drivers.

6. Accessories:
a. Where indicated, provide compatible accessory wall switches for manual override control.
7. Time Interval: Field selectable range of presets available up to **<< 12 hours; or _____>>**.
8. Provide field selectable audible and visual indication to warn that end of interval operation is about to turn off load.
9. Provide power outage backup to retain programming and maintain clock.
10. Manual override: Capable of both turning load off and resetting timer to original preset time interval.
11. Switch Configuration: Suitable for use in either SPST or 3-way application.
12. Contact Ratings: As required to control the load indicated on drawings.

2.09 OUTDOOR PHOTO CONTROLS

A. Manufacturers:
1. Intermatic, Inc**<< ; _____; or None - N/A>>**: www.intermatic.com/#sle.
2. Tork, a division of NSI Industries LLC**<< ; _____; or None - N/A>>**: www.tork.com/#sle.
3. NSi Industries LLC
4. Cooper
5. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
6. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.

B. Stem-Mounted Outdoor Photo Controls:
1. Description: Direct-wired photo control unit with threaded conduit mounting stem**<< and field-adjustable swivel base; _____; or None - N/A>>**, listed and labeled as complying with **<<UL 773A>>**.
2. Housing: Weatherproof, **<< impact resistant polycarbonate; heavy duty die cast metal; or _____>>**.
3. Photo Sensor: Solid State.
4. Provide external sliding shield for field adjustment of light level activation.
5. Light Level Activation: **<< 1 to 5 footcandles; _____; or 1 to 10 footcandles>>** turn-on with delayed turn-off of 15 seconds minimum.

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6. Voltage: **<< As required to control load indicated on drawings; 120 V unless otherwise indicated; 208-277 V unless otherwise indicated; or _____>>**.
7. Failure Mode: Fails to the on position.
8. Load Rating: **<< As required to control load indicated on drawings; 1,800 W for tungsten load or 1,000 VA for ballast load; or _____>>**.
9. Provide accessory wall-mounting bracket where indicated or as required to complete installation.

C. Locking Receptacle-Mounted Outdoor Photo Controls
1. Description: Plug-in locking type**<< None - N/A; utility grade; or _____>>** photo control unit complying with **<<ANSI C136.10>>** for mounting on compatible receptacle, listed and labeled as complying with **<<UL 773>>**.
2. Housing: Weatherproof, **<< impact resistant UV stabilized polypropylene; or _____>><< , color to be selected; , color coded by voltage according to ANSI C136.10; , color _____; or None - N/A>>**.
3. Photo Sensor: Solid State.
4. Light Level Activation: **<< 1 to 3 footcandles; 1.5 to 10 footcandles; or _____>>** turn-on **<< with instant turn-on and delayed turn-off; with instant turn-on and turn-off; or _____>>**.
5. Voltage: **<< As required to control load indicated on drawings; 120-277 V unless otherwise indicated; 120 V unless otherwise indicated; 208-277 V unless otherwise indicated; or _____>>**.
6. Failure Mode: Fails to the **<< on; or off>>** position.
7. Load Rating: **<< As required to control load indicated on drawings; 1,000 W for tungsten load or 1,000 VA for ballast load; or _____>>**.
8. Surge Protection: **<< 160 joule metal oxide varistor; 320 joule metal oxide varistor; Air gap arrester with 2.5 kV spark over; or _____>>**.
9. Provide the following accessories where indicated or as required to complete installation:
   a. Receptacle: Complying with **<<ANSI C136.10>>**.
   b. Mounting Bracket.
   c. Shorting Cap: Suitable for replacing locking photo control to complete circuit.

D. Button Type Outdoor Photo Controls
1. Description: Direct-wired photo control unit complying with **<<ANSI C136.24>><< with weatherproof gasketed wall plate where required or indicated; _____; or None - N/A>>**, listed and labeled as complying with **<<UL 773A>>**.
2. Housing: Weather resistant polycarbonate.
3. Photo Sensor: Solid State.
4. Light Level Activation: **<< 1 to 3 footcandles; 1.5 to 10 footcandles; or _____>>** turn-on with delayed turn-off of 15 seconds minimum.
5. Voltage: **<< As required to control load indicated on drawings; 120 V unless otherwise indicated; 208-277 V unless otherwise indicated; or _____>>**.
6. Failure Mode: Fails to the on position.
7. Load Rating: **<< As required to control load indicated on drawings; 1,500 W for tungsten load or 1,000 VA for ballast load; or _____>>**.

2.10 DIGITAL LOAD CONTROLLERS

A. Manufacturers:
1. ILC - Evo System

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2. Crestron - Zum System
3. Current - NX System
4. Acuity - nLight System
5. Wattstopper - WLM System
6. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
7. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. System Description:
1. Stand-alone system, including interconnected modules and accessories, for lighting and plug load low-voltage control as indicated on the drawings.
2. [endif][endif]Product standard system configurations preconfigured out of box, plug-and-play, automatically self-addressing devices for communications, and without need to field configure or program features, or requiring device setting adjustments. LEDs on unit indicate operation and troubleshooting without software intervention.
3. [endif]Provide quantity and configuration of power and slave packs, communication modules, and load expansion modules, including associated wiring, wired and wireless components, and accessories to control loads indicated.
4. [endif]Also referred to as room, area, or architectural digital load controllers, as indicated, depending on space and functionality. Each controller includes one or more channels for load control, also referred to as zones.
5. [endif]Provide networkable digital load controllers and system components for future integration of luminaires and devices.

C. General Requirements
1. Listed for powering and controlling line-voltage loads, power packs, contactors, relays, and other lighting control devices.
a. UL 916 listed for energy management.

2.11 LIGHTING CONTACTORS

A. Manufacturers:
1. Allen Bradley/Rockwell Automation
2. ASCO Power Technologies
3. General Electric Company
4. Schneider Electric; Square D Products**<< ; _____; or None - N/A>>**: www.schneider-electric.us/#sle.
5. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.

B. Description: Electrically operated, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.
1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

C. Short Circuit Current Rating:

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1. Provide contactors with listed short circuit current rating not less than available fault current at installed location as determined by short circuit study performed in accordance with Section **<< 260573>>**.

D. Enclosures:
   1. Comply with **<<NEMA IA 10030>>**.
   2. Environment Type per **<<NEMA EN 10250>>**: **<< Unless otherwise indicated, as specified for the following installation locations:; As indicated on the drawings.; or _____ .>>**
      a. Indoor Clean, Dry Locations: **<< Type 1; Type 3R; or _____>>**.
      b. Outdoor Locations: **<< Type 3R; Type 4X; or _____>>**.
   3. Finish: **<< Manufacturer's standard unless otherwise indicated; or _____>>**.

2.12 EMERGENCY LOAD CONTROL DEVICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

B. Acuity Brands Lighting, Inc.
   1. Watt Stopper.
   2. Bodine
   3. Functional Devices
   4. LVS
   5. Myers

C. Automatic Load Control Relay (ALCR)
   1. Description: Normally closed, electrically held relay and control circuitry for bypassing the normal switching and dimming means when normal utility power is lost, per NEC 700.26. When normal power is lost, relay will close on the emergency lighting circuit to energize the emergency fixtures.
      a. Voltage rating: 120-277 VAC
      b. Load rating: as required to control load indicated on drawings.
      c. Compatible with 0-10 Vdc dimming drivers and allows for override for full illumination upon loss of normal power.
      d. Integral test switch as well as remote test inputs (dry contacts) for an alternate test switch or for fire alarm panel contact switching.
      e. Normal power indicator light and an alternate power indicator light contained in the enclosure.
      f. UL Listed (UL924) for field or factory installation in indoor or damp locations.

D. Brance Circuit Emergency Lighting Transfer Switch (BCELTS)
   1. Description: Automatic transfer switch and control circuitry for bypassing the normal switching means when normal utility power is lost, per NEC 700.25. When normal power is lost, switch will transfer from normal to emergency power to energize the emergency fixtures.
      a. Voltage rating: 120-277VAC
      b. Load rating: as required to control load indicated on drawings; 20A maximum per NEC 700.25.
      c. Integral test switch as well as remote test inputs (dry contacts) for an alternate test switch or for fire alarm panel contact switching.

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d. Normal power indicator light, an emergency power indicator light and a load power indicator light contained in the enclosure.
e. UL Listed (UL1008) for field installation in indoor or damp locations.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with **<<NFPA 70>>**.
C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
D. Verify that final surface finishes are complete**<< , including painting; , _____; or None - N/A>>**.
E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
F. Verify that service voltage and ratings of lighting control devices are appropriate for service voltage and load requirements at location to be installed.
G. Verify that conditions are satisfactory for installation prior to starting work.
H. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
I. Examine roughing-in for controls to verify actual locations of controls and electrical connections before installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.
B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Coordinate locations of outlet boxes as required for installation of lighting control devices; see Section **<< 260534>>**.
B. Maintain separation of remote-control, signaling, and power-limited circuits.
   1. See manufacturer instructions and Section **<< 260519>>** for control wiring conductors, wiring methods, and identification requirements.
C. Install lighting control devices in accordance with manufacturer's instructions.
D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
E. Install lighting control devices plumb and level, and held securely in place.
F. Where required and not furnished with lighting control device, provide wall plate; see Section **<< 262726>>**.
G. Provide required supports; see Section **<< 260529>>**.
H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on

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wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings.**<< Do not use oversized wall plates in lieu of meeting this requirement.; _____ .; or None - N/A>>**

I. Outdoor Photo Control Locations:
   1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.
   2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by photo control itself.

J. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into photo control.

K. Contactor Installation
   1. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

L. Wiring Installation
   1. Wiring Method: Comply with section **<< 260519>>**. Minimum conduit size is 3/4 inch.
   2. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.
   3. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
   4. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

M. Daylighting Control Photo Sensor Locations:
   1. Unless otherwise indicated, locate photo sensors for closed loop systems to accurately measure light level controlled at designated task location, while minimizing measured amount of direct light from natural or artificial sources such as windows or pendant luminaires.
   2. Unless otherwise indicated, locate photo sensors for open loop systems to accurately measure the level of daylight coming into space, while minimizing measured amount of lighting from artificial sources.

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3.04 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Inspect each lighting control device for damage and defects.

C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area**<< . Record test results in written report to be included with submittals; _____; or None - N/A>>**.

D. Test time switches to verify proper operation.

E. Test outdoor photo controls to verify proper operation, including time delays where applicable.

F. Test daylighting controls to verify proper operation, including light level measurements and time delays where applicable**<< . Record test results in written report to be included with submittals; _____; or None - N/A>>**.

G. Correct wiring deficiencies and replace damaged or defective conductors, cables, and lighting control devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by **<<Architect>>**.

C. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by **<<Architect>><< . Record settings in written report to be included with submittals; or None - N/A>>**.

D. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by **<<Architect>>**.

E. Occupancy Adjustments: When requested within **<< 1 year; and _____>>** of Final Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to project during other-than-normal occupancy hours for this purpose.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of lighting control devices to **<<Architect>>**, and correct deficiencies or make adjustments as directed.

B. Training: Train **<<Owner>>**'s personnel on operation, adjustment, programming, and maintenance of **<< lighting control devices; or _____>>**.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

END OF SECTION 260923

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SECTION 260943
LIGHTING CONTROL RELAY PANELS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section **<< 260526 - Grounding and Bonding for Electrical Systems>>**.

B. Section **<< 260529 - Hangers and Supports for Electrical Systems>>**

C. Section **<< 260534 - Boxes for Electrical Systems>>**.

D. Section **<< 260553 - Identification for Electrical Systems>>**: Identification products and requirements.

E. Section **<< 260573 - Power System Studies>>**.

F. Section **<< 262726 - Wiring Devices>>**

G. Section **<< 260923>>**-Lighting Control Devices

H. Section **<< 265100 - Interior Lighting>>**.

I. Section **<< 265600 - Exterior Lighting>>**.

1.02 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices.

C. NECA 407 - Standard for Installing and Maintaining Panelboards.

D. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts.

F. NFPA 70 - National Electrical Code.

G. UL 924 - Emergency Lighting and Power Equipment.

H. UL 1472 - Solid-State Dimming Controls.

I. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules.

J. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of devices and equipment with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.
3. Notify **<<Architect>>** of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.04 SUBMITTALS

A. Product Data:

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1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control modules, power distribution components, relays, manual switches and plates, and conductors and cables.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Sound data including results of operational tests of central dimming controls.
4. Operational documentation for software and firmware.

B. Shop Drawings:
1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail wiring partition configuration, current, and voltage ratings.
4. Short-circuit current rating of relays.
5. Address Drawing: Reflected ceiling plan and floor plans, showing connected luminaires, address for each luminaire, and luminaire groups. Base plans on construction plans, using the same legend, symbols, and schedules.
6. Point List and Data Bus Load: Summary list of all control devices, sensors, ballasts, and other loads. Include percentage of rated connected load and device addresses.
7. Wire Termination Diagrams and Schedules: Coordinate nomenclature and presentation with Drawings and block diagram. Differentiate between manufacturer-installed and field-installed wiring.
8. Retain "Block Diagram" Subparagraph below when control is digital, PC or IP based.
9. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.

C. Field Quality Control Reports.

D. Operation and Maintenance Data: For each type of device, include detailed information on device programming and setup as well as emergency, operation and maintenance manuals..

E. Project Record Documents: Record actual installed locations settings, and MAC and IP addresses (where applicable) for lighting control devices.

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1.05 QUALITY ASSURANCE

A. Comply with requirements of **<<NFPA 70>>**.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum **<< five; or _____>>** years**<< documented; _____; or None - N/A>>** experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND PROTECTION

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.07 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.08 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Manufacturer's standard form in which manufacturer agrees to repair or replace components that fail in materials or workmanship or from transient voltage surges, and the Contractor agrees to provide associated electrical work within the specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Failure equipment to operate, or to operate reliably.
   b. Damage of electronic components due to transient voltage surges.
2. Warranty Period: Five years from date of Final Acceptance for material and labor.
3. Extended Material Warranty Period Failure Due to Transient Voltage Surges: 10 years from date of Final Acceptance.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Input signal from manual switches, digital signal sources, contact closure input or a protocol signal from the BAS system shall open or close one or more lighting control relays in the lighting control panels. Any combination of inputs shall be programmable to any number of control relays. Control panels shall also be capable of setting separate and independent control schedules from BAS system.

B. Surge Protective Device: Factory installed as an integral part of control components or field-mounted surge suppressors complying with UL 1449, SPD Type 2.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with 47 CFR, Subparts A and B, for Class A digital devices.

E. Comply with UL 916 and UL 508.

F. Provide products listed, classified, and labeled as suitable for the purpose intended.

2.02 LOW VOLTAGE LIGHTING CONTROL RELAY PANELS

A. Manufacturers:

1. Current Lighting Controls
2. Leviton Manufacturing Co., Inc.
3. Acuity Brands Lighting, Inc.
4. WattStopper.
5. ILC

B. Description: Standalone lighting control panel using relays to control lighting.

C. Lighting Control Panel:

1. A single enclosure with incoming lighting branch circuits, control circuits, switching relays, and on-board timing and control unit.
2. A vertical barrier separating branch circuits from control wiring.

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D. Relays: Electrically operated, single-pole switch, rated at 20 A at 277 V. Short-circuit current rating shall be not less than 5 kA. Control shall be three-wire, 24-V ac.

E. Power Supply: NFPA 70, Class 2, sized for connected equipment, plus 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, low-voltage inputs, field-installed occupancy sensors, and photo sensors.

F. Control Unit: Contain the power supply and electronic control for operating and monitoring individual relays.
   1. Timing Unit:
      a. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
      b. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.
      c. Four independent schedules, each having 24 time periods.
      d. Schedule periods settable to the minute.
      e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
      f. 16 special date periods.
   2. Nonvolatile memory shall retain all setup configurations. After a power failure, the controller shall automatically reboot and return to normal system operation, including accurate time of day and date.
   3. Operator Interface:
      a. Integral alphanumeric keypad and digital display, and intuitive drop-down menus to assist in programming.
      b. Log and display relay on-time.
      c. Connect relays to one or more time and sequencing schemes.

2.03 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG, complying with Section **<< 260519>>**.

B. Classes 2 and 3 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Section **<< 260519>>** .

C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Section **<< 260519>>**.

D. Digital and Multiplexed Signal Cables: Unshielded, twisted-pair cable with copper conductors, complying with TIA/EIA-568-B.2, Category 6 for horizontal copper cable and with Section **<< 271000>>**.

2.04 MANUAL SWITCHES AND PLATES

A. Push-Button Switches: Modular, momentary contact, three wire, for operating one or more relays and to override automatic controls.
   1. Match color and style specified in Section **<< 262726>>**.
   2. Integral green LED pilot light to indicate when circuit is on.
   3. Internal white LED locator light to illuminate when circuit is off.

B. Wall Plates: Single and multigang plates as specified in Section **<< 262726>>**.

C. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

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2.05 FIELD-MOUNTED SIGNAL SOURCES

A. Daylight Harvesting Switching Controls: Comply with Section **<< 260923>>**. Control power may be taken from the lighting control panel, and signal shall be compatible with the relays.

B. Indoor Occupancy Sensors: Comply with Section **<< 260923>>** Control power may be taken from the lighting control panel, and signal shall be compatible with the relays.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with **<<NFPA 70>>**.

C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

E. Verify that conditions are satisfactory for installation prior to starting work.

F. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

G. Examine roughing-in for controls to verify actual locations of controls and electrical connections before installation. Proceed with installation only after unsatisfactory conditions have been corrected.

H. Examine panels before installation. Reject panels that are damaged or rusted or have been subjected to water saturation.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Wiring
   1. Wiring Method: Comply with section **<< 260519>>**.
   2. Raceway: Comply with section **<< 260533>>**. Minimum raceway size is 3/4 inch.
   3. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.
   4. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

B. Panels
   1. Comply with NECA 1.
   2. Install panels and accessories according to NECA 407.
   3. Mount top of trim 90 inches above finished floor unless otherwise indicated.
   4. Mount panel cabinet plumb and rigid without distortion of box.
   5. Install filler plates in unused spaces.

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3.04 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section **<< 260553>>**.

B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section **<< 260553>>**.

C. Create a directory to indicate loads served by each relay; incorporate Owner's final room designations. Obtain approval before installing. Use a PC or typewriter to create directory; handwritten directories are unacceptable.

D. Lighting Control Panel Nameplates: Label each panel with a nameplate complying with requirements for identification specified in Section **<< 260553>>**.

3.05 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Perform the following tests and inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Acceptance Testing Preparation: Test continuity of each circuit.

D. Lighting control panel will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies lighting control panels and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.06 ADJUSTING

A. When requested, within 12 months of Final Completion, provide on-site assistance in adjusting control schedules and programming of lighting control system to suit actual occupied conditions. Provide up to two visits to project site during other-than-normal occupancy hours for this purpose.

3.07 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.08 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of lighting control devices to **<<Architect>>** and owner, and correct deficiencies or make adjustments as directed.

B. Training: Train **<<Owner>>**'s personnel on operation, adjustment, programming, and maintenance of the lighting control system.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

END OF SECTION 260943

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SECTION 262200
LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General-purpose transformers.

1.02 RELATED REQUIREMENTS

A. Section **<< 033000 - Cast-in-Place Concrete>>**: Concrete equipment pads.

B. Section **<< 260526 - Grounding and Bonding for Electrical Systems>>**.

C. Section **<< 260529 - Hangers and Supports for Electrical Systems>>**.

D. Section **<< 260533 - Conduit for Electrical Systems>>**: Flexible conduit connections.

1.03 REFERENCE STANDARDS

A. 10 CFR 431 - Energy Efficiency Program for Certain Commercial and Industrial Equipment - Distribution Transformers.

B. IEEE C57.94 - IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type Distribution and Power Transformers.

C. IEEE C57.96 - IEEE Standard Guide for Loading Dry-Type Distribution and Power Transformers.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction.

E. NECA 409 - Standard for Installing and Maintaining Dry-Type Transformers.

F. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

G. NEMA ST 20 - Dry Type Transformers for General Applications.

H. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems.

I. NFPA 70 - National Electrical Code.

J. UL 506 - Standard for Specialty Transformers.

K. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers.

1.04 SUBMITTALS

A. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.

B. Shop Drawings: Provide dimensioned plan and elevation views of transformers and adjacent equipment with all required clearances indicated.

C. Field Quality Control Test Reports.

D. Maintenance Data: Include recommended maintenance procedures and intervals.
   1. Final settings for transformer taps and measured voltage.

E. Certifications:
   1. Specified sound levels.
   2. Compliance with DOE 2016 for energy efficiency.

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1.05 QUALITY ASSURANCE

A. Comply with requirements of **<<NFPA 70>>**.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

C. UL Energy Verification Mark to confirm compliance with DOE 2016.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.07 PROTECTION

A. Apply temporary heat within indoor transformer enclosures, in accordance with manufacturer's recommendations, until the space temperature and humidity are under normal control.

1.08 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ABB: www.electrification.us.abb.com/#sle.

B. Eaton Corporation: www.eaton.com/#sle.

C. Schneider Electric: www.se.com/#sle.

D. Siemens Industry, Inc: www.new.siemens.com/#sle.

E. Source Limitations: Each transformer shall be from the same, single source manufacturer. All panelboards, switchboards, circuit breakers, transformers and disconnect switches shall be of the same manufacturer.

2.02 TRANSFORMERS - GENERAL REQUIREMENTS

A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with **<<NEMA ST 20>>** and listed, classified, and labeled as suitable for the purpose intended.

B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to **<<IEEE C57.96>>** under the following service conditions:

1. Altitude: Less than **<< 3,300 feet>>**.
2. Ambient Temperature:
   a. Greater than 10 kVA: Not exceeding **<< 104 degrees F>>**.
   b. Less than 10 kVA: Not exceeding **<< 77 degrees F>>**.

C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.

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D. Coils: Continuou aluminum windings without plices except for taps.

E. Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.

F. Basic Impulse Level: 10 kV.

G. Enclosure: Heavy-gage steel enclosure and base, arranged for conduit entrance on the primary and secondary sides and provided with adequate louvered openings to allow suitable ventilation and cooling. NEMA 250 Type 1.

H. Enclosure Finish: Degreased, cleaned, phosphatized, primed and finished with baked enamel paint. Comply with NEMA 250; color manufacturer's standard gray.

I. Isolate core and coil from enclosure using vibration-absorbing mounts.

J. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

K. Taps: Four, 2.5 percent rated kVA taps, two below and two above rated primary voltages, except transformers rated 15 kVA and smaller may have two 5-percent-rated kVA taps, one above and one below rated primary voltage.

L. Sound levels based on NEMA ST 20 test procedure:
   1. Transformers 50 kVA and smaller: Not more than 45 dB.
   2. Transformers 51 to 150 kVA: Not more than 50 dB.
   3. Transformers 151 to 300 kVA: Not more than 55 dB.
   4. Transformers 500 kVA: Not more than 60 dB.

2.03 GENERAL PURPOSE TRANSFORMERS

A. Description: Self-cooled, two winding transformers listed and labeled as complying with **<<UL 506>>** or **<<UL 1561>>**; ratings as indicated on the drawings.

B. Insulation System and Allowable Average Winding Temperature Rise: The maximum hot spot temperature can be 30 degrees C higher than the specified below.
   1. Less than 15 kVA: Class 180 degrees C insulation system with 115 degrees C average winding temperature rise.
   2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.

C. Energy Efficiency: Comply with **<<10 CFR 431>>**, Subpart K.

D. Mounting Provisions:
   1. As indicated on the drawings.

E. Accessories:
   1. Mounting Brackets: Provide manufacturer's standard brackets.
   2. Weathershield Kits: Provide for ventilated transformers installed outdoors to provide a listed **<<NEMA EN 10250>>**, type 3R assembly.
   3. Lug Kits: Sized as required for termination of conductors as indicated**<< on the drawings; _____; or None - N/A>>**.

PART 3 EXECUTION

3.01 INSTALLATION

A. Perform work in accordance with **<<NECA 1>>** (general workmanship).

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B. Install products in accordance with manufacturer's instructions.

C. Install transformers in accordance with **<< NECA 409; IEEE C57.94; and _____>>**.

D. Use flexible conduit, under the provisions of Section **<< 260533>>**, **<< 2 feet; or _____>>** minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

E. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and **<<NFPA 70>>**.

F. Install transformers plumb and level.

G. Mount on wall, ceiling, or floor as indicated on the drawings. Transformers shall not be mounted in corrosive areas.

1. Wall mount: Use manufacturer's wall-mounted bracket in accordance with manufacturer's instructions.
2. Ceiling mount: Use one of the following two methods:
   a. Use manufacturer's ceiling mounted bracket in accordance with manufacturer's instructions.
   b. Field-fabricated trapeze mount: Trapeze mounting made from galvanized-steel struct or channel. Suspend trapeze from galvanized-steel rods, anchor to ceiling or structure above. If trapeze is adjacent to wall, additionally fasten to wall. Provide vibration isolation between transformer and trapeze or between trapeze and its supports.
3. Floor mount: On equipment foundation (4" concrete housekeeping pad).
4. Exterior mount: On equipment foundation as shown on the drawings.

H. Provide grounding and bonding in accordance with Section **<< 260526>>**.

I. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.

J. Where not factory-installed, install lugs sized as required for termination of conductors as indicated.

K. Where furnished as a separate accessory, install transformer weathershield per manufacturer's instructions.

L. Protect against overload on the primary side by circuit breakers in the panelboard as indicated.

M. Install transformers on neoprene vibration isolator pads.

N. Make immediate connections to and from transformers through flexible metal conduit.

3.02 IDENTIFICATION

A. Materials: Refer to Division 26 Section "Identification for Electrical Systems".

B. Nameplates: Refer to Division 26 Section "Identification for Electrical Systems" for additional requirements. Provide identification nameplate for each transformer located on front of assembly.

3.03 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Inspect and test in accordance with **<<NETA ATS>>**, except Section 4.

C. Remove and replace units that do not pass tests or inspections and retest as specified above.

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D. Test Labeling: On completion of satisfactory testing of each unit, attach a date and signed "Satisfactory Test" label to tested component.

E. Prepare and submit test reports.

3.04 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.
   1. Measure voltage on the secondary side of transformer during a typical occupancy period and adjust taps to achieve nominal voltage output. Nominal voltage shall be plus three percent or minus two percent of nameplate secondary voltage.

B. Record final tap settings and measure voltage and include in Operation and Maintenance manuals.

C. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from transformer components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 262200

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SECTION 262413
SWITCHBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Low-voltage (600 V and less) switchboards and associated accessories for service and distribution applications.

B. Overcurrent protective devices for switchboards.

1.02 RELATED REQUIREMENTS

A. Section **<< 033000 - Cast-in-Place Concrete>>**: Concrete equipment pads.

B. Section **<< 260526 - Grounding and Bonding for Electrical Systems>>**.

C. Section **<< 260529 - Hangers and Supports for Electrical Systems>>**.

D. Section **<< 260553 - Identification for Electrical Systems>>**: Identification products and requirements.

E. Section **<< 260573 - Power System Studies>>**: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

F. Section **<< 262713 - Electricity Metering>>**: For interface with equipment specified in this section.

G. Section **<< 262813 - Fuses>>**: Fuses for fusible switches.

H. Section **<< 264300 - Surge Protective Devices>>**.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.

B. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction.

D. NECA 400 - Standard for Installing and Maintaining Switchboards.

E. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

F. NEMA PB 2 - Deadfront Distribution Switchboards.

G. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 1000 Volts or Less.

H. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems.

I. NFPA 70 - National Electrical Code.

J. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

K. UL 869A - Reference Standard for Service Equipment.

L. UL 891 - Switchboards.

M. UL 1053 - Ground-Fault Sensing and Relaying Equipment.

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1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by **<<NFPA 70>>**.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
   4. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.
   5. Notify **<<Architect>>** of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Service Entrance Switchboards:
   1. Coordinate with Utility Company to provide switchboards with suitable provisions for electrical service and utility metering, where applicable.
   2. Coordinate with **<<Owner>>** to arrange for Utility Company required access to equipment for installation and maintenance.
   3. Obtain Utility Company approval of switchboard prior to fabrication.
   4. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.05 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchboards, enclosures, overcurrent protective devices, and other installed components and accessories.

B. Shop Drawings: Indicate dimensions, voltage, bus ampacities, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include dimensioned plan and elevation views of switchboards and adjacent equipment with all required clearances indicated.
   2. Single-line diagram representation of switchboard, bus configuration, current, and voltage ratings.
   3. Short-circuit current rating of switchboard assembly and overcurrent protective devices.
   4. Utility company metering provisions with indication of approval by Utility Company.
   5. Include time-current coordination curves for each type and rating of overcurrent protective devices included in switchboards.
   6. Include wiring diagrams showing all factory and field connections.

C. Service Entrance Switchboards: Include documentation of Utility Company approval of switchboard.

D. Coordination Drawings: Floor plans, drawn to 1/4" = 1'-0" scale, on which the follwing items are shown and coordinated with each other based on input from installers of the items involved:
   1. Dimensioned concrete based: outline of equipment; and required clearances; relationship between components and adjacent architectural, structural and mechanical elements.
   2. Underground conduit stub-up locations, where applicable.
   3. Overhead conduit riser locations.
   4. Grounding cable locations and terminations.

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5. Identify equipment sections including front and rear orientation.

E. Field Quality Control Test Reports.

F. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

G. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.
1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
2. Enclosure Keys: **<< Two; or _____>>** of each different key.

1.06 QUALITY ASSURANCE

A. Comply with requirements of **<<NFPA 70>>**.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

C. Source limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

D. Product selectino for restricted space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.07 COORDINATION

A. Coordinate layout and installation of switchgear and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.

B. Coordinate size and location of concrete bases.

C. Coordinate location of underslab conduit.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store switchboards in accordance with **<< manufacturer's instructions; NECA 400; NEMA PB 2.1; and _____>>**.

B. Store in a clean, dry space having a uniform temperature to prevent condensation (including outdoor switchboards, which are not weatherproof until completely and properly installed). Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.

C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.09 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Switchboards:
1. ABB: www.electrification.us.abb.com/#sle.
2. Eaton Corporation: www.eaton.com/#sle.

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3. Schneider Electric: www.se.com/#sle.
4. Siemens Industry, Inc: www.new.siemens.com/#sle.

2.02 SWITCHBOARDS

A. Provide switchboards consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Dead-front switchboard assemblies with front accesscomplying with **<<NEMA PB 2>>**, and listed and labeled as complying with **<<UL 891>>**; ratings, configurations and features as indicated on the drawings.

D. Service Entrance Switchboards:
   1. Listed and labeled as suitable for use as service equipment according to **<<UL 869A>>**.
   2. For solidly-grounded wye systems, provide factory-installed main bonding jumper between neutral and ground busses, and removable neutral disconnecting link for testing purposes.
   3. Comply with Utility Company requirements for electrical service.

E. Service Conditions:
   1. Provide switchboards and associated components suitable for operation under the following service conditions without derating:
      a. Altitude: Less than **<< 6,600 feet>>**.
      b. Ambient Temperature:
         1) Switchboards Containing Molded Case or Insulated Case Circuit Breakers: Between **<< 23 degrees F>>** and **<< 104 degrees F>>**.
   2. Provide switchboards and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

F. Short Circuit Current Rating:
   1. Provide switchboards with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section **<< 260573>>**.
   2. Listed series ratings are **<< acceptable, except where not permitted by motor contribution according to NFPA 70; acceptable only where specifically indicated; not acceptable; or _____>>**.

G. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide separate pull section and/or top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.

H. Bussing: Sized in accordance with **<<UL 891>>** temperature rise requirements.
   1. Through bus (horizontal cross bus) to be fully rated through full length of switchboard (non-tapered). Tapered bus is not permitted. Ampacity and braced to ahve short-circuit current rating of RMS symmetrical amperes, as shown on the drawings. The through bus shall have provisions for the addition of future sections. Bolt supports, connections and joints with grade 5 hex head bolts and belleville washers.
   2. Provide solidly bonded equipment ground bus through full length of switchboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
   3. Phase and Neutral Bus Material: Copper or Aluminum.
   4. Ground Bus Material: Copper.

I. Enclosures:

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1. Environment Type per **<<NEMA EN 10250>>**: **<< Unless otherwise indicated, as specified for the following installation locations:; As indicated on the drawings.; or _____ .>>**
   a. Indoor Clean, Dry Locations: **<< Type 1 or Type 2 (drip-proof); Type 2 (drip-proof); or _____>>**.
   b. Outdoor Locations: **<< Type 3R; or _____>>**.
2. Finish: **<< Manufacturer's standard unless otherwise indicated; or _____>>**.
3. Sections: Each shall have an open bottom and individual removable top plate for installatino and termination of conduit.
   a. Wireway front covers: Hinged to permit access to the branch breaker load side terminals without removing the covers.

J. Future Provisions:
   1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

K. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section **<< 264300>>**, list switchboards as a complete assembly including surge protective device.
   1. As part of the switchboard, provide service entrance SPD in accordance with Section 264300 Surge Protective Devices.

L. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with **<<UL 1053>>**.

M. **<<Owner>>** Metering:
   1. Provide microprocessor-based digital electrical metering system including all instrument transformers, wiring, and connections necessary for measurements specified.
   2. Meter shall be capable of BACnet communication and connection to the building automation system.
   3. Measured Parameters:
      a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
      b. Current (Amps): For each phase**<< and neutral; _____; or None - N/A>>**.
      c. Frequency (Hz).
      d. Real power (kW): For each phase, 3-phase total.
      e. Reactive power (kVAR): For each phase, 3-phase total.
      f. Apparent power (kVA): For each phase, 3-phase total.
      g. Power factor.
   4. Meter Accuracy: Plus/minus **<< 1.0; 0.5; 0.2; or ___>>** percent.

N. Instrument Transformers:
   1. Comply with **<<IEEE C57.13>>**.
   2. Select suitable ratio, burden, and accuracy as required for connected devices.
   3. Current Transformers: Connect secondaries to shorting terminal blocks.
   4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

2.03 OVERCURRENT PROTECTIVE DEVICES

A. Circuit Breakers:
   1. Interrupting Capacity:

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a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

2. Molded Case Circuit Breakers:
a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with **<<UL 489>><< , and complying with FS W-C-375 where applicable; , _____; or None - N/A>>**; ratings, configurations, and features as indicated**<< on the drawings; _____; or None - N/A>>**.
b. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
c. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
1) Provide the following field-adjustable trip response settings:
(a) Long time delay.
(b) Short time pickup and delay.

B. Energy reductino maintenance switch (ERMS):
1. Switchboard shall contain an arc energy reduction maintenance switch (ERMS) for each circuit breaker rated 1200-amps or larger, including any provisional spaces as indicated as "space and provision" and marked with 1200-amp or greater frame size. The ERMS shall include the following features:
a. External override and circuitry which shall be connected to a breaker's trip unit, and shall be adjustable between 2.5x - 10x trip unit sensor rating.
b. Operation: Enabled via a mode selector switch located adjacent the circuit breaker or electronic trip unit integral to circuit breaker.
1) Mode selector switch: A separate local LED status indicator light shall demonstrate switch is in the "normal" or "maintenance" mode. The selector switch shall be lockable and accessibly mounted on the front enclosure cover above or adjacent to each breaker position served.
2) Electronic trip unit: Confirmation of protection mode via LED indicator light.
c. An ERMS hazard warning label shall be provided indicating presence of the ERMS.
2. Provide trip unit settings for maintenance after performing arc flash study in accordance with the NFPA 70E. The arc flash study shall provide arc flash energy and hazard category with "normal" and "maintenance" device protection (trip unit) settings respecfively including protective coordination curves.

2.04 SOURCE QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Factory test switchboards according to **<<NEMA PB 2>>**, including the following production (routine) tests on each switchboard assembly or component:
1. Dielectric tests.
2. Mechanical operation tests.
3. Grounding of instrument transformer cases test.
4. Electrical operation and control wiring tests, including polarity and sequence tests.
5. Ground-fault sensing equipment test.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of the switchboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive switchboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install switchboards in accordance with **<<NECA 1>>** (general workmanship), **<<NECA 400>>**, and **<<NEMA PB 2.1>>**.

C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any drawout devices.

D. Where switchboard is indicated to be mounted with inaccessible side against wall, provide minimum clearance of **<< 1/2 inch; or _____>>** between switchboard and wall.

E. Provide required support and attachment in accordance with Section **<< 260529>>**.

F. Install switchboards plumb and level.

G. Unless otherwise indicated, mount switchboards on properly sized **<< 4 inch; or _____>>** high concrete pad constructed in accordance with Section **<< 033000; or _____>>**.

H. Provide grounding and bonding in accordance with Section **<< 260526>>**.

I. Install all field-installed devices, components, and accessories.

J. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

K. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed in accordance with Section **<< 260573>>**.

L. Set field-adjustable ground fault protection pickup and time delay settings**<< as indicated; as directed; or _____>>**.

M. Provide filler plates to cover unused spaces in switchboards.

3.03 CONNECTIONS

A. Connect switchboards and components to wiring systems according to other sections of Division 26 and instructed by manufacturer's recommendations.

B. Ground equipment according to Section 260526 Grounding and Bonding, and as instructed by manufacturer's recommendations.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's values are not indicated, use those specified inUL 486A adn UL 486B.

3.04 IDENTIFICATION

A. Identify field-installed wiring and components as specified in Section 260553 Identification for Electrical Systems.

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B. Nameplates: Provide identification nameplate for each switchboard and section, including associated components, located on front of assembly.

3.05 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Provide services of a manufacturer's authorized representative to **<< observe installation and assist in inspection and testing; perform inspection and testing; or _____>>**. Include manufacturer's reports with submittals.

C. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

D. Before energizing switchboard, perform insulation resistance testing in accordance with **<<NECA 400>>** and **<<NEMA PB 2.1>>**.

E. Inspect and test in accordance with **<<NETA ATS>>**, except Section 4.

F. Perform inspections and tests listed in **<<NETA ATS>>**, Section 7.1.

G. Molded Case and Insulated Case Circuit Breakers: Perform inspections and tests listed in **<<NETA ATS>>**, Section 7.6.1.1**<< for all main circuit breakers and circuit breakers larger than _____ amperes; for all main circuit breakers; for circuit breakers larger than _____ amperes; _____; or None - N/A>>**. Tests listed as optional are **<< not required.; required.; not required, except for the following:; or _____>>**

H. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by **<<NFPA 70>>**.

1. Perform inspections and tests listed in **<<NETA ATS>>**, Section 7.14. The insulation-resistance test on control wiring listed as optional is **<< not required; required; or _____>>**.

I. Meters: Perform inspections and tests listed in **<<NETA ATS>>**, Section 7.11.2.

J. Instrument Transformers: Perform inspections and tests listed in **<<NETA ATS>>**, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are **<< not required; required; or _____>>**.

K. Correct deficiencies and replace damaged or defective switchboards or associated components.

3.06 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of switchboard covers and doors.

3.07 CLEANING

A. Clean dirt and debris from switchboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred surfaces to match original factory finish.

3.08 CLOSEOUT ACTIVITIES

A. Training: Train **<<Owner>>**'s personnel on operation, adjustment, and maintenance of switchboard and associated devices.

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1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

END OF SECTION 262413

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SECTION 262416
PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Power distribution panelboards.

B. Lighting and appliance panelboards.

C. Overcurrent protective devices for panelboards.

1.02 RELATED REQUIREMENTS

A. Section **<< 260526 - Grounding and Bonding for Electrical Systems>>**.

B. Section **<< 260529 - Hangers and Supports for Electrical Systems>>**.

C. Section **<< 260553 - Identification for Electrical Systems>>**: Identification products and requirements.

D. Section **<< 260573 - Power System Studies>>**: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

E. Section **<< 264300 - Surge Protective Devices>>**.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

C. NECA 407 - Standard for Installing and Maintaining Panelboards.

D. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. NEMA PB 1 - Panelboards.

F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000V or Less.

G. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems.

H. NFPA 70 - National Electrical Code.

I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.

K. UL 67 - Panelboards.

L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

M. UL 869A - Reference Standard for Service Equipment.

N. UL 943 - Ground-Fault Circuit-Interrupters.

O. UL 1699 - Arc-Fault Circuit-Interrupters.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

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1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by **<<NFPA 70>>**.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify **<<Architect>>** of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.

B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

C. Field Quality Control Test Reports.

D. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

E. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.
1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
2. Panelboard Keys: **<< Two; or _____>>** of each different key.

1.06 QUALITY ASSURANCE

A. Comply with requirements of **<<NFPA 70>>**.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and **<<NECA 407>>**.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ABB: www.electrification.us.abb.com/#sle.

B. Eaton Corporation: www.eaton.com/#sle.

C. Schneider Electric: www.se.com/#sle.

D. Siemens Industry, Inc: www.new.siemens.com/#sle.

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E. Source Limitations: Provide panelboards and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from a single supplier.

2.02 PANELBOARDS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than **<< 6,600 feet>>**.
   2. Ambient Temperature:
      a. Panelboards Containing Circuit Breakers: Between **<< 23 degrees F>>** and **<< 104 degrees F>>**.

C. Short Circuit Current Rating:
   1. Provide panelboards with listed short circuit current rating **<< not less than the available fault current at the installed location as indicated on the drawings; as indicated on the drawings; or _____>>**.
   2. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section **<< 260573>>**.

D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to **<<UL 869A>>**.

E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

G. Bussing: Sized in accordance with **<<UL 67>>** temperature rise requirements.
   1. Provide **<< fully rated; 200 percent rated; or _____>>** neutral bus**<< unless otherwise indicated; where neutral is indicated; _____; or None - N/A>>**, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
   2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

H. Conductor Terminations: Suitable for use with the conductors to be installed.

I. Enclosures: Comply with **<<NEMA EN 10250>>**, and list and label as complying with **<<UL 50>>** and **<<UL 50E>>**.
   1. Environment Type per **<<NEMA EN 10250>>**: **<< Unless otherwise indicated, as specified for the following installation locations:; As indicated on the drawings.; or _____ .>>**
      a. Indoor Clean, Dry Locations: **<< Type 1; or _____>>**.
      b. Outdoor Locations: **<< Type 3R; Type 4X, stainless steel; or _____>>**.
   2. Boxes: Galvanized steel unless otherwise indicated.
      a. Provide wiring gutters sized to accommodate the conductors to be installed.
   3. Fronts:
      a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
      b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
   4. Lockable Doors: All locks keyed alike unless otherwise indicated.

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J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

K. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section **<< 264300>>**, list and label panelboards as a complete assembly including surge protective device.

1. Provide SPD where indicated on drawings.

L. All branch breakers serving electrical distribution equipment (transformers, panelboards, transfer switches, etc.) and all main breakers in panelboards on the life safety (NEC 700), legally required (NEC 701), and optional standby (NEC 702) systems shall have LSI (long time, short time, and instantaneous) settings.

M. All panelboards on the life safety (NEC 700) system shall have surge protection.

N. Multi-Section Panelboards: Provide enclosures of the same height, with **<< feed-through lugs; sub-feed lugs; or _____>>** and feeders as indicated or as required to interconnect sections.

1. Panelboard shall be a maximum of 42 poles per enclosure. Provide multiple sections as required to maintain pole quantity indicated on panelboard schedule.

2.03 POWER DISTRIBUTION PANELBOARDS

A. Description: Panelboards complying with **<<NEMA PB 1>>**, power and feeder distribution type, **<< circuit breaker type; fusible switch type; circuit breaker or fusible switch type as indicated; or _____>>**, and listed and labeled as complying with **<<UL 67>>**; ratings, configurations and features as indicated**<< on the drawings; _____; or None - N/A>>**.

B. Conductor Terminations:

1. Main and Neutral Lug Material: Copper, suitable for terminating aluminum or copper conductors.
2. Main and Neutral Lug Type: **<< Mechanical; Compression; or _____>>**.

C. Bussing:

1. Phase and Neutral Bus Material: Copper.
2. Ground Bus Material: Copper.

D. Circuit Breakers:

1. Provide **<< bolt-on; plug-in; or _____>>** type**<< or plug-in type secured with locking mechanical restraints; _____; or None - N/A>>**.

E. Enclosures:

1. Provide **<< surface-mounted; flush-mounted; or _____>>** enclosures**<< as indicated; unless otherwise indicated; _____; or None - N/A>>**.
2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
3. Provide **<< clear plastic; metal; or _____>>** circuit directory holder mounted on inside of door.

2.04 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with **<<NEMA PB 1>>**, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with **<<UL 67>>**; ratings, configurations and features as indicated**<< on the drawings; _____; or None - N/A>>**.

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B. Conductor Terminations:
   1. Main and Neutral Lug Material: Copper, suitable for terminating aluminum or copper conductors.
   2. Main and Neutral Lug Type: **<< Mechanical; Compression; or _____>>**.

C. Bussing:
   1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
   2. Phase and Neutral Bus Material: Copper.
   3. Ground Bus Material: Copper.

D. Circuit Breakers: Thermal magnetic **<< bolt-on; plug-in; or _____>>** type**<< unless otherwise indicated; _____; or None - N/A>>**.

E. Enclosures:
   1. Provide **<< surface-mounted; flush-mounted; or _____>>** enclosures**<< as indicated; unless otherwise indicated; _____; or None - N/A>>**.
   2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
   3. Provide **<< clear plastic; metal; or _____>>** circuit directory holder mounted on inside of door.

2.05 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:
   1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with **<<UL 489>><< , and complying with FS W-C-375 where applicable; , _____; or None - N/A>>**; ratings, configurations, and features as indicated**<< on the drawings; _____; or None - N/A>>**.
   2. Interrupting Capacity:
      a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating **<< indicated, but not less than:; indicated.; or _____>>**
      b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
   3. Conductor Terminations:
      a. Lug Material: Copper, suitable for terminating aluminum or copper conductors.
   4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
   5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
   6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
   7. Provide the following circuit breaker types where indicated:
      a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with **<<UL 943>>**, class A for protection of personnel.
      b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
      c. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Combination type listed as complying with **<<UL 1699>>**.

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8. Do not use tandem circuit breakers.
9. Do not use handle ties in lieu of multi-pole circuit breakers.
10. Provide **<< multi-pole circuit breakers; circuit breaker handle-ties; or _____>>** for multi-wire branch circuits as required by **<<NFPA 70>>**.
11. Provide the following features and accessories where indicated or where required to complete installation:
    a. Shunt Trip: Provide **<< coil voltage as required for connection to indicated trip actuator; 120 VAC coil; or _____>>**.
    b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.

2.06 SOURCE QUALITY CONTROL

A. Factory test panelboards according to **<<NEMA PB 1>>**.

PART 3 EXECUTION

3.01 INSTALLATION

A. Perform work in accordance with **<<NECA 1>>** (general workmanship).
B. Install products in accordance with manufacturer's instructions.
C. Install panelboards in accordance with **<< NECA 407; NEMA PB 1.1; and _____>>**.
D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and **<<NFPA 70>>**.
E. Provide required support and attachment in accordance with Section **<< 260529>>**.
F. Install panelboards plumb.
G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed **<< 79 inches>>** above the floor or working platform.
I. Provide minimum of four spare 1-inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
J. Provide grounding and bonding in accordance with Section **<< 260526>>**.
K. Install all field-installed branch devices, components, and accessories.
L. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
M. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by **<<NFPA 70>>**.
N. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section **<< 260573>>**.
O. Provide filler plates to cover unused spaces in panelboards.
P. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads**<< where indicated; as directed; _____; or None - N/A>>.<< Also provide for the following:; or None - N/A>>**
    1. Emergency and night lighting circuits.
    2. Fire detection and alarm circuits.
Q. Identify panelboards in accordance with Section **<< 260553>>**.

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3.02 CONNECTIONS

A. Connect panelboards and components to wiring and to ground as indicated.

B. Shared neutral conductors shall not be permitted, except where indicated.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's values are

3.03 IDENTIFICATION

A. Materials: Refer to Section 260553. Identify units, auxiliary devices, controls, and wiring. Identify equipment ratings.

B. Nameplates: Refer to Section 260553. Provide identification nameplate for each panelboard and associated components located on the front of the assembly.

C. Identify field-installed wiring and components. Refer to Section 260553.

D. Provide printed directory for each panelboard. Handwritten directories are not acceptable. Copying of panel schedules and descriptions on drawings is not acceptable. Circuit directory shall reflect final circuit installation. Include the following informaiton:

1. Panelboard designation and room location.
2. Circuit breakers, size and number of poles.
3. Circuit or feeder descripption including destination room name(s) and number(s).
4. Clear description of type of load circuit serves.
5. Panelboard ratings: Main bus ampacity, main circuit breaker or main lug ampacity, AIC rating.
6. Incoming primary feeder size and source panelboard circuit designation.

E. Room names and numbers on the panelboard directories shall match names and numbers used by the Owner. Note that room names and numbers on the drawings may not match the Owner's final room name and numbering scheme.

3.04 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Inspect and test in accordance with **<<NETA ATS>>**, except Section 4.

C. Molded Case Circuit Breakers: Perform inspections and tests listed in **<<NETA ATS>>**, Section 7.6.1.1**<< for all main circuit breakers and circuit breakers larger than _____ amperes; for all main circuit breakers; for circuit breakers larger than _____ amperes; _____; or None - N/A>>**. Tests listed as optional are **<< not required.; required.; not required, except for the following:; or _____>>**

D. Test GFCI circuit breakers to verify proper operation.

E. Test AFCI circuit breakers to verify proper operation.

F. Test shunt trips to verify proper operation.

G. Procure services of a qualified manufacturer's representative to observe installation and assist in **<< inspection; testing; and adjusting>>**. Include manufacturer's reports with field quality control submittals.

H. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.05 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

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B. Adjust alignment of panelboard fronts.

3.06 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 262416

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SECTION 262550
GENERATOR DOCKING STATIONS

PART 1 - GENERAL

1.01 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code.

B. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

C. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

1.02 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in **<<NFPA 70>>**, by a qualified testing agency, and marked for intended location and application.

B. ETL/UL LISTED

C. **<<UL 50>>** LISTED

1.03 COORDINATION

A. Coordinate layout and installation of Generator Docking Station, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels

1.04 WARRANTY

A. Manufacturer Warranty shall be provided for a minimum of 1 Year,
   1. Extended Warranty will be supplied upon at user's request at an additional charge from Manufacturer.

B. The equipment installed under this contract shall be left in proper working order

C. New materials and equipment shall be guaranteed against defects in composition, design or workmanship. Guarantee certificates shall be furnished.

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PART 2 - PRODUCTS

2.01 DOCKING STATION

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Basis of Design - TRYSTAR: Dual Purpose Docking Station DBDS-5
   2. Asco
   3. Eaton

2.02 GENERAL REQUIREMENTS

A. Enclosure
   1. NEMA 3R Rain-Tight Aluminum Enclosure
      a. Pad-lockable front door shall include a hinged access plate at the bottom for entry of temporary cabling that prevents unauthorized tampering while in use.
      b. NEMA 3R Integrity shall be maintained while temporary cabling is connected during use
      c. Front and Side shall be accessible for maintenance

d. Top, Side, and Bottom shall be accessible for permanent cabling

2. Powder coat
   a. Paint after fabrication shall be Hammer tone Gray

B. Phase, Neutral, and Ground Busbar
   1. Material: Silver-plated Copper
   2. Equipment Ground Bus: bonded to box.
   3. Ground Bus: 100% of phase size.
   4. Neutral Bus: Neutral bus rated 100 percent of phase bus.

C. Temporary generator and Load Bank connectors shall be Camlok style mounted on gland plate.
   1. Camlok shall be 16 Series model and color coded according to system voltage requirements.
   2. Camlok connections shall be Bus Bar Style, Cabling or Double Set Screw is not acceptable
   3. Camlok connection shall be protected against accidental contact while not in use

D. Permanent Connection shall be factory installed broad range set-screw mechanical type, located behind a physical barrier

E. Short Circuit & Withstand Rating
   1. Shall be minimum 65 KAIC unless otherwise indicated on drawings

F. Voltage & Amperage
   1. **<< as indicated on the drawings; _____; or None - N/A>>**

G. Factory Installed Phase Rotation Monitor Device:
   1. Phase monitoring relay to be Siemens 3U4512-1AR20 or equal and factory installed

H. Breaker Disconnects in Permanent Line, Temporary Line, and Temporary Load Bank Positions
   1. Must be **<<UL 489>>** Listed Breaker
   2. Breakers shall be removable for service and maintenance
   3. Interlocked permanent line breaker and temporary line breaker

I. Additional accessories shall be included in submittal drawing as follows:
   1. SCADA Terminal Port
   2. Kirk Key Door Interlock
   3. Listed Monitoring Device
   4. Surge Protection Device
   5. Utility Light/Alarm

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PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine elements and surfaces to receive Generator Docking Station for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected

3.02 INSTALLATION

A. Surface, Flush or Base Mounted: Determined by Application
   1. Install anchor bolts to elevations required for proper attachment to Generator Docking Station.

3.03 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

C. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.04 FACTORY COMMISSIONING

A. Upon completion of the installation, the docking station shall be commissioned by the Manufacturer’s factory authorized technician.

B. SCOPE OF WORK SHALL INCLUDE:

1. Review and verify the installation of all components and verify the correct electrical flow as depicted on the one-line drawings.
2. (If Applicable) The Manufacturer’s authorized technician will set the long time, short time, instantaneous and ground fault protection settings on the Generator Docking Station circuit breaker(s) in accordance with the engineer’s specifications or as provided as part of the coordination study.
3. Factory training for on-site personnel to educate them on how to connect the GDS to a portable generator.
4. The Manufacturer’s factory authorized technician shall, upon completion of the commissioning provide a written report to the electrical contractor and electrical engineer indicating the completion of the work.
5. Any issue that is found during the start-up that is determined at that time to be a warranty issue will be covered by Manufacturer. Any issues that are specific to the scope for the electrical installing contractor are the sole responsibility of the installing contractor.
6. Upon successful completion of the commissioning, provide a complimentary 12-month warranty extension, above and beyond the 12-month manufacturer warranty.

3.05 FIELD QUALITY CONTROL

A. Third Party Tests and Inspections to include the following:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

B. Prepare test and inspection reports, including a certified report that identifies Generator Docking Station and that describes scanning results. Include notation.

END OF SECTION 262550

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SECTION 262653
ELECTRIC VEHICLE CHARGING EQUIPMENT - LEVEL 2

SECTION 262653 - ELECTRIC VEHICLE CHARGING EQUIPMENT - LEVEL 2

PART 1 GENERAL

2.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

2.02 SUMMARY

A. Section includes EV charging equipment that provides Level 2 EV charging.

B. Provide duel chargers with one charging port.

2.03 DEFINITIONS

A. EV: Electric vehicle.

B. EV Cable: The off-board cable containing the conductor(s) to connect the EV power controller to the EV that provides both power and communications during energy transfer.

C. EV Capable: Parking spaces that include nearby termination of raceway (conduit) to a power source with sufficient electrical panel capacity designed for simultaneous charging of electric vehicles in all planned EV parking spaces. Electrical wiring need not be pulled through raceway (conduit) until charging station is installed.

D. EV Charger or EV Charging Equipment: See "EVSE".

E. EV Connector: A conductive device that, when electrically coupled to an EV inlet, establishes an electrical connection to the EV for the purpose of power transfer and information exchange. This device is part of the EV coupler.

F. EV Coupler: A mating EV inlet and connector set.

G. EV Inlet: The device in the vehicle into which the EV connector is inserted, and a conductive connection is made for the transfer of power and communication. This device is part of the EV coupler.

H. EV Make Ready: Parking spaces that include nearby termination of raceway (conduit) and electrical wiring pulled to a power source with sufficient electrical panel capacity for simultaneous charging of electric vehicles in all EV parking spaces.

I. EVSE: Electric Vehicle Supply Equipment. It includes the EV charging equipment and conductors, including the ungrounded, grounded, and equipment grounding conductors and EV cables, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for transferring energy between the premise wiring and the EV.

2.04 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NFPA 70 - National Electrical Code.

C. SAE J1772 - SAE Electric Vehicle and Plug in Hybrid Electric Vehicle Conductive Charge Coupler.

D. UL 486A-486B - Wire Connectors.

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E. UL 2231-1 - Standard for Safety for Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits: General Requirements.

F. UL 2231-2 - Standard for Safety for Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits: Particular Requirements for Protection Devices for Use in Charging Systems.

G. UL 2594 - Standard for Electric Vehicle Supply Equipment.

2.05 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at project site.

2.06 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for EV charging equipment.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For EV charging equipment.
   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Detail fabrication and assembly of mounting assemblies for EV charging equipment.
   4. Include diagrams for power, signal, and control wiring.
   5. Include verification of wireless communications service at each location of EV charging equipment.

C. Product Schedule: For EV charging equipment. Use same designations indicated on Drawings.

D. Sustainable Design Submittals: Refer to Division 1 Section “Sustainable Design Requirements.”

2.07 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Area plans and details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Structural members to which equipment will be attached.
   2. Electrical service.
   3. Communications service, including wireless communications equipment.

B. Qualification Data: For Installer.

C. Field quality-control reports.

D. Sample Warranty: For manufacturer's warranty.

2.08 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For EV charging equipment to include in operation and maintenance manuals.

B. Software and Firmware Operational Documentation:
   1. Online training and help documentation.
   2. Station activation sticker.

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2.09 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in **<<NFPA 70>>**, by a qualified testing agency, and marked for intended location and use.

C. Comply with **<<UL 2231-1>>**. **<<UL 2231-2>>**, **<<UL 2594>>**, and NEC Article 625.

D. Comply with **<<SAE J1772>>**.

E. Comply with FCC Part 15 Class A.

F. Meet the connected functionality criteria for ENERGY STAR certified EVSE.

G. Provide capability of responding to time-of-use market signals (e.g., price).

2.10 FIELD CONDITIONS

A. Wireless Survey: Complete wireless survey to determine if wireless provider signals meet or exceed manufacturer's recommended minimum values.

B. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not exceeding minus 22 to plus 122 deg F (minus 30 to plus 50 deg C).
2. Altitude: Not exceeding **<< 6600 feet>>**.

C. Rate Equipment for non-operation under the following conditions:

1. Ambient Temperature: Not exceeding minus 40 to plus 140 deg F (minus 40 to plus 60 deg C).
2. Altitude: Not exceeding **<< 6600 feet>>**.

D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner’s written permission.

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2.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of EV charging units that fail(s) in materials or workmanship within specified warranty period.

1. Standard Warranty Period: One year from date of Substantial Completion.
2. Extended Warranty Period: Five years from date of Substantial Completion.

2.12 SUBSTITUTIONS

A. Substitutions of the EV charging unit are allowed provided the following is provided with the Submittal package.

1. Provide all data as required for submittals with substitution package. Indicate variances with basis of design equipment.

PART 2 PRODUCTS

3.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
   1. ZeroVA Technologies AX48 Series (Basis of design)
   2. ChargePoint CT4000
   3. BTC Power EVP-2002-30
   4. Clipper Creek HCS-40
   5. EvoCharge

B. Source Limitations: Obtain EV charging equipment from single manufacturer.

3.02 EV CHARGING EQUIPMENT DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in **<<NFPA 70>>**, by a qualified testing agency, and marked for intended location and use.

B. Comply with **<<NFPA 70>>**.

C. ADA compliant.

D. Metering: +/- 2 percent from 2 percent to full scale of output (30 A).

E. EV Charging Equipment Mounting: Bollard mount.

F. Enclosures:
   1. Rated for environmental conditions at installed location.
      a. Outdoor Locations: NEMA 250, Type 3R.
      b. Aluminum and UV-resistant plastic.
      c. Paint and Anodized.
      d. Charging components protected by security screws.
      e. Charging connectors in locking holsters.
      f. Meter, modem, and CPU, tamper resistant.

G. EV Cable and Connectors:
   1. **<<SAE J1772>>** connector.
   2. Single station: One connector with locking holster.
   3. Dual station: Two connectors with locking holster.
   4. Minimum 24.6-foot (7.5-m) cable with cable management system.

H. Status Indicators:
   1. LEDs to indicate power, vehicle charging, charging complete, system status, faults, and service, as well as authorization.

I. Display Screen:
   1. VGA-resolution, daylight-viewable LCD screen with UV protection. Daylight readable and fingerprint resistant.
   2. Displays power, charging, charging complete, remote control, system status, faults, payment and pricing details, and service.

J. Networking:
   1. WAN Communications: Cellular GSM/GPRS and CDMA.
   2. LAN Communications: 2.4 GHz Wi-Fi 802.11b/g/n.

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3. Capable of remote configuration, diagnostics and reporting.
4. Capable of remote software updates (future proof).

K. Payment System:
1. RFID (ISO 15693, ISO 14443), NFC, Contactless credit card reader.
2. PCI (Payment Card Industry) compliant.
3. Capable of remote control and authorization including mobile phone application or toll free phone number.

L. Charging Network: Compatible with the Manufacturers EV charging network.
1. Multiple units shall independently connect to charging network.
2. Multiple units shall have one unit designated as a master unit that is configured as a gateway unit between the EV charging equipment and the charging network.
3. Individual units shall be capable of indicating station status and availability providing or connecting user to customer support and remote control.

3.03 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

B. Surge Withstand: 6 kV at 3000 A.

C. Integral GFCI.

D. Auto-GFCI fault retry.

E. Input Power:
1. One 60 A, 208/240-V ac, 60 Hz, single phase per charger.
2. Dual circuits do not need to be interlocked.

F. EV Charging Levels:
1. Single vehicle: AC Level 2 at up to 11.5 kW per vehicle.
2. Dual vehicles, AC Level 2 at up to 11.5 kW per vehicle.
3. Multiple vehicles simultaneously charging at a site using Automatic Power Load Management may be charged up to 11.5 kW per vehicle.

3.04 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

4.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for EV charging equipment electrical conduit to verify actual locations of conduit connections before equipment installation.

C. Examine walls, floors, and pavement for suitable conditions where EV charging equipment will be installed.

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D. Proceed with installation only after unsatisfactory conditions have been corrected.

4.02 INSTALLATION

A. Comply with **<<NECA 1>>** and NECA 413.

B. Concrete Base Mounting:

1. Install EV charging equipment on 6-inch (150-mm) nominal-thickness concrete base. Base should be 24-inch **<< 23.62 inch>>** diameter or square (minimum 12-inch (**<< 11.81 inch>>**) from the center located conduit stub-up). Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete".
    a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
    b. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
    c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    d. Install anchor bolts to elevations required for proper attachment to supported equipment.
    e. Secure EV charging equipment to concrete base according to manufacturer's written instructions.

C. Bollard Mounting:

1. Allow a minimum of **<< 24 inches>>** of clearance around EV charging equipment.
2. EV charging equipment receptacles or holders shall be not less than **<< 24 inches>>** and not more than **<< 4 feet>>** above finished grade.
3. Mount EV charging equipment plumb and rigid without distortion of enclosure.
4. Secure EV charging equipment according to manufacturer's written instructions.

D. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Wiring Method: Install cables in raceways and cable trays. Conceal raceway and cables except in unfinished spaces.

1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

F. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

G. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

H. Circuit Breakers: Comply with Section 262816 "Enclosed Switches and Circuit Breakers."

I. Secure covers to enclosure.

4.03 CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Comply with grounding requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

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C. Comply with requirements for installation of conduit in Section 260533 "Raceways and Boxes for Electrical Systems." Drawings indicate general arrangement of conduit, fittings, and specialties.

D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in **<<UL 486A-486B>>**.

4.04 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

4.05 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections with the assistance of a factory-authorized service representative.

C. Tests and Inspections:
   1. For each unit of EV charging equipment, perform the following tests and inspections:
      a. Unit self-test.
      b. Operation test with load bank.
      c. Operation test with EV.
      d. Network communications test.

D. EV charging equipment will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

4.06 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.

4.07 ONGOING MANAGEMENT SERVICES

A. Engage a station manufacturer that offers a service to manage the administration and policies of the electric vehicle charging stations on an ongoing basis.

4.08 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for the duration of an active Manufacturers Network Service Plan.

B. Upgrade Service: At Substantial Completion, remotely update software to latest version. Install and program software upgrades that become available while an active Manufacturers Network Service Plan is maintained. Upgrading software shall include operating system and new or revised licenses for using software.

4.09 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain EV charging equipment.

END OF SECTION 262653

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SECTION 262713
ELECTRICITY METERING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Equipment for electricity metering by utility company.

B. Equipment for **<<Owner>>** electricity metering:

1. Single circuit electricity meters.
2. Multi-circuit electricity meters.

1.02 RELATED REQUIREMENTS

A. Section **<< 260526 - Grounding and Bonding for Electrical Systems>>**.

B. Section **<< 260529 - Hangers and Supports for Electrical Systems>>**.

C. Section **<< 260534 - Boxes for Electrical Systems>>**: Cabinets and enclosures for metering system components.

D. Section **<< 260553 - Identification for Electrical Systems>>**: Identification products and requirements.

E. Section **<< 262413 - Switchboards>>**: For interface with meters specified in this section.

F. Section **<< 262416 - Panelboards>>**: For interface with meters specified in this section.

G. Section **<< 262813 - Fuses>>**.

1.03 REFERENCE STANDARDS

A. ANSI C12.1 - Electric Meters - Code for Electricity Metering.

B. ANSI C12.20 - American National Standard for Electricity Meters - 0.1, 0.2, and 0.5 Accuracy Classes.

C. IEC 62053-21 - Electricity Metering Equipment - Particular Requirements - Part 21: Static Meters for AC Active Energy (Classes 0,5, 1 and 2).

D. IEC 62053-23 - Electricity Metering Equipment - Particular Requirements - Part 23: Static Meters for Reactive Energy (Classes 2 and 3).

E. IEEE 1459 - IEEE Standard Definitions for the Measurement of Electric Power Quantities Under Sinusoidal, Nonsinusoidal, Balanced, or Unbalanced Conditions.

F. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers.

G. NECA 1 - Standard for Good Workmanship in Electrical Construction.

H. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

I. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems.

J. NFPA 70 - National Electrical Code.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate work to provide equipment suitable for interface with electricity metering systems to be provided.

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2. Notify **<<Architect>>** of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>**, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for electricity metering systems and associated components and accessories. Include ratings, configurations, standard wiring diagrams, dimensions, service condition requirements, and installed features.

C. Shop Drawings: Include system interconnection schematic diagrams showing all factory and field connections. Include requirements for interface with other systems.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.
   1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
   2. Operating and applications software documentation.
   3. Software licenses.
   4. Software service agreement.
   5. PC installation and operating documentation, manuals, and software for the PC and all installed peripherals. Software shall include system restore, emergency boot diskettes, and drivers for al linstalled hardware. Provide separately for each PC.
   6. Hard copies of manufacturer's specifications sheets, operating specifications, design guidelines, user's guides for software and hardware, and PDF files on USB thumb drive of the hard copy submittal.

1.06 QUALITY ASSURANCE

A. Comply with requirements of **<<NFPA 70>>**.

1.07 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

1.08 PROJECT CONDITIONS

A. Interruption of existing electrical service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to the requirements indicated:
   1. Notify Construction Manager no fewer than 14 days in advance of proposed interruption of electrical service.
   2. Do not proceed with interruption of electrical service without Owner's written authorization.

1.09 COORDINATION

A. Electrical service connections: Coordinate with utility companies and components they furnish as follows:
   1. Comply with requirements of utilities providing electrical power services.
   2. Coordinate installation and connection of utilties and services, including provision for electricity-metering components.

B. Coordinate features of distribution equipment and power monitoring and control components to form an integrated interconnection of compatible components.

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1. Match components and interconnections for optimum performance of specified functions.

C. Coordinate work of this section with those in sections specifying distribution components that are metered, monitored or controlled by metering, power monitoring and control equipment.

PART 2 PRODUCTS

2.01 EQUIPMENT FOR ELECTRICILITY METERING BY UTILITY COMPANY

A. Meters will be furnished by utility company.

B. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.

C. Meter sockets: Comply with requirements of electrical power utility company.
1. Steady-state and short-circuit current ratings shall meet indicated circuit ratings.

2.02 EQUIPMENT FOR OWNER ELECTRICITY METERING

A. Manufacturers:
1. Leviton.
2. Eaton Corporation.
3. General Electric Company.
4. Schneider Electric USA, Inc.

B. Provide power monitoring, metering & controll in accordance with the International Energy Conservation Code 2021.
1. Provide measurement devices to monitor the electrical energy use for each of the following load types indicated on the contract documents.
2. The electrical energy use for all load types specified shall be recorded a minimum of every 15 minutes and reported at least hourly, daily, monthly and annually.
3. System shall automatically communicate consumption to data acquisition sytem.

C. Provide a system that can communicate with Owner's BAS system. BACnet IP protocol is required. If that is not possible, provide a BACnet gateway to communicate with the BAS system.

D. Provide microprocessor-based digital electricity metering systems including all instrument transformers, wiring, and connections necessary for measurements specified.

E. Provide products listed, classified, and labeled as suitable for the purpose intended.

F. Provide electricity metering systems and associated components compatible with the equipment and associated circuits to be metered.

G. Service Conditions: Provide electricity meters suitable for operation under the service conditions at the installed location.

H. Enclosures:
1. Where not furnished by manufacturer, provide required cabinets and enclosures in accordance with Section **<< 260534>>**.
2. Environment Type per **<<NEMA EN 10250>>**: **<< Unless otherwise indicated, as specified for the following installation locations:; As indicated on the drawings.; or _____ .>>**
a. Indoor Clean, Dry Locations: **<< Type 1; or _____>>**.
b. Outdoor Locations: **<< Type 3R or Type 4; Type 4X; or _____>>**.
3. Provide lockable door(s)**<< for outdoor locations; where indicated; _____; or None - N/A>>**.

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4. Finish: **<< Manufacturer's standard unless otherwise indicated; or _____>>**.

I. Instrument Transformers:
1. Comply with **<<IEEE C57.13>>**, where applicable.
2. Select suitable ratio, burden, and accuracy as required for connected devices.
3. Current Transformers: Compatible with connected meters; replace meters damaged by connection of incompatible current transformers. Provide shorting terminal blocks for connection of secondaries where applicable.
4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

J. Accessories:
1. Wiring: Provide manufacturer's recommended cables as indicated or as required for connections between system components.

K. Interface with Other Work:
1. Interface with building automation system as specified in Section 230900 - Building Automation System.

2.03 SINGLE CIRCUIT ELECTRICITY METERS

A. Single Circuit Electricity Meter**<< Type _____; for _____; _____; or None - N/A>>**:
1. Accuracy:
a. Real/Active Power/Energy: **<< Revenue grade; plus/minus 1.0 percent; complying with ANSI C12.1 and/or IEC 62053-21 Class 1; Revenue grade; plus/minus 0.5 percent, complying with ANSI C12.20 accuracy and/or IEC 62053-22 Class 0.5S; Revenue grade; plus/minus 0.2 percent, complying with ANSI C12.20 accuracy and/or IEC 62053-22 Class 0.2S; Plus/minus ____ percent; or _____>>**.
b. Reactive Power/Energy: **<< Plus/minus 2.0 percent, complying with IEC 62053-23 Class 2; Plus/minus _____ percent; or _____>>**.
c. Voltage: Plus/minus 2.0 percent.
d. Current: Plus/minus 2.0 percent.
2. Measured Parameters:
a. Voltage (Volts AC); line-to-line and line-to-neutral; **<< per phase; average of all phases; and _____>>**.
b. Current (Amps); **<< per phase; average of all phases; and _____>>**.
c. Frequency (Hz).
d. Real/active power (kW); **<< per phase; total of all phases; and _____>>**.
e. Reactive power (kVAR); **<< per phase; total of all phases; and _____>>**.
f. Apparent power (kVA); **<< per phase; total of all phases; and _____>>**.
g. Power factor; **<< per phase; total of all phases; and _____>>**.
h. Real/active energy (kWh).
i. Reactive energy (kVARh).
j. Apparent energy (kVAh).
k. Power demand; **<< real/active; reactive; apparent; and _____>><< ; present and maximum; ; _____; or None - N/A>>**.
l. Current demand**<< ; present and maximum; ; _____; or None - N/A>>**.
3. Data logging.
a. Storage Capacity: A minimum of 36 months of readings at 15 minute intervals.

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4. Inputs:
   a. Pulse Contact Accumulator Input(s): **<< One; Two; or _____>>**; user-configurable to support measurement of other related energy values (gas, water, steam, etc.) using pulse-output transducers.
5. Communications: Compatible with connected systems. Provide all accessories necessary for proper interface.
   a. Serial Communications: **<< RS-485; or _____>>**; support for **<< Modbus RTU; BACnet MS/TP; or _____>>** & BACnet protocol.
   b. Ethernet Communications: Support for **<< Modbus TCP; BACnet IP; and _____>>** & BACnet protocol.

B. ----------

C. Use the following paragraphs to specify basis of design products from selected manufacturers or use the paragraphs above to specify generic, nonproprietary descriptions.

D. VERIS BASIS OF DESIGN PRODUCTS----->

2.04 MULTI-CIRCUIT ELECTRICITY METERS

A. Multi-Circuit Electricity Meter**<< Type _____; for _____; _____; or None - N/A>>**:
1. Metering Capacity: **<< As indicated or as required for circuits to be metered; _____ single phase or _____ three-phase circuits; One main device, one neutral, and _____ branch circuits; or _____>>**.
2. Accuracy:
   a. Real/Active Power/Energy: **<< Revenue grade; plus/minus 1.0 percent; complying with ANSI C12.1 and/or IEC 62053-21 Class 1; Revenue grade; plus/minus 0.5 percent, complying with ANSI C12.20 accuracy and/or IEC 62053-22 Class 0.5S; Revenue grade; plus/minus 0.2 percent, complying with ANSI C12.20 accuracy and/or IEC 62053-22 Class 0.2S; Plus/minus _____ percent; or _____>>**.
   b. Reactive Power/Energy: **<< Plus/minus 2.0 percent, complying with IEC 62053-23 Class 2; Plus/minus _____ percent; or _____>>**.
   c. Voltage: Plus/minus 2.0 percent.
   d. Current: Plus/minus 2.0 percent.
3. Measured Parameters:
   a. Voltage (Volts AC); line-to-line and line-to-neutral; **<< per phase; average of all phases; and _____>>**.
   b. Current (Amps); **<< per phase; average of all phases; and _____>>**.
   c. Frequency (Hz).
   d. Real/active power (kW); **<< per phase; total of all phases; and _____>>**.
   e. Reactive power (kVAR); **<< per phase; total of all phases; and _____>>**.
   f. Apparent power (kVA); **<< per phase; total of all phases; and _____>>**.
   g. Power factor; **<< per phase; total of all phases; and _____>>**.
   h. Real/active energy (kWh).
   i. Reactive energy (kVARh).
   j. Apparent energy (kVAh).
   k. Power demand; **<< real/active; reactive; apparent; and _____>><< ; present and maximum; ; _____; or None - N/A>>**.

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l. Current demand**<< ; present and maximum; ; _____; or None - N/A>>**.

4. Data logging.
   a. Storage Capacity: 36 months of readings at 15 minute intervals.
5. Inputs:
   a. Pulse Contact Accumulator Input(s): **<< One; Two; or _____>>**; user-configurable to support measurement of other related energy values (gas, water, steam, etc.) using pulse-output transducers.
6. Communications: Compatible with connected systems. Provide all accessories necessary for proper interface.
   a. Serial Communications: **<< RS-485; or _____>>**; support for **<< Modbus RTU; BACnet MS/TP; or _____>>** & BACnet protocol.
   b. Ethernet Communications: Support for **<< Modbus TCP; BACnet IP; and _____>>** & BACnet protocol.

B. ----------

C. Use the following paragraphs to specify basis of design products from selected manufacturers or use the paragraphs above to specify generic, nonproprietary descriptions.

D. VERIS BASIS OF DESIGN PRODUCTS----->

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of metering systems and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive meters.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with **<<NECA 1>>** (general workmanship).

B. Utility Company Meter:
   1. Install meters furnished by utility company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

C. Install products in accordance with manufacturer's instructions.

D. Provide required support and attachment components in accordance with Section **<< 260529>>**.

E. Provide grounding and bonding in accordance with Section **<< 260526>>**.

F. Provide fuses complying with Section **<< 262813>>** as required.

G. Identify meters and associated wiring in accordance with Section **<< 260553>>**.

3.03 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Inspect and test in accordance with **<<NETA ATS>>**, except Section 4.

C. Meters: Perform inspections and tests listed in **<<NETA ATS>>**, Section 7.11.2.

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D. Instrument Transformers: Perform inspections and tests listed in **<<NETA ATS>>**, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are **<< not required; required; or _____>>**.

E. Correct deficiencies and replace damaged or defective metering system components.

3.04 ADJUSTING

A. Program system parameters according to requirements of **<<Owner>>**.

3.05 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION 262713

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SECTION 262726
WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall switches.

B. Receptacles.

C. Wall plates and covers.

D. Floor box service fittings.

E. Poke-through assemblies.

1.02 RELATED REQUIREMENTS

A. Section **<< 260519 - Low-Voltage Electrical Power Conductors and Cables>>**: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.

B. Section **<< 260526 - Grounding and Bonding for Electrical Systems>>**.

C. Section **<< 260534 - Boxes for Electrical Systems>>**.

D. Section **<< 260553 - Identification for Electrical Systems>>**: Identification products and requirements.

E. Section **<< 260923 - Lighting Control Devices>>**: Devices for automatic control of lighting, including **<< occupancy sensors; in-wall time switches; in-wall interval timers; and _____>>**.

F. Section **<< 271000 - Structured Cabling>>**: Voice and data jacks.

1.03 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for.

B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).

C. NECA 1 - Standard for Good Workmanship in Electrical Construction.

D. NECA 130 - Standard for Installing and Maintaining Wiring Devices.

E. NEMA WD 1 - General Color Requirements for Wiring Devices.

F. NEMA WD 6 - Wiring Devices - Dimensional Specifications.

G. NFPA 70 - National Electrical Code.

H. UL 20 - General-Use Snap Switches.

I. UL 498 - Attachment Plugs and Receptacles.

J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices.

K. UL 943 - Ground-Fault Circuit-Interrupters.

L. UL 1310 - Class 2 Power Units.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

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1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
6. Notify **<<Architect>>** of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>**, for submittal procedures.

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

C. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.
   1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
   2. Extra Wall Plates: **<< One; Two; Ten (10); or ____>>** of each style, size, and finish.

1.06 QUALITY ASSURANCE

A. Comply with requirements of **<<NFPA 70>>**.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

C. Product Evaluation and Listing Organization Qualifications: Organization engaged in evaluation of products and services, including those recognized by OSHA as Nationally Recognized Testing Laboratories (NRTL), and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 WIRING DEVICES - GENERAL REQUIREMENTS

A. Provide wiring devices suitable for intended use with ratings adequate for load served.

2.02 WALL SWITCHES

A. Manufacturers:
   1. Hubbell Incorporated**<< ; _____; or None - N/A>>**: www.hubbell.com/#sle.
   2. Leviton Manufacturing Company, Inc**<< ; _____; or None - N/A>>**: www.leviton.com/#sle.
   3. Pass & Seymour, a brand of Legrand North America, Inc**<< ; _____; or None - N/A>>**: www.legrand.us/#sle.

B. General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with **<<NEMA WD 1>>** and **<<NEMA WD 6>>**, and listed as complying with **<<UL 20>><< and where applicable, FS W-S-896; _____; or None - N/A>>**; types as indicated**<< on the drawings; _____; or None - N/A>>**.

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1. Wiring Provisions: Terminal screws for side wiring**<< and screw actuated binding clamp for back wiring; _____; or None - N/A>>** with separate ground terminal screw.

C. Standard Wall Switches: **<< Industrial specification grade; Commercial specification grade; Residential grade; or _____>>**, **<< 20; 15; or _____>>** A, **<< 120/277; 120; or _____>>** V with **<< standard toggle type; decorator style rocker type; or _____>>** switch actuator and maintained contacts; **<< single pole single throw; double pole single throw; three way; four way; or _____>>** as indicated**<< on the drawings; _____; or None - N/A>>**.

D. Pilot Light Wall Switches: **<< Industrial specification grade; Commercial specification grade; Residential grade; or _____>>**, **<< 20; 15; or _____>>** A, **<< 120/277; 120; or _____>>** V with **<< red; green; clear; or _____>>** illuminated **<< standard toggle type; decorator style rocker type; or _____>>** switch actuator and maintained contacts; illuminated with load on; **<< single pole single throw; double pole single throw; three way; four way; or _____>>** as indicated**<< on the drawings; _____; or None - N/A>>**.

E. Locking Wall Switches: **<< Industrial specification grade; Commercial specification grade; Residential grade; or _____>>**, **<< 20; 15; or _____>>** A, **<< 120/277; 120; or _____>>** V with **<< lever type; cylinder type; or _____>>** keyed switch actuator and maintained contacts; switches keyed alike; **<< single pole single throw; double pole single throw; three way; four way; or _____>>** as indicated**<< on the drawings; _____; or None - N/A>>**.

2.03 RECEPTACLES

A. Manufacturers:
1. Hubbell Incorporated: www.hubbell.com/#sle.
2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
3. Lutron Electronics Company, Inc: www.lutron.com/#sle.
4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
5. Eaton ArrowHart Wiring Devices.
6. Source Limitations: Where wall controls are furnished as part of **<< lighting control system; window shade control system; or _____>>**, provide accessory matching receptacles and wallplates by the same manufacturer**<< in locations indicated; _____; or None - N/A>>**.

B. General Requirements: Self-grounding, complying with **<<NEMA WD 1>>** and **<<NEMA WD 6>>**, and listed as complying with **<<UL 498>><< , and where applicable, FS W-C-596; , _____; or None - N/A>>**; types as indicated**<< on the drawings; _____; or None - N/A>>**.
1. Wiring Provisions: Terminal screws for side wiring**<< or screw actuated binding clamp for back wiring; _____; or None - N/A>>** with separate ground terminal screw.
2. NEMA configurations specified are according to **<<NEMA WD 6>>**.
3. All receptacles shall be federal specification grade. Provide brass mounting strap.
4. Device finish color:
   a. General purpose receptacles: White.
   b. Generator power receptacles: Red.
5. Device plates finish color: Finish color of device plates shall match finish color of devices, unless otherwise indicated.

C. Convenience Receptacles:

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1. Standard Convenience Receptacles: **<< Industrial specification grade; Commercial specification grade; Hospital grade; Residential grade; or _____>>**, **<< 20A, 125V, NEMA 5-20R; 15A, 125V, NEMA 5-15R; or _____>><< None - N/A; , rectangular decorator style; or , _____>>**; single or duplex as indicated**<< on the drawings; _____; or None - N/A>>**.
2. Automatically Controlled Convenience Receptacles: **<< Industrial specification grade, ; Commercial specification grade, ; Hospital grade, ; _____; or None - N/A>><< 20A, 125V, NEMA 5-20R; 15A, 125V, NEMA 5-15R; or _____>><< None - N/A; , rectangular decorator style; or , _____>>**; controlled receptacle marking on device face per **<<NFPA 70>>**; single or duplex as indicated**<< on the drawings; _____; or None - N/A>>**.
3. Weather Resistant Convenience Receptacles: **<< Industrial specification grade; Commercial specification grade; Hospital grade; Residential grade; or _____>>**, **<< 20A, 125V, NEMA 5-20R; 15A, 125V, NEMA 5-15R; or _____>><< None - N/A; , rectangular decorator style; or , _____>>**, listed and labeled as weather resistant type complying with **<<UL 498>>** Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated**<< on the drawings; _____; or None - N/A>>**.
4. Tamper Resistant Convenience Receptacles: **<< Industrial specification grade; Commercial specification grade; Hospital grade; Residential grade; or _____>>**, **<< 20A, 125V, NEMA 5-20R; 15A, 125V, NEMA 5-15R; or _____>><< None - N/A; , rectangular decorator style; or , _____>>**, listed and labeled as tamper resistant type; single or duplex as indicated**<< on the drawings; _____; or None - N/A>>**.
5. Tamper Resistant and Weather Resistant Convenience Receptacles: **<< Industrial specification grade; Commercial specification grade; Hospital grade; Residential grade; or _____>>**, **<< 20A, 125V, NEMA 5-20R; 15A, 125V, NEMA 5-15R; or _____>><< None - N/A; , rectangular decorator style; or , _____>>**, listed and labeled as tamper resistant type and as weather resistant type complying with **<<UL 498>>** Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated**<< on the drawings; _____; or None - N/A>>**.

D. GFCI Receptacles:

1. General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with **<<UL 943>>**, class A.
2. Standard GFCI Receptacles: **<< Industrial specification grade; Commercial specification grade; Hospital grade; Residential grade; or _____>>**, duplex, **<< 20A, 125V, NEMA 5-20R; 15A, 125V, NEMA 5-15R; or _____>><< , rectangular decorator style; , _____; or None - N/A>>**.
3. Weather Resistant GFCI Receptacles: **<< Industrial specification grade; Commercial specification grade; Hospital grade; Residential grade; or _____>>**, duplex, **<< 20A, 125V, NEMA 5-20R; 15A, 125V, NEMA 5-15R; or _____>><< , rectangular decorator style; , _____; or None - N/A>>**, listed and labeled as weather resistant type complying with **<<UL 498>>** Supplement SD suitable for installation in damp or wet locations.
4. Tamper Resistant GFCI Receptacles: **<< Industrial specification grade; Commercial specification grade; Hospital grade; Residential grade; or _____>>**, duplex, **<< 20A, 125V, NEMA 5-20R; 15A, 125V, NEMA 5-15R; or _____>><< , rectangular decorator style; , _____; or None - N/A>>**, listed and labeled as tamper resistant type.

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5. Tamper Resistant and Weather Resistant GFCI Receptacles: **<< Industrial specification grade; Commercial specification grade; Hospital grade; Residential grade; or _____>>**, duplex, **<< 20A, 125V, NEMA 5-20R; 15A, 125V, NEMA 5-15R; or _____>><< , rectangular decorator style; , _____; or None - N/A>>**, listed and labeled as tamper resistant type and as weather resistant type complying with **<<UL 498>>** Supplement SD suitable for installation in damp or wet locations.

E. USB Charging Devices:
1. General Requirements: Listed as complying with **<<UL 1310>>**.
a. Charging Capacity - Two-Port Devices: **<< 2.1 A; or _____>>**, minimum.
2. USB Charging/Tamper Resistant Receptacle Combination Devices: Two-port (**<< Type A; or _____>>**) USB charging device and receptacle, **<< commercial specification grade; hospital grade; residential grade; or _____>>**, **<< duplex; single; single or duplex as indicated; or _____>>**, **<< 20A, 125V, NEMA 5-20R; 15A, 125V, NEMA 5-15R; 15A, 125V, NEMA 5-15R or 20A, 125V, NEMA 5-20R as indicated; or _____>>**, listed and labeled as tamper resistant type**<< ; rectangular decorator style; ; _____; or None - N/A>>**.

F. Locking Receptacles: **<< Industrial specification grade; or _____>><< , configuration as indicated on the drawings; , _____; or None - N/A>>**.

2.04 WALL PLATES AND COVERS

A. Wall Plates: Comply with **<<UL 514D>>**.
1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
2. Size: Standard.
3. Screws: Metal with slotted heads finished to match wall plate finish.

B. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.

C. Stainless Steel Wall Plates: Brushed satin finish, **<< Type 302; Type 430; or _____>>** stainless steel.

D. Weatherproof Receptacle Covers for Damp Locations: Gasketed, **<< cast aluminum; thermoplastic; zinc die-cast; or _____>>**, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.

E. Weatherproof Receptacle Covers for Wet Locations: Gasketed, **<< cast aluminum; thermoplastic; or _____>>**, with hinged, clear lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

2.05 FLOOR BOX SERVICE FITTINGS

A. Floor box service fittings for power and communications: As specified in Section 260534, provide specification grade 20-ampere, 125-volt receptacles as indicated on the drawings.

B. Description: Service fittings compatible with floor boxes provided under Section **<< 260534>>** with components, adapters, and trims required for complete installation.

2.06 POKE-THROUGH ASSEMBLIES

A. Poke-through assemblies for power and communications: As specified in Section 260534, provide specification grade 20-ampere, 125-volt receptacles as indicated on the drawings.

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B. Description: Assembly comprising floor service fitting, poke-through component, fire stops and smoke barriers, and junction box for conduit termination; fire rating listed to match fire rating of floor and suitable for floor thickness where installed.

2.07 RELAYS

A. Equal to Square D Company, Class 8501 Type C in NEMA 250 Type 1 enclosure.

B. Contacts: Double break fine silver, convertible from normally open to normally closed contacts. Provide contact status indication.

C. Coils: Molded construction, terminals provided with pressure wire connectors.

D. Coil voltage and number of contacts shall be as indicated on the drawings.

2.08 TERMINAL BLOCKS

A. Terminal blocks: Equal to Hoffman Engineering Company screw-terminal type size as required by NEC. Terminal blocks shall be housed in NEMA 1 boxes with hinged cover.

2.09 CONTACTORS

A. Equal to Square D 8903, UL 508 listed, in NEMA 250 Type 1 enclosure, mechanically held, electrically operated, enclosed silver-alloy double-break contacts, coil-clearing contacts; withstand rating as indicated on the drawings; Hand-Off-Auto selector switch on cover.

1. Provide contactor with two-wire control relay for two-wire control of mechanically held lighting contactor.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with **<<NFPA 70>>**.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete**<< , including painting; or None - N/A>>**.

E. Verify that floor boxes are adjusted properly.

F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

G. Verify that core drilled holes for poke-through assemblies are in proper locations.

H. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with **<<NECA 1>>** (general workmanship) and, where applicable, **<<NECA 130>><< , including mounting heights specified in those standards unless otherwise indicated; , except for mounting heights specified in those standards; , _____; or None - N/A>>**.

B. Coordinate locations of outlet boxes provided under Section **<< 260534>>** as required for installation of wiring devices provided under this section.

1. Locate wall switches on strike side of door with edge of wall plate **<< 3 inches; _____ inches; or _____>>** from edge of door frame. Where locations are indicated otherwise, notify **<<Architect>>** to obtain direction prior to proceeding with work.

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2. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.

C. Install wiring devices in accordance with manufacturer's instructions.

D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

E. Where required, connect wiring devices using pigtails not less than **<< 6 inches; _____ inches; or _____>>** long. Do not connect more than one conductor to wiring device terminals.

F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.

I. Where split-wired duplex receptacles are indicated, remove tabs connecting top and bottom receptacles.

J. Install wiring devices plumb and level with mounting yoke held rigidly in place.

K. Install wall switches with OFF position down.

L. Install vertically mounted receptacles with grounding pole on **<< top; bottom; or _____>>** and horizontally mounted receptacles with grounding pole on **<< left; right; or _____>>**.

M. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings **<< Do not use oversized wall plates in lieu of meeting this requirement.; or None - N/A>>**

N. Provide a single cover plate where two or more devices are grouped together in one box.

O. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

P. Identify wiring devices in accordance with Section **<< 260553>>**.

1. Attach nameplates securely to receptacle cover plates. Provide nameplates for all devices except 120-volt receptacles and lighting switches, identifying equipment and use.

Q. Install poke-through closure plugs in each unused core holes to maintain fire rating of floor.

3.03 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Inspect each wiring device for damage and defects.

C. Test each receptacle to verify operation and proper polarity.

D. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

E. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.04 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

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3.05 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION 262726

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SECTION 262813
FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fuses.

B. Spare fuse cabinet.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses.

B. NFPA 70 - National Electrical Code.

C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements.

D. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses.

E. UL 248-8 - Low-Voltage Fuses - Part 8: Class J Fuses.

F. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses.

G. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses.

H. UL 248-15 - Low-Voltage Fuses - Part 15: Class T Fuses.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
3. Notify **<<Architect>>** of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. Product Data: Each type of fuse.

B. Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.

1. Spare Fuse Cabinet: Include dimensions.

C. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.

1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
2. Extra Fuses: Provide up to 50% of each type and amperage, with no less than one, if only one of each type. ***** MCPS STANDARD *****
3. Spare Fuse Cabinet Keys: **<< Two; or _____>>**.

1.06 QUALITY ASSURANCE

A. Comply with requirements of **<<NFPA 70>>**.

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B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

C. Comply with the following standards:
   1. UL 198E.
   2. UL 198C, Class L fuses, also Classes G and J.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com/#sle.

B. Littelfuse, Inc: www.littelfuse.com/#sle.

C. Mersen: ep-us.mersen.com/#sle.

2.02 APPLICATIONS

A. Service Entrance:
   1. Fusible Switches up to 600 Amperes: **<< Class RK1, time-delay; Class RK1, fast-acting, non-time-delay; Class RK5, time-delay; Class RK5, fast-acting, non-time-delay; Class J, time-delay; Class J, fast-acting, non-time-delay; Class T; or ____>>**.
   2. Fusible Switches Larger Than 600 Amperes: **<< Class L, time-delay; Class L, fast-acting, non-time-delay; Class T; or ____>>**.

B. Feeders:
   1. Fusible Switches up to 600 Amperes: **<< Class RK1, time-delay; Class RK1, fast-acting, non-time-delay; Class RK5, time-delay; Class RK5, fast-acting, non-time-delay; Class J, time-delay; Class J, fast-acting, non-time-delay; Class T; or ____>>**.
   2. Fusible Switches Larger Than 600 Amperes: **<< Class L, time-delay; Class L, fast-acting, non-time-delay; Class T; or ____>>**.

C. General Purpose Branch Circuits: **<< Class RK1, time-delay; Class RK1, fast-acting, non-time-delay; Class RK5, time delay; Class RK5, fast-acting, non-time-delay; Class J, time-delay; Class J, fast-acting, non-time-delay; Class T; or ____>>**.

D. Individual Motor Branch Circuits: **<< Class RK1, time-delay; Class RK5, time-delay; Class J, time-delay; or ____>>**.

2.03 FUSES

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

C. Provide fuses of the same type, rating, and manufacturer within the same switch.

D. Comply with **<<UL 248-1>>**.

E. Unless otherwise indicated, provide cartridge type fuses complying with **<<NEMA FU 1>>**, Class and ratings as indicated.

F. Voltage Rating: Suitable for circuit voltage.

G. Class R Fuses: Comply with **<<UL 248-12>>**.

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H. Class L Fuses: Comply with **<<UL 248-10>>**.

I. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

J. Provide the following accessories where indicated or where required to complete installation:
   1. Fuseholders: Compatible with indicated fuses.
   2. Fuse Reducers: For adapting indicated fuses to permit installation in switch designed for fuses with larger ampere ratings.

2.04 SPARE FUSE CABINET

A. Description: Wall-mounted sheet metal cabinet with shelves and hinged door with cylinder lock, suitably sized to store spare fuses and fuse pullers specified.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

B. Verify that mounting surfaces are ready to receive spare fuse cabinet.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Do not install fuses until circuits are ready to be energized.

B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

C. Install spare fuse cabinet to wall location selected by Own.

END OF SECTION 262813

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SECTION 262816
ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed circuit breakers.

1.02 RELATED REQUIREMENTS

A. Section **<< 260526 - Grounding and Bonding for Electrical Systems>>**.

B. Section **<< 260529 - Hangers and Supports for Electrical Systems>>**.

C. Section **<< 260573 - Power System Studies>>**: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems.

E. NFPA 70 - National Electrical Code.

F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.

H. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

I. UL 869A - Reference Standard for Service Equipment.

J. UL 1053 - Ground-Fault Sensing and Relaying Equipment.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within dedicated equipment spaces and within working clearances for electrical equipment required by **<<NFPA 70>>**.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify **<<Architect>>** of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for circuit breakers, enclosures, and other installed components and accessories.

B. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

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1.06 QUALITY ASSURANCE

A. Comply with requirements of **<<NFPA 70>>**.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed circuit breaker internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature between **<< 23 degrees F>>** and **<< 104 degrees F>>** during and after installation of enclosed circuit breakers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ABB: www.electrification.us.abb.com/#sle.

B. Eaton Corporation: www.eaton.com/#sle.

C. Schneider Electric: www.se.com/#sle.

D. Siemens Industry, Inc: www.new.siemens.com/#sle.

E. Source Limitations: Provide enclosed circuit breakers and associated components produced by **<< same manufacturer as other electrical distribution equipment used for project; single manufacturer; or _____>>** and obtained from single supplier.

2.02 ENCLOSED CIRCUIT BREAKERS

A. Description: Units consisting of molded case circuit breakers individually mounted in enclosures.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Separately enclosed circuit breakers, as indicated, manually operated, trip-free from the handle, and provided with inverse-time, thermal-element overload protection and instantaneous magnetic short-circuit protection on all poles.

D. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:

1. Altitude: Less than **<< 6,600 feet>>**.
2. Ambient Temperature: Between **<< 23 degrees F>>** and **<< 104 degrees F>>**.

E. Short Circuit Current Rating:

1. Provide enclosed circuit breakers with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section **<< 260573>>**.

F. Enclosed Circuit Breakers Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to **<<UL 869A>>**.

G. Conductor Terminations: Suitable for use with the conductors to be installed.

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H. Provide thermal magnetic circuit breakers**<< unless otherwise indicated; for circuit breaker frame sizes less than 60A and not on the NEC 700, 701, or 702 branch of the generator; _____; or None - N/A>>**.

I. Breaker sizes, calibrations and interrupting capacity: Noted on the drawings. Breakers shall be calibrated for 50 degrees C ambient.

J. Provide insulated, groundable fully rated solid neutral assembly**<< where a neutral connection is required; where indicated; _____; or None - N/A>>**, with a suitable lug for terminating each neutral conductor.

K. Provide solidly bonded equipment ground bus **<< in each enclosed circuit breaker; where equipment grounding conductors are provided; or _____>>**, with a suitable lug for terminating each equipment grounding conductor.

L. Enclosures: Comply with **<<NEMA EN 10250>>**, and list and label as complying with **<<UL 50>>** and **<<UL 50E>>**.

1. Environment Type per **<<NEMA EN 10250>>**: **<< Unless otherwise indicated, as specified for the following installation locations:; As indicated on the drawings.; or _____ .>>**
   a. Indoor Clean, Dry Locations: Type 1.
   b. Outdoor Locations: Type 3R with raintight hubs.
2. Provide **<< surface-mounted; flush-mounted; or _____>>** enclosures**<< as indicated; unless otherwise indicated; _____; or None - N/A>>**.

M. Provide externally operable handle with means for locking in the OFF position. Operating handles shall clearly idnicated the positions ON, TRIP and OFF.

N. Provide shunt trip operation where indicated on the drawings.

O. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with **<<UL 1053>>**.

1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.

P. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

2.03 MOLDED CASE CIRCUIT BREAKERS

A. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with **<<UL 489>><< , and complying with FS W-C-375 where applicable; , _____; or None - N/A>>**; ratings, configurations, and features as indicated**<< on the drawings; _____; or None - N/A>>**.

B. Interrupting Capacity:

1. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating **<< indicated, but not less than:; indicated.; or _____>>**
2. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

C. Conductor Terminations:

1. Lug Material: **<< Aluminum, suitable for terminating aluminum or copper conductors; Copper, suitable for terminating copper conductors only; or _____>>**.

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D. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.

E. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
   1. Provide the following field-adjustable trip response settings:
      a. Ground fault pickup and delay**<< where ground fault protection is indicated; _____; or None - N/A>>**.

F. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings of the enclosed circuit breakers are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed circuit breakers.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with **<<NECA 1>>** (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and **<<NFPA 70>>**.

D. Provide required support and attachment in accordance with Section **<< 260529>>**.

E. Install enclosed circuit breakers plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed circuit breakers such that the highest position of the operating handle does not exceed **<< 79 inches>>** above the floor or working platform.

G. Provide grounding and bonding in accordance with Section **<< 260526>>**.

H. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

I. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section **<< 260573>>**.

J. Set field-adjustable ground fault protection pickup and time delay settings**<< as indicated; as directed; or _____>>**.

3.03 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Inspect and test in accordance with manufacturer's instructions and **<<NETA ATS>>**, except Section 4.

C. Perform inspections and tests listed in **<<NETA ATS>>**, Section 7.6.1.1**<< for circuit breakers used for service entrance and for circuit breakers larger than _____ amperes; for circuit breakers used for service entrance; for circuit breakers larger than _____**

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amperes; _____; or None - N/A>>. Tests listed as optional are **<< not required.; required.; not required, except for the following:; or _____>>**

1. Perform insulation-resistance tests on all control wiring with respect to ground.

D. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by **<<NFPA 70>>**.

E. Correct deficiencies and replace damaged or defective enclosed circuit breakers.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from circuit breaker enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 262816

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SECTION 262817
ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed safety switches.

1.02 RELATED REQUIREMENTS

A. Section **<< 260526 - Grounding and Bonding for Electrical Systems>>**.

B. Section **<< 260529 - Hangers and Supports for Electrical Systems>>**.

C. Section **<< 260553 - Identification for Electrical Systems>>**: Identification products and requirements.

D. Section **<< 260573 - Power System Studies>>**: Additional criteria for the selection of equipment and associated protective devices specified in this section.

E. Section **<< 262813 - Fuses>>**.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).

D. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems.

E. NFPA 70 - National Electrical Code.

F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.

H. UL 98 - Enclosed and Dead-Front Switches.

I. UL 869A - Reference Standard for Service Equipment.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by **<<NFPA 70>>**.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify **<<Architect>>** of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

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B. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.06 QUALITY ASSURANCE

A. Comply with requirements of **<<NFPA 70>>**.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature between **<< -22 degrees F>>** and **<< 104 degrees F>>** during and after installation of enclosed switches.

PART 2 PRODUCTS

2.01 ENCLOSED SAFETY SWITCHES

A. Manufacturers:
1. ABB: www.electrification.us.abb.com/#sle.
2. Eaton Corporation: www.eaton.com/#sle.
3. Schneider Electric: www.se.com/#sle.
4. Siemens Industry, Inc: www.siemens.com/#sle.

B. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with **<<UL 98>>**; **<< heavy duty; general duty; heavy or general duty as indicated; or _____>>**; ratings, configurations, and features as indicated**<< on the drawings; _____; or None - N/A>>**.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Properly size switches for number of poles and provide fused or non-fused as required for project conditions and to meet NFPA 70 requirements.
1. Neutral kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.
2. Auxiliary contact kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.

E. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
1. Altitude: Less than **<< 6,600 feet>>**.
2. Ambient Temperature: Between **<< -22 degrees F>>** and **<< 104 degrees F>>**.

F. Horsepower Rating: Suitable for connected load.

G. Voltage Rating: Suitable for circuit voltage.

H. Short Circuit Current Rating:

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1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section **<< 260573>>**.
2. Minimum Ratings:
   a. Heavy Duty Single Throw Switches Protected by **<< Class R; Class J; Class L; Class T; or _____>>** Fuses: **<< 200,000; or _____>>** rms symmetrical amperes.

I. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to **<<UL 869A>>**.

J. Provide with switch blade contact position that is visible when the cover is open.

K. Fuse Clips for Fusible Switches: As required to accept fuses indicated.

L. Conductor Terminations: Suitable for use with the conductors to be installed.

M. Provide insulated, groundable fully rated solid neutral assembly**<< where a neutral connection is required; where indicated; _____; or None - N/A>>**, with a suitable lug for terminating each neutral conductor.

N. Provide solidly bonded equipment ground bus **<< in each enclosed safety switch; where equipment grounding conductors are provided; or _____>>**, with a suitable lug for terminating each equipment grounding conductor.

O. Enclosures: Comply with **<<NEMA EN 10250>>**, and list and label as complying with **<<UL 50>>** and **<<UL 50E>>**.
   1. Environment Type per **<<NEMA EN 10250>>: << Unless otherwise indicated, as specified for the following installation locations:; As indicated on the drawings.; or _____ .>>**
      a. Indoor Clean, Dry Locations: Type 1.
      b. Outdoor Locations: Type 3R with raintight hubs.

P. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

Q. Fuse contacts and quick-make/quick-break jaws shall insure positive contacts with reinforcing spring clips or approved means.

R. Switches shall be front-operated.

S. Hinges: Noncurrent-carrying.

T. Switches shall be lockable in either open or closed position.

U. Type:
   1. Nonfused switches: General duty type on 120/208-volt or 120/240-volt systems, and heavy duty type on 277/480-volt or 240/480-volt systems.
   2. Fused switches: Heavy duty type.

V. Heavy Duty Switches:
   1. Comply with **<<NEMA BS 31047>>**.
   2. Conductor Terminations:
      a. Lug Material: **<< Aluminum, suitable for terminating aluminum or copper conductors; Copper, suitable for terminating copper conductors only; or _____>>**.
   3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed safety switches.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Provide fusible disconnect switches for all equipment. Provide one replacement fuse per disconnect switch.

B. Certain equipment, as indicated, shall be furnished with control panels and auxiliary control components. Mount the panels, furnish and install source wiring and disconnects, and completely connect controls and motors.

C. Provide source wiring, connections, and disconnects for mechanical heating, ventilating, and air-conditioning (HVAC) equipment specified in Division 23. Refer to sections of Division 23 for equipment and controls.

1. Provide weathertight enclosures for disconnects for outdoor equipment.
2. Mount starters, where required, and provide proper size overload protection.

D.

E. Install products in accordance with manufacturer's instructions. Install enclosed switches where indicated and as required for motor outlets or other equipment.

F. Provide an enclosed switch for each motor, as required by NFPA 70, except where it is provided in a panelboard within sight and easy reach of the motor, and provide wiring and connections from source.

G. Perform work in accordance with **<<NECA 1>>** (general workmanship).

H. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and **<<NFPA 70>>**.

I. Provide required support and attachment in accordance with Section **<< 260529>>**.

J. Install enclosed switches plumb.

K. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed **<< 79 inches>>** above the floor or working platform.

L. Provide grounding and bonding in accordance with Section **<< 260526>>**.

M. Provide fuses complying with Section **<< 262813>>** for fusible switches as indicated or as required by equipment manufacturer's recommendations.

N. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

O. Identify enclosed switches in accordance with Section **<< 260553>>**.

P. Provide neutral kit where required for four-wire applications.

Q. Provide auxiliary contact kit where indicated on drawings.

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3.03 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Inspect and test in accordance with **<<NETA ATS>>**, except Section 4.

C. Perform inspections and tests listed in **<<NETA ATS>>**, Section 7.5.1.1.

D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 262817

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SECTION 262913
ENCLOSED CONTROLLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed NEMA controllers for low-voltage (600 V and less) applications:
   1. Magnetic motor starters and combination starters.
   2. Manual motor starters.

B. Phase and voltage p

1.02 RELATED REQUIREMENTS

A. Section **<< 260553 - Identification for Electrical Systems>>**: Identification products and requirements.

B. Section 220513 - Common Motor Requirements for Plumbing Equipment.

C. Section 230513 - Common Motor Requirements for HVAC Equipment.

D. Section 230934 - Variable-Frequency Motor Controllers.

1.03 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.
   1. Include characteristic trip curves for each type and rating of overcurrent protective device included in the project.

B. Shop Drawings: Indicate dimensions, voltage, controller sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include wiring diagrams showing all factory and field connections.

C. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

D. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.
   1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.

1.04 QUALITY ASSURANCE

A. Comply with requirements of **<<NFPA 70>>**.

B. Source limitations: Obtain motor starters of a single type through one source from a single manufacturer.

1.05 COORDINATION

A. Coordinate layout and installation of motor starters with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for work space and for access.

B. Coordinate features, accessories, and functions of each motor starter with ratings and characteristics of supply circuit, motor, control sequence, and duty cycle of motor and load.
   1. Refer to wiring diagrams required in the sections specifying the

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PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ABB**<< ; _____; or None - N/A>>**: www.electrification.us.abb.com/#sle.

B. Eaton Corporation**<< ; _____; or None - N/A>>**: www.eaton.com/#sle.

C. Schneider Electric**<< ; _____; or None - N/A>>**: www.se.com/#sle.

D. Siemens Industry, Inc**<< ; _____; or None - N/A>>**: www.new.siemens.com/#sle.

E. Source Limitations: Provide enclosed motor controllers and associated components produced by **<< single manufacturer; same manufacturer as other electrical distribution equipment used for project; or _____>>** and obtained from single supplier.

2.02 ENCLOSED CONTROLLERS

A. Provide enclosed controller assemblies consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Enclosed controllers complying with **<<NEMA ICS 2>>**, and listed and labeled as complying with **<<UL 60947-1>>** and **<<UL 60947-4-1>>**; ratings, configurations and features as indicated**<< on the drawings; _____; or None - N/A>>**.

D. Enclosures:

1. Comply with **<<NEMA IA 10030>>**.
2. Environment Type per **<<NEMA EN 10250>>**: **<< Unless otherwise indicated, as specified for the following installation locations:; As indicated on the drawings.; or _____ .>>**
   a. Indoor Clean, Dry Locations: Type 1.
   b. Outdoor Locations: Type 3R.
   c. Kitchen Areas: Type 4X, stainless steel.
3. Finish: **<< Manufacturer's standard unless otherwise indicated; or _____>>**.

E. Magnetic Motor Starters: Motor starters and combination starters shall be across-the-line magnetic type, equal to Square D Company, Class 85326, Type S, rated in accordance with NEMA standards, sizes and horsepower ratings.

1. Contacts: Double-break silver-alloy type, replacement from the front without removing power wiring or removing the starter from its mounting.
2. Overload protection: Melting-alloy or bimetallic thermal overload device, one-piece construction, interchangeable, with reset button set in cover.
   a. Heaters in each phase: Matched to nameplate full-load current of the motor to which they connect and with appropriate adjustment for duty cycle.
3. Starter shall operate when protective relays are in place.
4. Combination starters shall be lockable in the OFF position.
5. Disconnecting switch for combination starters: NEMA KS 1, heavy-duty, nonfusible switch. Interlock with unit cover.

F. Control Circuit: 120-Volt.

1. Control power transformer: Primary voltage as required for the motor, 120-V secondary voltage; capacity to operate connected indicating and control devices and 100 percent spare capacity.

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2. Primary and secondary fuse protection for each control power transformer: Class CC fuses, current-limiting rejection type, rated 0.1 to 30 A, 600V, and 200 kA interrupting rating.

G. Auxiliary control contacts:
   1. One spare normally open and one spare normally
   2. Additional contacts required by the automatic temperature control system.

H. Selector switches, indicating lights, and identification on each motor starter cover, complete with wiring and interconnections to starter and auxiliary control contacts:
   1. Selector switch: Hand-Off-Automatic (HOA), heavy-duty.
   2. Indicating lights: Push-to-test, 30.5 mm or 22 mm, transformer type, LED or neon. Indications:
      a. Red for Stopped.
      b. Green for Running.
   3. Identification: Printed or engraved nameplates for HOA switch and for each indicating light.

2.03 MANUAL MOTOR STARTERS:

A. Enclosures: NEMA 250 Type 1 for interior use and NEMA 250 Type 3R for exterior or damp or wet locations.
   1. Mounting:
   2. Indicating lights mounted in enclosure.
   3. Engraved plastic identification plates.

B. Manual motor-starting switch: Equal to Square D Class 2510, single- or two-pole as required, with or without built-in thermal overload protection as indicated on drawings.

C. Switch: Toggle, quick-make and quick-break, with self-indicating, trip-free handle, and means for locking in OFF position.

D. Overload protection unit: Melting-alloy type, interchangeable; starter shall be inoperative if unit is removed.

2.04 PHASE AND VOLTAGE PROTECTION DEVICE

A. Device designed to protect 3-phase equipment from phase loss, under- and over-voltage events, and phase unbalance, with automatic reset. Basis of design product is ICM Controls ICM450; subject to compliance with requirements, provide the specified product.

B. Phase unbalance protection: Voltage, 2-20 percent adjustable.

C. Over- and under-voltage protection: Each 2-25 percent adjustable.

D. Phase loss protection: 25 percent of nominal for any phase; system will shut down and a fault will be recorded.

E. Delay on breaker timer: Control voltage 18-240 Vac; time delay 0-10 minutes, adjustable.

F. Fault interrogation delay: 0-15 seconds, adjustable, between fault detection and system shutdown, to eliminate nuisance trips and unnecessary shutdowns.

G. Temperatures: Control operating minus 40 to 75 degrees C, storage minus 40 to 80 degrees C; LCD operating minus 20 to 75 degrees C.

H. Mounting: Surface-mounted in separate enclosure with screws: screw terminals.

I. Enclosure: NEMA 250 Type 1, unless otherwise indicated.

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J. Indicator: LED display with buttons for setting, reading, and indicating faults.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install controllers in accordance with **<<NECA 1>>** (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and **<<NFPA 70>>**.

D. Provide required support and attachment in accordance with Section **<< 260529>>**. For equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For equipment not at walls, mount on lightweight structural-steel channels bolted to floor or to structure above ceiling.

E. Install enclosed controllers plumb and level.

F. Provide grounding and bonding in accordance with Section **<< 260526>>**.

G. Install all field-installed devices, components, and accessories.

H. Applications: Magnetic motor starters for all equipment unless otherwise specified or indicated on drawings.

I. Install starters, phase and voltage protection devices, auxiliary contacts, and automatic control devices furnished with equipment, except those that are already mounted on the equipment, fully wired and connected. See coordination requirements specified in Part 1 above.

J. Installing phase and voltage protection devices: Provide one device for each magnetic motor starter or combination starter indicated on the drawings.

1. Connect protection device output contacts in series with the control circuit of the starter so that when the protection devices drops out, the starter opens.
2. Install in separate enclosure, adjacent to starter.

K. Check the size of the overload protection, and change or adjust it as required, after the HVAC systems have been adjusted and balanced as specified in Section 230593 - Testing, Adjusting, and Balancing for HVAC.

3.02 FIELD QUALITY CONTROL

A. Provide services of a manufacturer's authorized representative to **<< observe installation and assist in inspection and testing; perform inspection and testing; or _____>>**. Include manufacturer's reports with submittals.

B. Inspect and test in accordance with **<<NETA ATS>>**, except Section 4.

3.03 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.04 CLEANING

A. Clean dirt and debris from controller enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 262913

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SECTION 263100
PHOTOVOLTAIC COLLECTORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Photovoltaic system requirements.

B. Photovoltaic modules.

C. Photovoltaic module mounting system.

D. Photovoltaic inverters.

E. Charge controllers.

F. Monitoring system.

1.02 RELATED REQUIREMENTS

A. Section **<< 260519 - Low-Voltage Electrical Power Conductors and Cables>>**.

B. Section **<< 260526 - Grounding and Bonding for Electrical Systems>>**.

C. Section **<< 260529 - Hangers and Supports for Electrical Systems>>**.

D. Section **<< 260553 - Identification for Electrical Systems>>**: Identification products and requirements.

E. Section **<< 262813 - Fuses>>**.

F. Section **<< 264300 - Surge Protective Devices>>**.

1.03 REFERENCE STANDARDS

A. IEC 61215-1 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 1: Test Requirements.

B. IEC 61215-1-1 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 1-1: Special Requirements for Testing of Crystalline Silicon Photovoltaic (PV) Modules.

C. IEC 61215-1-2 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 1-2: Special Requirements for Testing of Thin-Film Cadmium Telluride (CdTe) Based Photovoltaic (PV) Modules.

D. IEC 61215-1-3 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 1-3: Special Requirements for Testing of Thin-Film Amorphous Silicon Based Photovoltaic (PV) Modules.

E. IEC 61215-1-4 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 1-4: Special Requirements for Testing of Thin-Film Cu(In,GA)(S,Se)2 Based Photovoltaic (PV) Modules.

F. IEC 61215-2 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 2: Test Procedures.

G. IEEE 1547 - IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces.

H. NECA 1 - Standard for Good Workmanship in Electrical Construction.

I. NECA 412 - Standard for Installing and Maintaining Photovoltaic (PV) Power Systems.

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J. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

K. NFPA 70 - National Electrical Code.

L. UL 489B - Outline of Investigation for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures for Use with Photovoltaic (PV) Systems.

M. UL 1449 - Standard for Surge Protective Devices.

N. UL 1699B - Outline of Investigation for Photovoltaic (PV) DC Arc-Fault Circuit Protection; Current Edition.

O. UL 1703 - Flat Plate Photovoltaic Modules and Panels.

P. UL 1741 - Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment or other potential obstructions within the spaces dedicated for photovoltaic system components.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Roof-Mounted Arrays: Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
4. Notify **<<Architect>>** of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Utility Interconnection:

1. **<< Prepare and submit; Assist in preparing and submitting; or _____>>** documentation as required for securing utility interconnection agreement between **<<Owner>>** and Utility Company.
2. Preinstallation Meeting: Convene a minimum of two weeks prior to commencing work of this section to review interconnection requirements and details with Utility Company representative.
3. Coordinate with Utility Company to provide utility metering suitable for system requirements.
4. Arrange for inspections and secure permits necessary to obtain Utility Company approval of system.

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1.05 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>**, for submittal procedures.

B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, details, and description of operation.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product. Include ratings, configurations, standard wiring diagrams, outline and support point dimensions, finishes, weights, service condition requirements, and installed features.

D. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, attachment locations and details, and proposed size, type, and routing of conduits and cables. Include system interconnection schematic diagrams showing all factory and field connections.

E. Manufacturer's detailed field testing procedures.

F. Source quality control test reports.

G. Field quality control test reports.
   1. Include manufacturer's field reports.

H. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in **<<Owner>>**'s name and registered with manufacturer.

I. Maintenance contracts.

J. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.
   1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.

1.06 QUALITY ASSURANCE

A. Comply with **<<NFPA 70>>**.

B. Comply with Utility Company requirements for interconnection.

C. Electrical Designer Qualifications: Registered electrical engineer licensed in **<<the State in which the Project is located>>** experienced in the design of photovoltaic systems.

D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum **<< three; or _____>>** years**<< documented; _____; or None - N/A>>** experience.

E. Installer Qualifications: Company**<< specializing in performing the work of this section; _____; or None - N/A>>** with minimum **<< five; or _____>>** years**<< documented; _____; or None - N/A>>** experience with photovoltaic systems of similar size, type, and complexity.
   1. Licensed in **<<the State in which the Project is located>>** to install photovoltaic systems.
   2. Manufacturer's authorized installer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.08 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Specified warranties indicate minimum requirements. Provide additional warranties or extended warranty periods where required to qualify for rebate and incentive programs.

C. Photovoltaic Modules:
   1. Provide minimum **<< five; or _____>>** year manufacturer warranty covering repair or replacement due to defective materials or workmanship.
   2. Provide**<< linear; _____; or None - N/A>>** manufacturer warranty guaranteeing minimum **<< 90; or _____>>** percent of rated power output for **<< 10; or _____>>** years and minimum **<< 80; or _____>>** percent of rated power output for 25 years.

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PART 2 PRODUCTS

2.01 PHOTOVOLTAIC SYSTEM REQUIREMENTS

A. **<< Provide; Design and provide; or _____>>** complete photovoltaic system consisting of **<< photovoltaic modules; or _____>>** and associated balance of system components**<< necessary for connection to facility electrical system; necessary for connection to _____; _____; or None - N/A>>**.

B. System Description:

1. Photovoltaic array is **<< roof-mounted; ground-mounted; pole-mounted; or _____>><< in location indicated on the drawings; _____; or None - N/A>>**.
2. Orientation of array is **<< as indicated on the drawings; South; or _____>>**.
3. System **<< includes interconnection with utility grid (grid-tied system); does not include interconnection with utility grid (off-grid system); or _____>>**.
   a. Utility metering configuration: **<< Net metering; or _____>>**.
4. System **<< does not include; includes; or _____>>** battery storage system.
5. System **<< includes; does not include; or _____>>** DC system surge protection.
6. System **<< does not include; includes; or _____>>** monitoring system.

C. Capacity:

1. Minimum Expected Annual Energy Production: **<< _____ kWh; _____ percent of facility expected annual energy requirements; or _____>><< , as calculated by National Renewable Energy Laboratory's PVWatts calculator or approved equivalent; , as calculated by National Renewable Energy Laboratory's PVWatts calculator; , as calculated by _____; , _____; or None - N/A>>**.
2. Total Nominal Rated Power Output of Array: **<< Equal to or greater than the rated output of the basis of design array; _____ kW, rated under Standard Test Conditions (STC); or _____>>**.
3. Nominal Rated Power Output of Individual Modules: **<< Equal to or greater than the rated output of the basis of design module; _____ W, rated under Standard Test Conditions (STC); or _____>>**.

D. Size:

1. Array: **<< Designed to fit within the area designated on the drawings; Designed to fit within the same area as the basis of design array; Designed to fit within an area of _____; Array size is not critical; or _____>>**.
2. Individual Modules: **<< Size is not critical; Same exact size as basis of design module; _____ by _____ by _____ inches; or _____>>**.

E. Provide photovoltaic system and associated components suitable for wind loads, snow loads, seismic loads, and other structural design considerations of the installed location.

F. Provide photovoltaic system and associated components suitable for continuous operation under **<< the service conditions at the installed location.; the following service conditions:; or _____ .>>**

G. Provide products listed, classified, and labeled as suitable for the purpose intended.

H. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system.

I. DC Arc Fault Circuit Protection: Provide DC photovoltaic arc-fault protection devices listed as complying with **<<UL 1699B>>** as required for compliance with **<<NFPA 70>>**.

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J. Rapid Shutdown of Photovoltaic Systems on Buildings: Provide listed equipment arranged to provide rapid shutdown in accordance with **<<NFPA 70>>**.

K. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and **<<NFPA 70>>**.

L. Arrange array to minimize shading during peak production periods.

M. Roof-Mounted Arrays:

1. Arrange array such that normal roof drainage is not affected.
2. Arrange array to maintain required safety clearances from edges of roof **<< as indicated; as directed; as required by authority having jurisdiction; or _____>>**.
3. Arrange array to maintain access and clearance requirements for other roof-mounted equipment.
4. Arrange array to avoid spanning of expansion joints.

2.02 PHOTOVOLTAIC MODULES

A. Acceptable Module Types: **<< Either crystalline silicon or thin film modules complying with specified requirements will be considered for this project; Only crystalline silicon modules are acceptable. Thin film modules will not be considered for this project; Only thin film modules are acceptable. Crystalline silicon modules will not be considered for this project; or _____>>**.

B. General Requirements:

1. Photovoltaic Modules: Factory assembled; consisting of photovoltaic cells, frame, junction box, cables for series connection, and bypass diodes for shade tolerance; rated for 600 V DC; complying with **<<IEC 61215-1>>** and **<<IEC 61215-2>>** and listed as complying with **<<UL 1703>>**.
2. Crystalline Silicon Photovoltaic Modules: Comply with **<<IEC 61215-1-1>>**.
3. Thin Film Photovoltaic Modules: Comply with **<<IEC 61215-1-2>>**, **<<IEC 61215-1-3>>**, or **<<IEC 61215-1-4>>** as applicable.
4. Frame: Anodized aluminum.
5. Factory-Installed Junction Box: Weatherproof, with factory-installed terminals and bypass diodes.
6. Factory-Installed Cables: Type USE-2 or listed photovoltaic (PV) wire with polarized locking connectors.
7. Unless otherwise indicated, specified module performance characteristics are rated under Standard Test Conditions (STC).

2.03 BALANCE OF SYSTEM COMPONENTS

A. Photovoltaic Module Mounting System:

1. Provide complete mounting system compatible with modules to be installed and suitable to properly install them in the location indicated, including all necessary hardware and accessories.
2. Support Structure and Associated Hardware Materials: Use **<< aluminum; galvanized steel; stainless steel; or _____>>**.
3. Roof-Mounted Arrays:
   a. Acceptable System Types: **<< Either non-penetrating or penetrating systems complying with specified requirements will be considered for this project; Only non-penetrating systems are acceptable. Penetrating systems will not be**

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considered for this project; Only penetrating systems are acceptable. Non-penetrating systems will not be considered for this project; or _____>>.

b. Provide system compatible with the roof at the installed location.

c. Module Tilt Angle: **<< As required to provide maximum energy production for installed location; _____ degrees; No tilt; As indicated on drawings; or _____>>**.

d. Provide minimum clearance of **<< 3 inches; or _____ inches>>** between roof and module for air circulation and drainage.

B. Photovoltaic Inverters:

1. Provide inverter(s) as indicated or as required for connection of the photovoltaic array DC system to the AC system indicated.
2. Inverters: Suitable for the requirements of the connected array; output configuration compatible with connected system; listed as complying with **<<UL 1741>>**; furnished with the following features:
   a. Maximum power point tracking (MPPT).
   b. LCD display.
3. Grid-Tied Inverters: Comply with **<<IEEE 1547>>**, including over/under grid voltage and frequency protection, and anti-islanding protection to automatically disconnect upon loss of utility power and to remain disconnected until utility power restoration has been maintained for five minutes.
4. Total Harmonic Distortion: Less than **<< five; or _____>>** percent.
5. Enclosure Environment Type per **<<NEMA EN 10250>>**: **<< Unless otherwise indicated, as specified for the following installation locations:; As indicated on the drawings.; or _____ .>>**
   a. Indoor Clean, Dry Locations: **<< Type 1; or _____>>**.
   b. Outdoor Locations: **<< Type 3R; or _____>>**.

C. Surge Protective Devices, in Addition to Requirements of Section **<< 264300>>**:

1. Surge Protective Devices for DC System:
   a. Rated for **<< 600; or _____>>** V DC.
   b. Listed and labeled as complying with **<<UL 1449>>**, Type 1.
   c. Surge Current Rating: Not less than **<< 50 kA per mode; or _____>>**.
   d. **<<UL 1449>>** Nominal Discharge Current (I-n): 20 kA.

D. Molded-Case Circuit Breakers and Switches for DC System: Rated for **<< 600; or ____>>** V DC; listed as complying with **<<UL 489B>>**.

E. Monitoring System:

1. Provide a system to monitor photovoltaic system performance including all sensors, dataloggers, connections, software, equipment and accessories necessary for a complete operating system.
2. System communications interfaces to be **<< wired; wireless; or _____>>**, with compatible interconnected components.
   a. Provide suitable raceway, minimum **<< 3/4 inch; or _____ inch>>** trade size, for all required wired connections.
3. System to monitor and record**<< , in 15 minute intervals; , _____; or None - N/A>>**:
   a. Inverter status.
   b. Instantaneous power (kW).

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c. Cumulative energy production (kWh).

4. Energy Production Meter: Revenue grade, with accuracy of plus or minus two percent.
5. System real-time and historical data to be accessible from the following locations:
   a. Remote public display(s)**<< , quantity and location as indicated on the drawings; , _____; or None - N/A>>**.
6. System to provide alarm notification**<< via e-mail or instant message; _____; or None - N/A>>**.

2.04 SOURCE QUALITY CONTROL

A. Factory test the following products to verify operation and performance characteristics**<< . Include test reports with submittals; or None - N/A>>**.
   1. Photovoltaic modules.
   2. Photovoltaic inverters.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings and configurations of system components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive system components.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with **<<NECA 1>>** (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install photovoltaic system in accordance with **<<NECA 412>>**.

D. Provide required support and attachment in accordance with Section **<< 260529>>**.

E. Mount equipment such that the highest position of any operating handle for circuit breakers or switches does not exceed **<< 79 inches>>** above the floor, ground, or working platform.

F. Circuiting Requirements, in Addition to Requirements of Section **<< 260519>>**:
   1. Photovoltaic DC System Conductor Color Code:
   2. Maintain separation of photovoltaic and non-photovoltaic circuits in accordance with **<<NFPA 70>>**.

G. Grounding and Bonding Requirements, in Addition to Requirements of Section **<< 260526>>**:
   1. Ensure that there is only one AC System bonding connection between grounding system and grounded/neutral conductor, including external connections and connections internal to equipment.

H. Identification Requirements, in Addition to Those Specified in Section **<< 260553>>**:
   1. Use **<< identification nameplate; means of identification acceptable to authority having jurisdiction; or _____>>** to identify the presence of multiple power sources and the location of main service disconnecting means and each photovoltaic system disconnecting means. Locate **<< at main service disconnecting means and at each photovoltaic system disconnecting means; or _____>>**. Verify format and descriptions with authorities having jurisdiction.

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2. Use **<< identification nameplate; or _____>>** to identify each photovoltaic system disconnecting means**<< with text "PV SYSTEM DISCONNECT"; _____; or None - N/A>>**.
3. Use **<< identification nameplate; identification label; or _____>>** to identify systems equipped with rapid shutdown and associated rapid shutdown switch(es). Format, descriptions, and locations to comply with **<<NFPA 70>>** and requirements of authorities having jurisdiction.
4. Use **<< identification nameplate; identification label; or _____>>** to identify the information required by **<<NFPA 70>>** for marking of direct-current photovoltaic power sources. Locate at each DC disconnect means requiring marking.
5. Use **<< identification nameplate; identification label; or _____>>** to identify the interactive system point of interconnection at the disconnecting means as a power source and with the rated AC output current and the nominal operating AC voltage.
6. Use **<< warning labels; or _____>>** to identify electrical hazards for photovoltaic system disconnecting means. Include the word message **<< "Warning - Electric Shock Hazard; Terminals on the line and load sides may be energized in the open position"; or _____>><< or approved equivalent; _____; or None - N/A>>**.
7. Use **<< wire and cable markers; or _____>>** to identify photovoltaic system source, output, and inverter circuit conductors at all points of termination, connection, and splices.
8. Use **<< voltage markers; identification labels; stenciled text; suitable permanent marking approved by authority having jurisdiction; or _____>>** to identify exposed raceways, cable trays, pull boxes, junction boxes, and conduit bodies**<< with the text "Warning: Photovoltaic Power Source"; _____; or None - N/A>>** at maximum intervals of **<< 10 feet; or _____ feet>>** in accordance with **<<NFPA 70>>**.

3.03 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. See article "SYSTEM STARTUP" below for additional requirements related to testing and inspection.

C. Provide services of a manufacturer's authorized representative to **<< observe installation and assist in inspection and testing; perform inspection and testing; or _____>>**. Include manufacturer's **<< detailed testing procedures; field reports; and _____>>** with submittals.

D. Inspection and testing to include, at a minimum:
   1. Inspect each system component for damage and defects.
   2. Verify that equipment enclosures, boxes, and associated connections installed outdoors are weatherproof.
   3. Verify proper wiring connections have been made and check for conductor continuity. Verify proper polarity.
   4. Verify tightness of mechanical and electrical connections are according to manufacturer's recommended torque settings.
   5. Measure and record voltages at the inverter AC and DC inputs.
   6. Measure and record AC output power.
   7. Perform inverter functional test.
      a. Grid-Tied Inverters: Include simulation of loss of utility power and subsequent power restoration.

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8. Verify proper operation of monitoring system.

E. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

F. Repair roof or adjacent roof-mounted items damaged as a result of work of this section.

3.04 SYSTEM STARTUP

A. Obtain **<<Owner>>**'s approval prior to performing system startup.

B. Grid-Tied Systems: Obtain Utility Company's approval prior to performing system startup.

C. Prepare and start system in accordance with manufacturer's instructions.

3.05 CLEANING

A. Clean modules using only methods recommended by manufacturer to avoid scratches and other damage. Clean exposed surfaces on other components to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.06 MAINTENANCE

A. Provide to **<<Owner>><< , a proposal as an alternate to the base bid,; , at no extra cost,; , _____ ,; or None - N/A>>** a separate maintenance contract for the service and maintenance of photovoltaic system for **<< two years; or _____>>** from date of Substantial Completion, to include the work described below; Include a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.

END OF SECTION 263100

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SECTION 263213
ENGINE GENERATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Packaged engine generator system and associated components and accessories:
   1. Natural gas or Diesel engine with electronic generator set controls, governor, and voltage regulator.
   2. Generator set enclosure: located in outdoor, weather-protected, sound-attenuated enclosure.
   3. Generator remote annunciator and accessories.

1.02 RELATED REQUIREMENTS

A. Section **<< 033000 - Cast-in-Place Concrete>>**: Concrete equipment pads.

B. Section **<< 231113 - Facility Fuel-Oil Piping>>**:
   1. Diesel fuel piping.

C. Section **<< 231123 - Facility Natural-Gas Piping>>**.

D. Section **<< 235100 - Breechings, Chimneys, and Stacks>>**: Engine exhaust piping.
   1. Includes installation of exhaust silencer specified in this section.

E. Section **<< 260526 - Grounding and Bonding for Electrical Systems>>**.

F. Section **<< 260529 - Hangers and Supports for Electrical Systems>>**.

G. Section **<< 260553 - Identification for Electrical Systems>>**: Identification products and requirements.

H. Section **<< 263600 - Transfer Switches>>**.

1.03 REFERENCE STANDARDS

A. ASTM D975 - Standard Specification for Diesel Fuel.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

C. NECA/EGSA 404 - Standard for Installing Generator Sets.

D. NEMA MG 00001 - Motors and Generators.

E. NFPA 30 - Flammable and Combustible Liquids Code.

F. NFPA 37 - Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.

G. NFPA 70 - National Electrical Code.

H. NFPA 99 - Health Care Facilities Code.

I. NFPA 110 - Standard for Emergency and Standby Power Systems.

J. UL 142 - Steel Aboveground Tanks for Flammable and Combustible Liquids.

K. UL 1236 - Battery Chargers for Charging Engine-Starter Batteries.

L. UL 2085 - Protected Aboveground Tanks for Flammable and Combustible Liquids.

M. UL 2200 - Stationary Engine Generator Assemblies.

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1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate compatibility of generator sets to be installed with work provided under other sections or by others.
      a. Transfer Switches: See Section **<< 263600; or _____>>**.
   2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment or other potential obstructions within the spaces dedicated for engine generator system.
   3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   4. Coordinate the work to provide electrical circuits suitable for the power requirements of the actual auxiliary equipment and accessories to be installed.
   5. Notify **<<Architect>>** of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Preinstallation Meeting: Convene **<< one week; two weeks; or _____>>** before starting work of this section; require attendance of all affected installers.

1.05 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>**, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features. Include alternator starting capabilities, engine fuel consumption rates, and cooling, combustion air, and exhaust requirements.
   1. Include generator set sound level test data.
   2. Include characteristic trip curves for overcurrent protective devices.
   3. Include manufacturer's factory emissions certification
   4. Include alternator thermal damage curve.
   5. Documentation proving that generator provided has sufficient starting kVA to start the loads under any load sequence.
   6. Generator accessories:
      a. Batteries
      b. Battery charger
      c. Silencer
      d. Jacket heater
   7. Remote alarm annunciator panel.
   8. Enclosure components and accessories.

C. Bill of materials: Provide detailed list of components.

D. Shop Drawings: Include dimensioned plan views and sections, of specific project installation and location, indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections. Include fuel storage tank calculations indicating maximum running time for generator set configuration provided.

E. Source quality control test reports.

F. Provide **<<NFPA 110>>** required documentation from manufacturer**<< where requested by authorities having jurisdiction; _____; or None - N/A>>**, including but not limited to:
   1. Certified prototype tests.

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2. Torsional vibration compatibility certification.
3. **<<NFPA 110>>** compliance certification.
4. Certified rated load test at rated power factor.

G. Manufacturer's detailed field testing procedures.

H. Field quality control test reports.

I. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.

J. Maintenance contracts.

K. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.
1. Extra Fuses: **<< One; Two; or _____>>** of each type and size.
2. Extra Filter Elements: **<< One; Two; or _____>>** of each type, including fuel, oil and air.

1.06 QUALITY ASSURANCE

A. Comply with the following:
1. **<<NFPA 70>>** (National Electrical Code).
2. **<<NFPA 110>>** (Standard for Emergency and Standby Power Systems)**<< ; meet requirements for Level 1 system; ; meet requirements for Level 2 system; ; _____; or None - N/A>>**.
3. **<<NFPA 37>>** (Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines).
4. **<<NFPA 30>>** (Flammable and Combustible Liquids Code).

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum **<< three; or _____>>** years**<< documented; _____; or None - N/A>>** experience.
1. Authorized service facilities located within **<< 200 miles; 100 miles; _____ miles; or _____>>** of project site.

C. Installer Qualifications: Company**<< specializing in performing the work of this section; _____; or None - N/A>>** with minimum **<< three; or _____>>** years**<< documented; _____; or None - N/A>>** experience with engine generator systems of similar size, type, and complexity**<< ; manufacturer's authorized installer; ; _____; or None - N/A>>**.

D. Maintenance Contractor Qualifications: **<< Same entity as installer or different entity with specified qualifications; Same entity as installer; or _____>>**.
1. Contract maintenance office located within **<< 200 miles; 100 miles; or ___ miles>>** of project site.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

F. Emissions: Equipment shall be certified to U.S. EPA Stationary Emission Regulation, 40 CFR, Part 60.

G. Permits: Serve as the Owner's representative during the application process. Collect generator information, prepare and submit required applications for air quality construction and operational permits required by the State of Maryland Department of the Environment in

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compliance of state environmental regulations. Include payment for applicable permit costs. Approved permits and registration shall be issued to the Owner.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store generator sets in accordance with manufacturer's instructions and **<<NECA/EGSA 404>>**.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's instructions to avoid damage to generator set components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Provide minimum five year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

1. Warranty shall include all parts and labor with no deductible.

1.10 EXTRA MATERIALS

A. Furnish extraa materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every ten of each type and rating, but no fewer than one of each.
2. Indicator lamps: One for every five of each type used, but no fewer than two of each.
3. Filters: One set of each of lubricating oil, fuel, and combustion-air filters.

B. Provide fuel required for resting, re-testing, and demonstrations.

1.11 MAINTENANCE SERVICE

A. Initial maintenance service: Beginning at substantial completion, provide 12 months', full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in manufacture and installation of original equipment. Provide detailed service records from all services with 12 month service period to Owner for record.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Packaged Engine Generator Set:

1. Caterpillar Inc: www.cat.com/#sle.
2. Cummins Power Generation Inc: www.cumminspower.com/#sle.
3. Generac Power Systems: www.generac.com/industrial/#sle.
4. Rehlko: www.powersystems.rehlko.com/#sle.
5. Rolls-Royce Power Systems; MTU: www.mtu-solutions.com/#sle.

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B. Source Limitations: Furnish engine generator sets and associated components and accessories produced by single manufacturer and obtained from single supplier.

2.02 PACKAGED ENGINE GENERATOR SYSTEM

A. Provide **<< new; modifications and additions to existing; or _____>>** engine generator system consisting of all required equipment, sensors, conduit, boxes, wiring, piping, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. System Description:

1. Application: **<< Emergency/standby; Prime power; Continuous duty; or _____>>**.

D. Packaged Engine Generator Set:

1. Type: **<< Diesel (compression ignition); Gaseous (spark ignition); or _____>>**.
2. Power Rating: **<< _____ kW; As indicated on drawings; or _____>>**, **<< standby; prime; continuous; or _____>><< , including applicable derating adjustments; , _____; or None - N/A>>**.
3. Voltage: **<< As indicated on drawings; 208Y/120 V, 3 phase, 60 Hz; 480Y/277 V, 3 phase, 60 Hz; 240/120 V, 1 phase, 60 Hz; 240/120 V, 3 phase, 60 Hz; or _____>>**.
4. Main Line Circuit Breaker**<< Number One; Number Two; Number _____; _____; or None - N/A>>**:
   a. Type: **<< Thermal magnetic; Electronic trip with long time and short time delay and instantaneous pickup; or _____>>**.
   b. Trip Rating: **<< Select according to generator set rating; As indicated on drawings; _____ amps; or _____>>**.
   c. Circuit breaker shall conform to standards established by UL 489 and NFPA 70.

E. Generator Set General Requirements:

1. Prototype tested in accordance with **<<NFPA 110>>** for Level 1 systems.
2. Factory-assembled, with components mounted on suitable base.
3. List and label engine generator assembly as complying with **<<UL 2200>>**.
4. Power Factor: Unless otherwise indicated, specified power ratings are at 0.8 power factor for three phase voltages and 1.0 power factor for single phase voltages.
5. Provide suitable guards to protect personnel from accidental contact with rotating parts, hot piping, and other potential sources of injury.
6. Main Line Circuit Breakers: Provide factory-installed line side connections with suitable lugs for load side connections.

F. Service Conditions: Provide engine generator system and associated components suitable for operation under the service conditions at the installed location.

1. Altitude: Sea level to minimum 1000 feet.
2. Ambient Temperature: Between 5 to 40 degrees C.
3. Relative humidity: 0 to 95 percent.
4. Available Natural Gas Pressure: 7 to 11 inches water column.

G. Starting and Load Acceptance Requirements:

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1. Cranking Method: **<< Cycle cranking complying with NFPA 110 (15 second crank period, followed by 15 second rest period, with cranking limiter time-out after 3 cycles); or _____>>**, unless otherwise required.
2. Cranking Limiter Time-Out: If generator set fails to start after specified cranking period, indicate overcrank alarm condition and lock-out generator set from further cranking until manually reset.
3. Start Time: Capable of starting and achieving conditions necessary for load acceptance within **<< 10 seconds (NFPA 110, Type 10); or _____>>**.
4. Maximum Load Step: Supports **<< 100 percent of rated load in one step; or _____>>**.

H. Exhaust Emissions Requirements:
1. Comply with federal (EPA), state, and local regulations applicable at the time of commissioning**<< ; include factory emissions certification with submittals; ; _____; or None - N/A>>**.
2. Do not make modifications affecting generator set factory emissions certification without approval of manufacturer**<< and Engineer; _____; or None - N/A>>**. Where such modifications are made, provide field emissions testing as necessary for certification.

I. Sound Level Requirements:
1. Minimum sound attenuation of 25 dB at 500 Hz.
2. Do not exceed 85 dBA when measured at 10 feet from generator set in free field (no sound barriers) while operating at full load**<< ; include manufacturer's sound data with submittals; ; _____; or None - N/A>>**.

J. Interface with building automation system**<< as specified in Section ____; _____; or None - N/A>>**.

2.03 ENGINE AND ENGINE ACCESSORY EQUIPMENT

A. Provide engine with adequate horsepower to achieve specified power output at rated speed, accounting for alternator efficiency and parasitic loads.

B. Engine Fuel System - Diesel (Compression Ignition):
1. Fuel Source: Diesel**<< , ASTM D975 No. 2-D or approved cold weather diesel blends; , _____; or None - N/A>>**.
2. Fuel Storage: **<< Sub-base fuel tank; Main fuel tank (bulk tank) without day tank; Main fuel tank (bulk tank) with day tank; or _____>>**.
3. Engine Fuel Supply: Provide engine-driven, positive displacement fuel pump with replaceable fuel filter(s), water separator, check valve to secure prime, manual fuel priming pump, and relief-bypass valve. Provide fuel cooler where recommended by manufacturer.
4. Engine Fuel Connections: Provide suitable, approved flexible fuel lines for coupling engine to fuel source.
5. Sub-Base Fuel Tank:
   a. Provide sub-base mounted, double-wall fuel tank with secondary containment; listed and labeled as complying with **<< UL 142; UL 2085 (protected tank); or _____>>**.
   b. Tank Capacity: Size for minimum of **<< 24 hours; 48 hours; 72 hours; 96 hours; or _____>>** of continuous engine generator operation at 100 percent rated load, but not larger than permissible by applicable codes.
   c. Features:
      1) Direct reading fuel level gauge.

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2) Normal atmospheric vent.
3) Emergency pressure relief vent.
4) Fuel fill opening with lockable cap.
5) Dedicated electrical conduit stub-up area.

C. Engine Fuel System - Gaseous (Spark Ignition):
1. Fuel Source: **<< Natural gas; Propane (LP), vapor withdrawal; Propane (LP), liquid withdrawal; Dual fuel configuration; primary fuel of natural gas with automatic changeover to secondary fuel of propane (LP), vapor withdrawal; Dual fuel configuration; primary fuel of natural gas with automatic changeover to secondary fuel of propane (LP), liquid withdrawal; or _____>>**.
2. Engine Fuel Connections: Provide suitable, approved flexible fuel lines for coupling engine to fuel source.
3. Provide components/features indicated and as necessary for operation and/or required by applicable codes, including but not limited to:
a. Carburetor.
b. Gas pressure regulators.
c. Fuel shutoff control valves.
d. Low gas pressure switches.

D. Engine Starting System:
1. System Type: Electric, with DC solenoid-activated starting motor(s).
2. Battery(s):
a. Battery Type: **<< Lead-acid; Nickel-cadmium; or _____>>**.
b. Battery Capacity: Size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature; capable of providing cranking through **<< two; or _____>>** complete periods of cranking limiter time-outs without recharging.
c. Provide battery rack, cables, and connectors suitable for the supplied battery(s); size battery cables according to manufacturer's recommendations for cable length to be installed.
3. Battery-Charging Alternator: Engine-driven, with integral solid-state voltage regulation.
4. Battery Charger:
a. Provide dual rate battery charger with automatic float and equalize charging modes**<< and minimum rating of 10 amps; _____; or None - N/A>>**; suitable for maintaining the supplied battery(s) at full charge without manual intervention.
b. Capable of returning supplied battery(s) from fully discharged to fully charged condition within **<< 24 hours, as required by NFPA 110 for Level 1 applications; time required by NFPA 110 for Level indicated; 12 hours; _____ hours; or _____>>** while carrying normal loads.
c. Listed as complying with **<<UL 1236>>**.
d. Furnished with integral overcurrent protection; current limited to protect charger during engine cranking; reverse polarity protection.
e. Provide integral DC output ammeter and voltmeter with five percent accuracy.
f. Provide alarm output contacts as necessary for alarm indications.

E. Engine Speed Control System (Governor):
1. Single Engine Generator Sets (Not Operated in Parallel): Provide **<< electronic isochronous governor; electronic isochronous or mechanical governor; or _____>>** for controlling engine speed/alternator frequency.

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2. Frequency Regulation, Electronic Isochronous Governors: No change in frequency from no load to full load; plus/minus **<< 0.25; or _____>>** percent at steady state.

F. Engine Lubrication System:

1. System Type: Full pressure, with engine-driven, positive displacement lubrication oil pump, replaceable full-flow oil filter(s), and dip-stick for oil level indication. Provide oil cooler where recommended by manufacturer.

G. Engine Cooling System:

1. System Type: Closed-loop, liquid-cooled, with **<< unit-mounted radiator/fan and engine-driven coolant pump; or _____>>**; suitable for providing adequate cooling while operating at full load under worst case ambient temperature.
2. Fan Guard: Provide suitable guard to protect personnel from accidental contact with fan.
3. Coolant Heater: Provide thermostatically controlled coolant heater to improve starting under cold ambient conditions; size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature.

H. Engine Air Intake and Exhaust System:

1. Air Intake Filtration: Provide engine-mounted, replaceable, dry element filter.
2. Engine Exhaust Connection: Provide suitable, approved flexible connector for coupling engine to exhaust system.
3. Exhaust Silencer: Provide**<< hospital grade or better; critical grade or better; residential grade or better; industrial grade or better; _____; or None - N/A>>** exhaust silencer**<< with sound attenuation not less than basis of design; with minimum sound attenuation of _____dBA; _____; or None - N/A>>**; select according to manufacturer's recommendations to meet sound performance requirements, where specified.

2.04 ALTERNATOR (GENERATOR)

A. Alternator: **<< 4-pole, 1800 rpm (60 Hz output); or _____>>** revolving field, synchronous generator complying with **<<NEMA MG 00001>>**; connected to engine with flexible coupling; voltage output configuration as indicated, with reconnectable leads for 3 phase alternators.

B. Exciter:

1. Exciter Type: Brushless; **<< provide permanent magnet generator (PMG) excitation system; self-excited (shunt) systems are not permitted; either self-excited (shunt) or permanent magnet generator (PMG) excitation systems are permitted; or _____>>**.
2. PMG Excitation Short-Circuit Current Support: Capable of sustaining 300 percent of rated output current for 10 seconds.
3. Voltage Regulation (with PMG excitation): **<< Plus/minus 0.5 percent; or _____>>** for any constant load from no load to full load.

C. Temperature Rise: **<< Comply with UL 2200; or _____>>**.

D. Insulation System: **<<NEMA MG 00001>><< , Class H; , Class F or Class H; , _____; or None - N/A>>**; suitable for alternator temperature rise.

E. Enclosure: **<<NEMA MG 00001>>**, drip-proof.

F. Total Harmonic Distortion: Not greater than **<< five; or _____>>** percent.

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2.05 GENERATOR SET CONTROL SYSTEM

A. Provide microprocessor-based control system for automatic control, monitoring, and protection of generator set. Include sensors, wiring, and connections necessary for functions/indications specified.

B. Control Panel:

1. Control Panel Mounting: **<< Unit-mounted unless otherwise indicated; vibration isolated; Wall-mounted, located as indicated on the drawings; Wall-mounted, located _____; or _____>>**.
2. Generator Set Control Functions:
   a. Automatic Mode: Initiates generator set start/shutdown upon receiving corresponding signal from remote device (e.g. automatic transfer switch).
   b. Manual Mode: Initiates generator set start/shutdown upon direction from operator.
   c. Reset Mode: Clears all faults, allowing generator set restart after a shutdown.
   d. Emergency Stop: Immediately shuts down generator set (without time delay) and prevents automatic restarting until manually reset.
   e. Cycle Cranking: Programmable crank time, rest time, and number of cycles.
   f. Time Delay: Programmable for **<< shutdown (engine cooldown); start (engine warmup); and _____>>**.
   g. Voltage Adjustment: Adjustable through range **<< of plus/minus 5 percent; of _____; or _____>>**.
3. Generator Set Status Indications:
   a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
   b. Current (Amps): For each phase.
   c. Frequency (Hz).
   d. Real power (W/kW).
   e. Reactive power (VAR/kVAR).
   f. Apparent power (VA/kVA).
   g. Power factor.
   h. Duty Level: Actual load as percentage of rated power.
   i. Engine speed (RPM).
   j. Battery voltage (Volts DC).
   k. Engine oil pressure.
   l. Engine coolant temperature.
   m. Engine run time.
   n. Generator powering load (position signal from transfer switch).
4. Generator Set Protection and Warning/Shutdown Indications:
   a. Comply with **<<NFPA 110>>**; configurable for **<<NFPA 110>>** Level 1 or Level 2, or **<<NFPA 99>>** systems including but not limited to the following protections/indications:
      1) Overcrank (shutdown).
      2) Low coolant temperature (warning).
      3) High coolant temperature (warning).
      4) High coolant temperature (shutdown).
      5) Low oil pressure (shutdown).
      6) Overspeed (shutdown).

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7) Low fuel level (warning).
8) Low coolant level (warning/shutdown).
9) Generator control not in automatic mode (warning).
10) High battery voltage (warning).
11) Low cranking voltage (warning).
12) Low battery voltage (warning).
13) Battery charger failure (warning).

b. In addition to **<<NFPA 110>>** requirements, provide the following protections/indications:
1) High AC voltage (shutdown).
2) Low AC voltage (shutdown).
3) High frequency (shutdown).
4) Low frequency (shutdown).
5) Overcurrent (shutdown).

c. Provide contacts for local and remote common alarm.
d. Provide lamp test function that illuminates all indicator lamps.

5. Other Control Panel Features:
a. Event log.

C. Remote Annunciator:
1. Remote Annunciator Mounting: Wall-mounted; Provide **<< flush-mounted annunciator for finished areas and surface-mounted annunciator for non-finished areas unless otherwise indicated; flush-mounted or surface-mounted annunciator as indicated; or _____>>**.
2. Generator Set Status Indications:
a. Generator powering load (via position signal from transfer switch).
b. Communication functional.
3. Generator Set Warning/Shutdown Indications:
a. Comply with **<<NFPA 110>>**; configurable for **<<NFPA 110>>** Level 1 or Level 2, or **<<NFPA 99>>** systems including but not limited to the following indications:
1) Overcrank (shutdown).
2) Low coolant temperature (warning).
3) High coolant temperature (warning).
4) High coolant temperature (shutdown).
5) Low oil pressure (shutdown).
6) Overspeed (shutdown).
7) Low fuel level (warning).
8) Low coolant level (warning/shutdown).
9) Generator control not in automatic mode (warning).
10) High battery voltage (warning).
11) Low cranking voltage (warning).
12) Low battery voltage (warning).
13) Battery charger failure (warning).

b. Provide audible alarm with silence function.
c. Provide lamp test function that illuminates all indicator lamps.

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D. Remote Emergency Stop: Provide approved red, mushroom style remote emergency stop button where indicated or required by authorities having jurisdiction.

2.06 GENERATOR SET ENCLOSURE

A. Enclosure Type: **<< Sound attenuating, weather protective; Weather protective (non-sound attenuating); or _____>>**.

B. Enclosure Material: **<< Steel or aluminum; Aluminum; or _____>>**.

C. Hardware Material: **<< Stainless steel; or _____>>**.

D. Color: **<< Manufacturer's standard; Custom color to be selected by Architect; or _____>>**.

E. Access Doors: Lockable, with all locks keyed alike.

F. Openings: Designed to prevent bird/rodent entry.

G. External Drains: Extend oil and coolant drain lines to exterior of enclosure for maintenance service.

H. Sound Attenuating Enclosures: Line enclosure with non-hydroscopic, self-extinguishing sound-attenuating material.

I. Exhaust Silencers: Where exhaust silencers are mounted within enclosure in main engine compartment, insulate silencer to minimize heat dissipation as necessary for operation at rated load under worst case ambient temperature.

2.07 SOURCE QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

B. Perform production tests on generator sets at factory to verify operation and performance characteristics prior to shipment**<< . Include certified test report with submittals; _____; or None - N/A>>**.

1. Tests: Comply with NFPA 110, Level 1, energy converters.
2. Alternator tests: Comply with IEEE 115.
3. Equivalent components and accessories: Submit evidence that items furnished with the unit, but that are not identical to those on the prototype, are reliable and compatible with the application.

C. Generator Set production testing to include, at a minimum:

1. Operation at rated load and rated power factor.
2. Single step load pick-up.
3. Transient and steady state voltage and frequency performance.
4. Operation of safety shutdowns.

D. Diesel Fuel Storage Tanks: Perform pressurized leak test prior to shipment.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of generator sets and auxiliary equipment are consistent with the indicated requirements.

C. Verify that rough-ins for field connections are in the proper locations.

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D. Verify that mounting surfaces are ready to receive equipment.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with **<<NECA 1>>** (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install generator sets and associated accessories in accordance with **<<NECA/EGSA 404>>**.

D. Arrange equipment to provide minimum clearances and required maintenance access.

E. Unless otherwise indicated, mount generator set on properly sized, minimum **<< 6 inch; or _____>>** high concrete pad constructed in accordance with Section **<< 033000; or _____>>**.

F. Provide required support and attachment in accordance with Section **<< 260529>>**.

G. Use manufacturer's recommended oil and coolant, suitable for the worst case ambient temperatures.

H. Provide diesel fuel piping and venting in accordance with Section **<< 231113; or _____>>**, where not factory installed.

I. Provide engine exhaust piping in accordance with Section **<< 235100; or _____>>**, where not factory installed.

1. Include piping expansion joints, piping insulation, thimble, condensation trap/drain, rain cap, hangers/supports, etc. as indicated or as required.
2. Do not exceed manufacturer's maximum back pressure requirements.

J. Do not insulate piping for engine components restricted by manufacturer.

K. Install exhaust silencer in accordance with Section **<< 235100; or _____>>**, where not factory installed.

L. Provide grounding and bonding in accordance with Section **<< 260526>>**.

M. Identify system wiring and components in accordance with Section **<< 260553>>**.

3.03 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Provide services of a manufacturer's authorized representative to **<< prepare and start systems and perform inspection and testing; or _____>>**. Include manufacturer's **<< detailed testing procedures; field reports; and _____>>** with submittals.

C. Notify **<<Owner>>** and **<<Architect>>** at least **<< two weeks; or _____>>** prior to scheduled inspections and tests.

D. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

E. Provide all equipment, tools, and supplies required to accomplish inspection and testing, including load bank and fuel.

F. Preliminary inspection and testing to include, at a minimum:

1. Inspect each system component for damage and defects.
2. Verify tightness of mechanical and electrical connections are according to manufacturer's recommended torque settings.
3. Check for proper oil and coolant levels.

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G. Prepare and start system in accordance with manufacturer's instructions.

H. Perform acceptance test in accordance with **<<NFPA 110>>**.

I. Provide field emissions testing where necessary for certification.

J. Sound Level Tests: Measure sound levels for compliance with specified requirements. Identify and report ambient noise conditions.

K. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

L. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish. Clean components internally using methods and materials recommended by the manufacturer.

3.05 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of system to **<<Owner>>**, and correct deficiencies or make adjustments as directed.

B. Training: Train **<<Owner>>**'s personnel on operation, adjustment, and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two sessions of four consecutive hours of additional instruction time and training for each system specified in this section.

C. After successful acceptance test and just prior to Substantial Completion, replace air, oil, and fuel filters**<< and fill fuel storage tank; _____; or None - N/A>>**.

3.06 ACCEPTANCE TESTING

A. In addition to the factory and field tests required, peform a scheduled on-site test and demonstration of the completely installed generator before making final electrical connections.

B. Test shall be witness by the Owner's representative, and manufacturer's representative. Manufacturer's representative shall conduct demonstrations.

C. Provide and utilize load bank for testing. Load banks shall be capable of providing full load at 0.8 power factor.

D. Test procedures: Test the generator in accordance with NFPA 110 and as follows:
   1. Test the generator for at least two hours under full load, starting and stopping at least five times.
      a. The unit shall operate without undue noise or vibration, or excessive heating. Correct defects and retest until unit is operating satisfactorily.
      b. Demonstrate satisfactory operation of each feature required of the generator set and accessories.

3.07 PROTECTION

A. Protect installed engine generator system from subsequent construction operations.

3.08 MAINTENANCE

A. Provide to **<<Owner>><< a proposal as an alternate to the base bid,; at no extra cost,; _____; or None - N/A>>** a separate maintenance contract for the service and

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maintenance of engine generator system for **<< two years; or _____>>** from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, inspection, and testing, with a detailed schedule.

B. Provide trouble call-back service upon notification by **<<Owner>>**:
   1. Provide on-site response within **<< 4 hours; or _____>>** of notification.
   2. Include allowance for call-back service during normal working hours at no extra cost to **<<Owner>>**.
   3. **<<Owner>>** will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

END OF SECTION 263213

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SECTION 263600
TRANSFER SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Transfer switches for low-voltage (600 V and less) applications.

1.02 RELATED REQUIREMENTS

A. Section **<< 033000 - Cast-in-Place Concrete>>**: Concrete equipment pads.

B. Section **<< 142100 - Electric Traction Elevators>>**: For interface with transfer switch.

C. Section **<< 142400 - Hydraulic Elevators>>**: For interface with transfer switch.

D. Section **<< 260526 - Grounding and Bonding for Electrical Systems>>**.

E. Section **<< 260529 - Hangers and Supports for Electrical Systems>>**.

F. Section **<< 260553 - Identification for Electrical Systems>>**: Identification products and requirements.

G. Section **<< 260573 - Power System Studies>>**: Additional criteria for the selection of equipment specified in this section.

H. Section **<< 263213 - Engine Generators>>**: For interface with transfer switches.

1. Includes code requirements applicable to work of this section.
2. Includes additional testing requirements.
3. Includes related demonstration and training requirements.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. NEMA IA 10042-1 - Industrial Control and Systems Part 1: Electromechanical AC Transfer Switch Equipment.

D. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems.

E. NFPA 70 - National Electrical Code.

F. NFPA 110 - Standard for Emergency and Standby Power Systems.

G. UL 869A - Reference Standard for Service Equipment.

H. UL 1008 - Transfer Switch Equipment.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate compatibility of transfer switches to be installed with work provided under other sections or by others.
2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by **<<NFPA 70>>**.
3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.

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4. Coordinate the work with placement of supports, anchors, etc. required for mounting.
5. Notify **<<Architect>>** of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Preinstallation Meeting: Convene **<< one week; or _____>>** before starting work of this section; require attendance of all affected installers.

C. Where work of this section involves interruption of existing electrical service, arrange service interruption with **<<Owner>>**.

1.05 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>**, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features.

C. Shop Drawings: Include dimensioned plan views of this project's installation, and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.

D. Certifications:
1. Product certificate(s) signed by manufacturer certifying that products furnished comply with requirements and that switches have been tested for applicable load ratings and short-circuit closing and withstand ratings.

E. Source quality control test reports.

F. Manufacturer’s detailed field testing procedures.

G. Executed Warranty: Submit documentation of final executed warranty completed in **<<Owner>>**'s name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Comply with the following:
1. **<<NFPA 70>>** (National Electrical Code).
2. **<<NFPA 110>>** (Standard for Emergency and Standby Power Systems); meet requirements for system Level specified in Section **<< 263213>>**.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum **<< three; or _____>>** years**<< documented; _____; or None - N/A>>** experience.

C. Installer Qualifications: Company**<< specializing in performing the work of this section; _____; or None - N/A>>** with minimum **<< three; or _____>>** years**<< documented; _____; or None - N/A>>** experience with power transfer systems of similar size, type, and complexity**<< ; manufacturer's authorized installer; ; _____; or None - N/A>>**.

D. Maintenance Contractor Qualifications: **<< Same entity as installer or different entity with specified qualifications; Same entity as installer; or _____>>**.
1. Contract maintenance office located within **<< 200 miles; 100 miles; or ___ miles>>** of project site.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

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1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store transfer switches in accordance with manufacturer's instructions.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's instructions to avoid damage to transfer switch components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Provide minimum **<< one; two; five; or _____ >>** year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Transfer Switches:

1. ABB: www.electrification.us.abb.com/#sle.
2. Eaton Corporation: www.eaton.com/#sle.
3. Generac Power Systems: www.generac.com/industrial/#sle.
4. Rehlko: www.powersystems.rehlko.com/#sle.
5. Schneider Electric; ASCO Power Technologies: www.ascopower.com/#sle.
6. Source Limitations: Provide transfer switches and accessories produced by single manufacturer and obtained from single supplier.

2.02 TRANSFER SWITCHES

A. Provide complete power transfer system consisting of all required equipment, conduit, boxes, wiring, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Applications:

1. Utilize open transition transfer unless otherwise indicated or required.
2. Neutral Switching (Single Phase, Three Wire and Three Phase, Four Wire Systems):
   a. Unless otherwise indicated or required, provide solid (unswitched) neutral.
3. Provide signal before transfer contacts for transfer switches serving elevators.

D. Construction Type: **<< Either "contactor type" (open contact) or "breaker type" (enclosed contact) transfer switches complying with specified requirements are acceptable; Only "contactor type" (open contact) transfer switches are acceptable. Do not use "breaker type" (enclosed contact) transfer switches; Only "breaker type" (enclosed contact) transfer switches are acceptable. Do not use "contactor type" (open contact) transfer switches; or _____>>**.

E. Automatic Transfer Switch**<< Number _____; _____; or None - N/A>>**:

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1. Transfer Switch Type: **<< As indicated on the drawings; Automatic transfer switch; Bypass/isolation automatic transfer switch; Service entrance rated automatic transfer switch; Service entrance rated bypass/isolation automatic transfer switch; or _____>>**.
2. Transition Configuration: **<< As indicated on the drawings; Open-transition (no neutral position); Open-transition (no neutral position), utilizing in-phase monitor; Delayed-transition (with neutral position); Closed-transition; or _____>>**.
3. Voltage: **<< As indicated on the drawings; or _____>>**.
4. Ampere Rating: **<< As indicated on the drawings; or _____>>**.
5. Neutral Configuration: **<< Solid neutral (unswitched), except as indicated; Switched neutral; No neutral; As indicated on the drawings; or _____>>**.

F. ----------

G. Use the following paragraphs to specify basis of design products from selected manufacturers or use the paragraphs above to specify generic, nonproprietary descriptions.

H. ----------

I. ----------

J. ----------

K. Use the following paragraphs to specify basis of design products from selected manufacturers or use the paragraphs above to specify generic, nonproprietary descriptions.

L. ----------

M. ----------

N. Manual Transfer Switch**<< Number _____; _____; or None - N/A>>**:
1. Voltage: **<< As indicated on the drawings; or _____>>**.
2. Ampere Rating: **<< As indicated on the drawings; or _____>>**.
3. Neutral Configuration: **<< Solid neutral (unswitched), except as indicated; Switched neutral; No neutral; As indicated on the drawings; or _____>>**.

O. ----------

P. Use the following paragraphs to specify basis of design products from selected manufacturers or use the paragraphs above to specify generic, nonproprietary descriptions.

Q. ----------

R. ----------

S. Comply with **<<NEMA IA 10042-1>>**, and list and label as complying with **<<UL 1008>>** for the classification of the intended application (e.g. emergency, optional standby).

T. Do not use double throw safety switches or other equipment not specifically designed for power transfer applications and listed as transfer switch equipment.

U. Load Classification: Classified for total system load (any combination of motor, electric discharge lamp, resistive, and tungsten lamp loads with tungsten lamp loads not exceeding 30 percent of the continuous current rating) unless otherwise indicated or required.

V. Switching Methods:
1. Open Transition:
   a. Provide break-before-make transfer without a neutral position that is not connected to either source, and with interlocks to prevent simultaneous connection of the load to both sources.

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2. Obtain control power for transfer operation from line side of source to which the load is to be transferred.

W. Service Conditions: Provide transfer switches suitable for continuous operation at indicated ratings under the service conditions at the installed location.

X. Enclosures:
1. Environment Type per **<<NEMA EN 10250>>**: **<< Unless otherwise indicated, as specified for the following installation locations:; As indicated on the drawings.; or _____ .>>**
a. Indoor Clean, Dry Locations: **<< Type 1 or Type 12; or _____>>**.
b. Outdoor Locations: **<< Type 3R or Type 4; or _____>>**.
2. Provide lockable door(s)**<< for outdoor locations; where indicated; _____; or None - N/A>>**.
3. Finish: **<< Manufacturer's standard unless otherwise indicated; or _____>>**.

Y. Short Circuit Current Rating:
1. Withstand and Closing Rating: Provide transfer switches, when protected by the supply side overcurrent protective devices to be installed, with listed withstand and closing rating not less than the available fault current at the installed location as determined by short circuit study**<< performed in accordance with Section 260573; _____; or None - N/A>>**.

Z. Automatic Transfer Switches:
1. Description: Transfer switches with automatically initiated transfer between sources; electrically operated and mechanically held.
2. Control Functions:
a. Automatic mode.
b. Test Mode: Simulates failure of primary/normal source.
c. Voltage and Frequency Sensing:
1) Undervoltage sensing for each phase of primary/normal source; adjustable dropout/pickup settings.
2) Undervoltage sensing for alternate/emergency source; adjustable dropout/pickup settings.
3) Underfrequency sensing for alternate/emergency source; adjustable dropout/pickup settings.
d. Outputs:
1) Contacts for engine start/shutdown (except where direct generator communication interface is provided).
2) Auxiliary contacts; **<< one; two; or _____>>** set(s) for each switch position.
e. Adjustable Time Delays:
1) Engine generator start time delay; delays engine start signal to override momentary primary/normal source failures.
2) Transfer to alternate/emergency source time delay.
3) Retransfer to primary/normal source time delay.
4) Engine generator cooldown time delay; delays engine shutdown following retransfer to primary/normal source to permit generator to run unloaded for cooldown period.
f. In-Phase Monitor (Open Transition Transfer Switches): Monitors phase angle difference between sources for initiating in-phase transfer.

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g. Engine Exerciser: Provides programmable scheduled exercising of engine generator selectable with or without transfer to load; provides memory retention during power outage.

3. Status Indications:
   a. Connected to alternate/emergency source.
   b. Connected to primary/normal source.
   c. Alternate/emergency source available.
4. Automatic Sequence of Operations:
   a. Upon failure of primary/normal source for a programmable time period (engine generator start time delay), initiate starting of engine generator where applicable.
   b. When alternate/emergency source is available, transfer load to alternate/emergency source after programmable time delay.
   c. When primary/normal source has been restored, retransfer to primary/normal source after a programmable time delay. Bypass time delay if alternate/emergency source fails and primary/normal source is available.
   d. Where applicable, initiate shutdown of engine generator after programmable engine cooldown time delay.

AA. Manual Transfer Switches:
1. Description: Transfer switches with manually initiated transfer between sources; mechanically operated and mechanically held.

BB. Service Entrance Rated Transfer Switches:
1. Furnished with integral disconnecting and overcurrent protective device on the primary/normal source and with ground-fault protection where indicated.
2. Listed and labeled as suitable for use as service equipment according to **<<UL 869A>>**.

CC. Interface with Other Work:
1. Interface with engine generators as specified in Section **<< 263213>>**.
2. Interface with elevators as specified in Section **<< 142100; or 142400>>**.
3. Interface with building automation system**<< as specified in Section _____; _____; or None - N/A>>**.

2.03 SOURCE QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Perform production tests on transfer switches at factory to verify operation and performance characteristics prior to shipment**<< . Include certified test report with submittals; or None - N/A>>**.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of transfer switches are consistent with the indicated requirements.

C. Verify that rough-ins for field connections are in the proper locations.

D. Verify that mounting surfaces are ready to receive transfer switches.

E. Verify that conditions are satisfactory for installation prior to starting work.

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3.02 INSTALLATION

A. Perform work in accordance with **<<NECA 1>>** (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Arrange equipment to provide minimum clearances and required maintenance access.

D. Provide required support and attachment in accordance with Section **<< 260529>>**.

E. Install transfer switches plumb and level.

F. Unless otherwise indicated, mount floor-mounted transfer switches on properly sized **<< 3 inch; 4 inch; or _____>>** high concrete pad constructed in accordance with Section **<< 033000; or _____>>**.

G. Provide grounding and bonding in accordance with Section **<< 260526>>**.

H. Identify transfer switches and associated system wiring in accordance with Section **<< 260553>>**.

3.03 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Provide services of a manufacturer's authorized representative to **<< observe installation and assist in inspection and testing; prepare and start systems and perform inspection and testing; or _____>>**. Include manufacturer's **<< detailed testing procedures; field reports; and _____>>** with submittals.

C. Prepare and start system in accordance with manufacturer's instructions.

D. Automatic Transfer Switches:

1. Inspect and test in accordance with **<<NETA ATS>>**, except Section 4.
2. Perform inspections and tests listed in **<<NETA ATS>>**, Section 7.22.3. The insulation-resistance tests listed as optional are **<< not required; required, when approved by the manufacturer; or _____>>**.

E. Provide additional inspection and testing as required for completion of associated engine generator testing as specified in Section **<< 263213>>**.

F. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

3.04 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of transfer switches to **<<Owner>>**, and correct deficiencies or make adjustments as directed.

B. Training: Train **<<Owner>>**'s personnel on operation, adjustment, and maintenance of transfer switches.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

C. Coordinate with related generator demonstration and training as specified in Section **<< 263213>>**.

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3.06 PROTECTION

A. Protect installed transfer switches from subsequent construction operations.

END OF SECTION 263600

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SECTION 264100
FACILITY LIGHTNING PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. A complete lightning protection system for buildings as indicated on the drawings.

B. Grounding and bonding for lightning protection.

1.02 RELATED REQUIREMENTS

A. Section **<< 260526 - Grounding and Bonding for Electrical Systems>>**: Electrical system grounds.

B. Surge Protection for Wiring Systems: Specified in individual system requirements.

1.03 REFERENCE STANDARDS

A. NFPA 780 - Standard for the Installation of Lightning Protection Systems.

B. UL 96 - Lightning Protection Components.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination with Roofing Work: Ensure adequate attachment of strike terminals and conductors without damage to roofing. Coordinate with roofing manufacturer and installer.

B. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.

C. Coordinate installation of counterpoise conductor and ground rods with installation of other buried systems and components.

D. Preinstallation Meeting: Convene meeting at least **<< at least two weeks; or _____>>** prior to commencement of work affected by lightning protection system requirements to discuss prerequisites and coordination required by other installers; require attendance by representatives of installers whose work will be affected.

1.05 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Shop Drawings: Indicate location and layout of air terminals, grounding electrodes, and bonding connections to structure and other metal objects. Include terminal, electrode, and conductor sizes, and connection and termination details.

1. Include engineering analysis of equalization of potential to metal bodies within structure.

C. Product Data: Provide dimensions and materials of each component, indication of testing agency listing, and installation instructions.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Installation Certification: Submit copy of certification agency's approval.

F. Operation and Maintenance Data: Provide recommended inspection and testing plan, including recommended intervals, to achieve periodic maintenance as recommended in **<<NFPA 780>>**; provide customized plan reflecting actual installation configuration with specific installed components identified.

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G. Project Record Documents: Record actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors in project record documents.

1.06 QUALITY ASSURANCE

A. Maintain **<< one copy; or _____ copies>>** of**<< each; _____; or None - N/A>>** referenced system design standard on site.

B. Install system under the supervision of the manufacturer's authorized and approved representative qualified as follows:
   1. Actively engaged in the installation of lightning protection systems.
   2. Having satisfactory record of performance, including providing adequate service, as demonstrated by at least 5 systems of the same type, and similar size and duty, which have performed for not less than 2 years.
   3. Certified Member in good standing of the Lightning Protection Institute.

C. Designer Qualifications: Person or entity, employed by installer, who specializes in lightning protection system design with**<< minimum three years; _____; or None - N/A>>** documented experience.

D. Electrical components, devices, and accessories: Comply with applicable requirements of NFPA 70

E. Comply with NFPA 780, UL 96, and UL 96A.

F. Installer Qualifications: Capable of providing specified certification of installed system.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Lightning Protection Components:
   1. Advanced Light
   2. East Coast Lightning Equipment Inc.
   3. Bonded Lightning Protection Systems, Inc.
   4. Advanced Lighting
   5.
   6. nVent ERICO**<< ; System 2000; ; _____; or None - N/A>>**: www.nvent.com/#sle.

2.02 LIGHTNING PROTECTION SYSTEM

A. Lightning Protection System: Provide complete system complying with **<<NFPA 780>>**, including air terminals, bonding, interconnecting conductors and grounding electrodes.
   1. Provide system that protects:
      a. Entire structure.
      b. Open air areas within **<< 100 feet; or _____ feet>>** of exterior walls at grade level.
      c. Open air areas within building footprint.
   2. Coordinate with other grounding and bonding systems specified.
   3. Provide copper, bronze, or stainless steel components, except where aluminum is allowed by **<<NFPA 780>>**.
   4. Provide system certified by **<< Underwriters Laboratories or Lightning Protection Institute; Underwriters Laboratories; Lightning Protection Institute; or _____>>**.

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2.03 COMPONENTS

A. All Components: Complying with applicable requirements of **<<UL 96>>**.

B. Air terminals adn conductors: NFPA 780 Class 1 copper or aluminum, unless otherwise indicated.
   1. Air terminals: Blunt end. Air terminals shall be approved by Architect prior to installation.
   2. Stack-mounting air terminals: Solid copper.
   3. Air terminals installed on single-ply roof membrane: Designed for this application.
   4. Where conductors are underground, provide copper conductors and accessories.

C. Through-roof and through-wall connectors: Assembly for conductors passing through roof or wall penetrations to facilitate water-tight seal.

D. Ground rods, ground loop conductors, and concrete-encased electrods: Comply with Section 260526 and with standards referenced in this section.

E. Conduit: Schedule 40 PVC, minimum trade size 1 inch.

F. Surge Suppression: Provide a surge suppression device (SPD) at every system entrance location including power, communications, and low-voltage systems. SPDs shall be UL listed and comply with Section 264313.
   1. Power: Service entrance surge suppression at service distribution equipment.
   2. Communications systems: Surge suppression for communications services such as data, telephone, and cable television as specified in Division 27.
   3. Low-voltage systems: Surge suppression for low-voltage systems such as exterior wireless access points and exterior video surveillance as specified in Division 27 and 28.

G. Strike (Air) Terminals: **<< Copper; or Aluminum>><< , solid; or None - N/A>><< , with adhesive bases for single-ply roof installations; or None - N/A>>**.

H. Grounding Rods: **<< Solid copper; or Stainless steel>>**.

I. Ground Plate: Copper.

J. Conductors: **<< Copper; or Aluminum>><< cable; strip; solid rod; or ____>>**.

K. Connectors and Splicers: **<< Bronze; or Aluminum>>**.

PART 3 EXECUTION

3.01 INSTALLATION

A. Do not begin work until shop drawings have been approved. Notify Architect a minimum of 48 hours in advance of concealing lightning protection work.

B. Install in accordance with referenced system standards**<< and as required for specified certification; _____; or None - N/A>>**.

C. Install conductors with direct horizontal and downward paths from air terminals to ground connections. Avoid sharp bends and narrow loops; make no bends sharper than 90 degrees and minimum bending radius of 8 inches.

D. Conceal the following conductors unless otherwise indicated on drawings:
   1. Down conductors.
   2. Conductors inside building.
   3. Conductors in normal view from exterior locations at grade within 200 ft of building.
   4. Exposed conductors subject to damage.

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E. Connect conductors using mechanical connectors or exothermic welding process; protect adjacent construction elements and finishes from damage.

F. Air terminals shall not extend less than 10 inches above the objects they are to protect.
   1. Air terminals on single-ply membrane roofing: Comply with adhesive manufacturer's written instructions.

G. Counterpoise conductors shall be buried a minimum of 24 inches below finished grade.

H. Structural steel framing elements may be used in lieu of down conductors at intervals not exceeding 100 feet around perimeter of the building or structure. Ensure continuity of steel framing and bond to lightning protection ground electrode system.

3.02 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the prescence of moisture unless moisture is permanently excluded from junction of such materials.

B. Install conductors in conduit or with protective coatings and where conditions would cause deterioration or corrosion of conductors.

3.03 GROUNDING AND BONDING

A. Provide equipment grounding and bonding connections sufficiently tight to ensure permanent and effective grounds and bonds.

3.04 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

B. Perform visual inspection as specified in **<<NFPA 780>>** as if this were a periodic follow-up inspection.

C. Perform continuity testing as specified in **<<NFPA 780>>** as if this were testing for periodic maintenance.

D. Inspection: Provide an inspection by an inspector certified by LPI to obtain an LPI certification.
   1. Inspection shall be peformed in accordance with LPI-177, "Inspection Guide for Certified Systems". Submit one copy of LPI-177 and retain one copy at the site during construction.
   2. Document inspections on LPI forms. Submit one copy of each completed form.

E. Inspection: Provide an inspection by a UL field inspector certified by UL.
   1. Inspection shall be peformed in accordance with UL 96A and NFPA 780.

F. Ispection documents:
   1. Provide LPI Certification of the system. Obtain necessary LPI Master Installtion certificates with signatures, preparing and handling the necessary forms.
   2. Provide UL inspection and submit UL Master Label Certificate.

G. Obtain services of specified certification agency to provide inspection and certification of lightning protection system, including performance of other testing required by that agency.

END OF SECTION 264100

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SECTION 264300
SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surge protective devices (SPD) for the protection of electrical circuits from the effects of lightning-induced currents, substation switching transients, and internally generated transients resulting from inductive or capacitive load switching.

1.02 RELATED REQUIREMENTS

A. Section **<< 260526 - Grounding and Bonding for Electrical Systems>>**.

B. Section **<< 262413 - Switchboards>>**.

C. Section **<< 262416 - Panelboards>>**.

D. Section **<< 262419 - Motor-Control Centers>>**.

1.03 ABBREVIATIONS AND ACRONYMS

A. SPD: Surge Protective Device.

1.04 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems.

D. NFPA 70 - National Electrical Code.

E. UL 1449 - Standard for Surge Protective Devices.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate size and location of overcurrent device compatible with the actual surge protective device and location to be installed. Notify **<<Architect>>** of any conflicts or deviations from Contract Documents to obtain direction prior to ordering equipment.

1.06 SUBMITTALS

A. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.

B. Certificates: Manufacturer's documentation of listing for compliance with the following standards:

1. **<<UL 1449>>**.
    a. Voltage protection rating (VPR)
    b. Maximum continuous operating voltage (MCOV).
2. **<<UL 1283>>** (for Type 2 SPDs).

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C. Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.

D. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in **<<Owner>>**'s name and registered with manufacturer.

1.07 QUALITY ASSURANCE

A. Comply with requirements of **<<NFPA 70>>**.

B. Each SPD shall be UL 1449 Third Edition listed and labeled.

1.08 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in accordance with manufacturer's written instructions.

1.09 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Manufacturer's Warranty: Provide minimum ten year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.

C. Exclude surge protective devices from any clause limiting warranty responsibility for acts of nature, including lightning, stated elsewhere.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Field-Installed, Externally Mounted Surge Protective Devices:

1. Ditek Surge Protection: www.diteksurgeprotection.com
2. Advanced Protection Technologies
3. Eaton
4. Intermatic, Inc**<< ; _____; or None - N/A>>**: www.intermatic.com/#sle.
5. nVent ERICO**<< ; _____; or None - N/A>>**: www.nvent.com/#sle.
6. Schneider Electric**<< ; _____; or None - N/A>>**: www.se.com/#sle.
7. Surge Suppression, LLC (SSI)**<< ; _____; or None - N/A>>**: www.surgesuppression.com/#sle.

B. Source Limitations: Provide surge protective devices produced by single manufacturer and obtained from single supplier.

2.02 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated**<< on the drawings; _____; or None - N/A>>**.

B. Unless otherwise indicated, provide **<< field-installed, externally-mounted or factory-installed, internally-mouonted; field-installed, externally-mounted; factory-installed, internally-mounted; or _____>>** SPDs.

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C. List and label as complying with **<<UL 1449>>**, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.

D. Suppression components shall be MOV based, serviceable

E. Protected Modes:
   1. Wye Systems: L-N, L-G, N-G, L-L.

F. **<<UL 1449>>** Voltage Protection Ratings (VPRs):
   1. 208Y/120V System Voltage: Not more than **<< 1,200 V; 1,000 V; 800 V; 700 V; or _____>>** for L-N, L-G, and N-G modes and **<< 1,500 V; 1,200 V; or _____>>** for L-L mode.
   2. 240/120V System Voltage: Not more than **<< 1,200 V; 1,000 V; 800 V; 700 V; or _____>>** for L-N, L-G, and N-G modes and **<< 1,500 V; 1,200 V; or _____>>** for L-L mode.
   3. 480Y/277V System Voltage: Not more than **<< 2,000 V; 1,500 V; 1,200 V; or _____>>** for L-N, L-G, and N-G modes and **<< 2,500 V; 2,000 V; or _____>>** for L-L mode.

G. **<<UL 1449>>** Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.

H. SPD shall be equipped with the following:
   1. Visual LED diagnostics, including a minimum of one green LED indicator pher phase, and one red service LED.
   2. Audible alarm with on/off silence function and diagnostic test function.

I. Enclosure Environment Type per **<<NEMA EN 10250>>**: **<< Unless otherwise indicated, as specified for the following installation locations:; As indicated on the drawings.; or _____ .>>**
   1. Indoor clean, dry locations: **<< Type 1; Type 12; or _____>>**.
   2. Outdoor locations: **<< Type 3R; Type 4X; or _____>>**.

J. Mounting for Field-installed, Externally Mounted SPDs: **<< Unless otherwise indicated, as specified for the following locations:; As indicated on the drawings.; or _____>>**
   1. Provide surface-mounted SPD where mounted **<< in non-public areas; adjacent to surface-mounted equipment; or _____>>**.
   2. Provide flush-mounted SPD where mounted **<< in public areas; adjacent to flush-mounted equipment; or _____>>**.

K. Equipment Containing Factory-installed, Internally Mounted SPDs: Listed and labeled as a complete assembly including SPD.
   1. Switchboards: See Section **<< 262413>>**.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.

C. Verify system grounding and bonding is in accordance with Section **<< 260526>>**, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.

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D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with **<<NECA 1>>** (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and **<<NFPA 70>>**.

D. Unless indicated otherwise, connect service entrance surge protective device **<< on load side of service disconnect main overcurrent device; on line side of service disconnect main overcurrent device; or _____>>**.

E. Provide conductors with minimum ampacity **<< as indicated on the drawings; as required by NFPA 70; not less than manufacturer's recommended minimum conductor size; and _____>>**.

F. Install conductors between SPD and equipment terminations as short and straight as possible, not exceeding manufacturer's recommended maximum conductor length.**<< Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible.; or None - N/A>>** Twist conductors together to reduce inductance.

G. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section **<< 260526>>** where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.

H. Disconnect SPD prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPD connected.

3.03 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Inspect and test in accordance with **<<NETA ATS>>**, except Section 4.

C. Perform inspections and tests listed in **<<NETA ATS>>** Section 7.19.1.

3.04 CLEANING

A. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 264300

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SECTION 265100
INTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior luminaires.

B. Emergency lighting units.

C. Exit signs.

D. Drivers.

1.02 RELATED REQUIREMENTS

A. Section **<< 260529 - Hangers and Supports for Electrical Systems>>**.

B. Section **<< 260534 - Boxes for Electrical Systems>>**.

1.03 REFERENCE STANDARDS

A. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems.

B. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems.

C. NFPA 70 - National Electrical Code.

D. NFPA 101 - Life Safety Code.

E. UL 924 - Emergency Lighting and Power Equipment.

F. UL 1598 - Luminaires.

1.04 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>**, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.

1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
2. Provide photometric calculations where luminaires are proposed for substitution.

C. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

1.05 QUALITY ASSURANCE

A. Comply with requirements of **<<NFPA 70>>**.

B. UL label and local testing: As specified in Section 260500, Common Work Results for Electrical.

C. Fixtures, emergency lighting units, and accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to

D. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

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1.06 COORDINATION

A. Fixtures, mounting hardware, and trim: Coordinte layout and installation of lighting fixtures with ceiling system and

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Deliver glassware and lamps in their original cartons, clearly labeled.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.08 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Provide 3-year manufacturer warranty for LED luminaires

C. Provide 5-year manufacturer warranty for LED drivers.

1. Special warranty period for LED drivers: Five years from date of manufacture, but not less than four years from date of substantial completion.

D. Provide **<< 5-year; 3-year; or _____>><< pro-rata; full; _____; or None - N/A>>** warranty for batteries for emergency lighting units.

E. Provide 10-year warranty for batteries for self-powered exit signs.

F. Provide 10-year warranty for batteries. Full warranty shall apply for first year, and prorated warranty for last nine years.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

A. Basis of design: Furnish products as indicated in light fixture schedule included on the drawings.

B. Substitutions: Subject to complaince with requirements and per Division 01 specifications. Provide supporting documentation for each substitution, ensuring lighting design is equal or better, and that substitutions comply with the design criteria for this project.

C. Open protocol systems are only to be considered. Non-proprietary systems shall not be used. An example of an open protocol system is Bacnet IP protocols.

2.02 LUMINAIRES

A. Provide products that comply with requirements of **<<NFPA 70>>**.

B. Provide products that are listed and labeled as complying with **<<UL 1598>>**, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

G. Metal parts: Free from burrs, sharp corners, and edges.

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H. Doors, frames, and other internal access: Smoothly operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.

I. Metal finishes: Painted after fixture fabrication.

J. Reflecting surfaces: Minimum reflectances as follows, unless otherwise indicated:
   1. White surfaces: 85 percent.
   2. Specular surfaces: 83 percent.
   3. Diffusing specular surfaces: 75 percent.
   4. Laminated silver metalized film: 90 percent.

K. Lenses, diffusers, covers, and globes: 100 percent virgin acrylic or annealed crystal glass, unless otherwise indicated, exactly as scheduled or specified in optical details and lighting characteristics.
   1. Plastic: High resistance to yellowing and other changes due to aging, exposture to heat, and ultravoilet radiation.
   2. Lens thickness: 0.125 inch minimum, unless greater thickness is indicated.

L. Wire guards:
   1. Wire guards: 14 gauge welded wire guard, four foot length, baked white enamel, 2 inch by 2 inch grid pattern mounted with four hinge-latch clips with captive knurled thumb screws.

2.03 EMERGENCY LIGHTING UNITS

A. Description: Emergency lighting units complying with **<<NFPA 101>><< and all applicable state and local codes; _____; or None - N/A>>**, and listed and labeled as complying with **<<UL 924>>**.

B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

C. Battery:
   1. Size battery to supply all connected lamps, including emergency remote heads where indicated.

D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.

E. Provide low-voltage disconnect to prevent battery damage from deep discharge.

2.04 EXIT SIGNS

A. Description: Exit signs complying with **<<NFPA 101>><< and applicable state and local codes; _____; or None - N/A>>**, and listed and labeled as complying with **<<UL 924>>**.
   1. Number of Faces: Single- or double-face as indicated or as required for installed location.
   2. Directional Arrows: As indicated or as required for installed location.
   3. Exit signs shall meet the Energy Star Program requirements to operate on 5 W or less input power per face.
      a. Sign colors and lettering size: Comply with authorities having jurisdiction.

B. Powered Exit Signs: Internally illuminated with LEDs unless otherwise indicated.

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1. Lamps for AC operation: Light-emitting diodes, 70,000 hours minimum rated lamp life.
2. Self-Powered Exit Signs:
   a. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
   b. Battery: Sealed, maintenance-free, **<< nickel cadmium; or _____>>** unless otherwise indicated.
   c. Provide low-voltage disconnect to prevent battery damage from deep discharge.
   d. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by **<<NFPA 101>><< where indicated; _____; or None - N/A>>**; provide indicator light(s) to report test and diagnostic status.

C. Accessories:
1. Provide compatible accessory high-impact polycarbonate vandal shields**<< where indicated; for exit signs located _____; or None - N/A>>**.
2. Provide compatible accessory wire guards**<< where indicated; for exit signs located _____; or None - N/A>>**.

2.05 LED DRIVERS

A. Driver shall operate from a 120-volt or 277-volt, 60-Hz input power source and be suitable for outputting power to 12-volt or 24-volt LED lamp sources, as required.

B. Drivers, where specified, shall be capable of being dimmed. Dimmable drivers shall be controlled by a Class 2 low-voltage 0-10 VDC controller.

C. Performance Criteria
1. Driver shall have a Class A sound rating.
2. Driver shall have a power factor (PF) greater than 0.90.
3. Driver shall have Total Harmonic Distortion (THD) of input current equal to or less than 20 percent.
4. Driver shall meet FCC and Title 47 CFR regulations for EMI/RFI.
5. Driver shall comply with ANSI C62.41 Class A requirements for transient protection.

2.06 EMERGENCY LIGHTING CONTROL TRANSFER RELAY DEVICE

A. Internal type (single fixture): Self-contained, modular unit mounted within fixture body. UL 924 listed as "emergency lighting equipment" and UL listed for field installation.
1. Operation: Upon interruption of normal power source, solid-state control automatically switches connected lamps to emergency power supply for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
2. Capable of bypassing the local switching means when normal utility power has been lost.
3. Device shall consist of a test switch, normal power indicator light and an alternate power indicator light.
4. Rated for 120 through 277 volts AC, up to 3 amperes of lighting load.
5. Equal to Bodine, Model GTD.
6. Diagnostics: Provide accessible and visible multi-chromatic combination test switch/indicator light to display charge, test, and diagnostic status and to manually activate emergency operation.

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B. External type (multiple fixtures): Self-contained, modular unit mounted within accessible ceiling. UL 1008 listed as "automatic transfer switch" and UL listed for field installation.
   1. Capable of bypassing the local switching means when normal utility power has been lost.
   2. Device shall consist of a remote test switch, normal power indicator light and an alternate power indicator light in a common faceplate. This remote indicating station shallbe mounted in an accoustical ceiling tile or drywall ceiling near the device whenever the location of the transfer relay device is obstructed from view.
   3. Rated for 120 through 277 volts AC, up to 20 amperes of lighting load.
   4. Equal to Bodine, Model GTD20A.

2.07 LAMPS

A. Lamps - General Requirements:
   1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
   2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
   3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
   4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature; with a tolerance of plus or minus 100K and within a range of three macadam ellipses. Noticeable color temperature variation between adjacent lighting fixtures shall be considered a failure to meet these specifications and shall be replaced at no cost to the owner. Replace lamps that are determined by the **<<Architect>>** to be inconsistent in perceived color temperature.
   5. Minimum performance characteristics:
      a. Life: Minimum lumen maintenance of L70 at 50,000 hours, as defined by IES LM-80.
      b. Lumen Output: Based on absolute photometry, lumens (total luminous flux exiting the physical luminaire), as specified on contract documents and schedules.
      c. Color Rendering Index: Rated at a minimum of 85.

2.08 FIXTURE SUPPORT COMPONENTS

A. Comply with Section 260529.

B. Single-stem hangers: 1/2-inch steel tubing with swival ball fitting and ceiling canopy. Finish same as fixture.

C. Twin-stem hangers: Two, 1/2-inch steel tubes with single canopy arranged to mount a single fixture. Finish same as

D. Ro

E. Hook hangers: Intergrated assembly matched to fixture and line voltage, and equipped with threaded

F. Aircraft cable support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

2.09 FINISHES

A. Fixtures: Manufacturer's standard, unless otherwise indicated.
   1. Paint finish: Applied after fabrication over corrosion-resistant treament or primer, free of defects.
   2. Metallic finish: Corrosion-resitant.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with **<<NFPA 70>>**.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

C. Before ordering the light fixtures, consult with the installer of the ceiligns to ensure that the correct fixture trim is supplied and installed. Provide supports and accessories required for installation in each ceiling system.

D. Before ordering the light fixtures, verify the specified voltage with the voltage shown on the drawings, to ensure the correct voltage is supplied.

3.03 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section **<< 260534>>** as required for installation of luminaires provided under this section.

B. Install products in accordance with manufacturer's instructions.

C. Install luminaires securely, in a neat and workmanlike manner, as specified in **<< NECA 500 (commercial lighting); NECA 502 (industrial lighting); and _____>>**.

D. Provide required support and attachment in accordance with Section **<< 260529>>**.

E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

F. Where a letter designating fixture type is adjacent to a row of fixtures, it shall be understood that all fixtures in the row shall be of this type, consisting of the largest length units in rows, availlable to achieve desired total length indicated. Where the catalog numbers of the LED fixtures refer to 4-foot units, 8-foot units may be used where applicable.

G. Install accessories furnished with each luminaire.

H. Bond products and metal accessories to branch circuit equipment grounding conductor.

I. Emergency Lighting Units:

J. Exit Signs:

K. Fluorescent Emergency Power Supply Units:

L. Install lamps in each luminaire.

3.04 FIXTURE SUPPORT

A. Support from building structure: Provide fasteners appropriate to the supporting substrate, and wire, jack chain, or rods as specified for particular fixture types below:

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1. Provide channels bolted or welded between joists where required to obtain proper spacing for lighting supports.
2. Connections to joists or beams: Beam clamps. For wire supports, wrap wire securely around structural member.
3. Connections to concrete: Embedded, as specified in Section 260533 #.

B. In suspended plaster and drywall ceilings, fixtures may be supported fromthe suspended ceiling construction. Fasten box and fixture supports securely to suspension system. Where fixtures are surface mounted, cut neat holes in plaster as required for supports.

C. Recessed fixtures in suspended acoustical ceilings: Coordinate fixture installation with ceiling installers. Ensure that ceiling supports are located to clear fixtures.
1. Support from building structure: Use fasteners specified in Section 260533 #, and No. 10 wire.
a. Provide two supports for each individual LED fixture, one at each end of fixture. In continuous rows, install additional supports at each joint.

D. Lighting fixtures mounted in gymnasium with open bar joists: Attach to a structural channel attached to top of the joists with fixture mounted flush with the bottom of the joists, unless noted otherwise. Provide lenses with safety chains.

E. Surface mounted and stem-suspended LED fixtures on or below suspended acoustical ceilings: Supported from the building structure above with No. 10 wire.
1. Provide two supports for each individual lighting fixture, one at each end of fixture. In continuous rows, install an additional support at each joint.
2. Surface mounted fixtures mounted on low-density ceilings shall be provided with spacers where required.

F. Where it is necessary for a a fixture to be installed directly below an air duct, install two hanger rods, one on each side of the duct, bolted to a channel or angle suspended from the hangers below the duct, and support the fixtures from the suspended channel or angle.

3.05 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by **<<Architect>>**. Secure locking fittings in place.

B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by **<<Architect>>** or authority having jurisdiction.

C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by **<<Architect>>** or authority having jurisdiction.

3.06 CLEANING

A. Clean surfaces according to **<< NECA 500 (commercial lighting); NECA 502 (industrial lighting); manufacturer's instructions; and _____>>** to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

END OF SECTION 265100

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SECTION 265561
THEATRICAL LIGHTING SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provide, install and test a complete lighting control system as specified herein for areas indicated in the contract documents.

B. Furnish all conduit, wire, connectors, hardware and other incidental items necessary for the complete and proper operation of the lighting control system.

C. Coordinate all work described in this section with all other applicable plans and specifications.

1.02 REFERENCE STANDARDS

A. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information.

B. NFPA 70 - National Electrical Code.

1.03 SYSTEM DESCRIPTION

A. The system shall be design for the control of architectural and theatrical lighting and shall consist of factory pre-wire dimming and processing rack enclosures containing relays, power supplies, circuit breakers, terminals and/or control electronics.

1. Provide a CAT 6 control system based on a LAN control approach with DNODE and LAN patching capability. Refer to TL drawings for additional details. ***** MCPS Standard *****

1.04 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>**, for submittal procedures.

B. Project Record Documents: Provide 6 sets of full system submittals. Submittals shall include the following:

1. Full system riser diagrams illustrating interconnection of system components, wiring requirements, back box sizes and any special installation considerations.
2. Full set of printed technical data sheets.
3. Detailed set of dimmer schedules.
4. Detailed set of circuit and control schedules, including a complete list of all deviations from specifications

C. Provide any additional manufacturer information, including equipment demonstation to verify compliance with specifications.

D. Provide a minimum of 14 days notice to owner to schedule training of staff to utilize

1.05 QUALITY ASSURANCE

A. Comply with requirements of **<<NFPA 70>>**.

B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section who has been continuously engaged in the manufacturing of lighting control equipment for a minimum of ten years. All dimmer and cabinet fabrication shall take place in a U.S. manufacturing plant.

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C. Products: Listed, classified, and labeled as suitable for the purpose intended. Proposed equipment shall be UL and C-UL listed, and/or CE marked (where applicable) and bear the appropriate labels.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The equipment herein specified shall be manufatured by Electronic Theatre Controls.

B. Substitutions: **<< See Section 016000 - Product Requirements; or Not permitted>>**.
   1. Alternative manufacturers shall be of equal quality and design.

C. Permission to bid does not imply acceptance of the manufacturer. It is the sole responsibility of the electrical contractor to ensure that any price quotations received, and submittals made are for controls systems that meet or exceed the contract documents.

D. Electronic component models shall be commercially available for at least one (1) year prior to bid or be approved by the Owner.

E. All equipment and material shall be new.

F. All equipment shall be UL listed or built to UL standards.

2.02 GENERAL

A. All equipment shall be professional grade and rated for continuous duty. Basic guidelines have been prepared with manufacturer names, makes and model numbers included as minimum performance requirements. These shall be satisified unless a variance (separate document) is submitted and approved by the Owner.

B. System shall be installed and configured for simplicity of operation, with user-friendly controls.

C. Product quantity shall be for a complete and fully operable system. If any quantities are given, Theater Lighting Contractor shall provide at least the given amount. Some of the product listed under this section may not be required to fulfill the work as outlined.

D. Regardless of the length or completeness of the descriptive paragraphs listed herein, each device shall meet the published manufacturer's specifications.

2.03 LIGHTING CONTROL COMPONENTS

A. Lighting Dimming and Control System.
   1. 48 Pole Sensor:
      a. Acceptable Product: Sensor IQ48
   2. 24 Pole Sensor:
      a. Acceptable Product: Sensor IQ24
   3. Circuit Breaker with Relay:
      a. Sensor IQ SM B20
   4. 48 Pole Surface Mount Door:
      a. Sensor IQ Door 120-48
   5. 24 Pole Surface Mount Door:
      a. Sensor IQ Door 120-24S
   6. 7" Touch Screen
      a. Acceptable Product: Paradigm P-TS7-4
   7. Touch Screen Backbox:

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a. Acceptable Product: Paradigm P-LCD-FBB
8. Fader Station
   a. Acceptable Product: Paradigm PI1104-4
9. 1-gang Inspire Faceplate:
   a. Acceptable Product: Paradigm P-
10. Architectural Control Processor:
    a. Acceptable Product: Paradigm P-LCD-FBB
11. Station Power Module:
    a. Acceptable Product: Paradigm P-LCD-FBB
12. Wall Mount Enclosure:
    a. Acceptable Product: Paradigm P-LCD-FBB
13. 4-Port Gateway Enclosure:
    a. Acceptable Product: Paradigm P-LCD-FBB
14. 12-Port Opto-Splitter:
    a. Acceptable Product: Paradigm P-LCD-FBB
15. 48-Port Patch Panel:
    a. Acceptable Products:
       1) Tripp
       2) Hubbell
16. PoE Switch:
    a. Acceptable Products:
       1) Netgear
       2) Cisco
17. Wireless Access Point:
    a. Acceptable Products:
       1) Netgear
       2) Cisco
18. UPS:
    a.
       1) APC
       2) Middle Atlantic
19. DMX Control Unit
    a. Acceptable Product: ETC BSPS 6RD
20. 35RU Equipment Rack:
    a. Acceptable Product: Middle Atlantic DWR-35-26PD
21. 1-gang Surface Mount Box:
    a. Acceptable Product: ETC ECPB PB1
22. NET Plug-in Station:
    a. Acceptable Product: ETC ECPB NET
23. Emergency Control:
    a. Acceptable Product: ETC SC1008

B. CONSOLE
   1. Auditorium Console:

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a. Acceptable Product: ETC GIO. Provide with dust cover. 24" Touch Screen Monitor (Qty: 2).

2. TV Studio Console:
   a. Accpetable Product: ETC XE-20-2K US. 24" Touch Screen Monitor (QTY: 1).

C. DISTRIBUTION
1. 1st and 2nd Electrics
   a. Acceptable Product: ETC 9956-(16AO/8)(16X/1)-X-XX
2. 3rd and 4th Electrics
   a. Acceptable Product: ETC 9956-(12AO/8)(12X/1)-X-XX
3. 10' Raceway
   a. Acceptable Product: ETC CSR10-3A/1-3X-X-111
   b. Provide with Hanger Bracket - ETC CSR HS WALL 111
4. 60' Raceway
   a. Acceptable Product: ETC CSR60-16A/4-16X-X-134
   b. Provide with Hanger Bracket - ETC HB CATWALK 134
5. 60' Raceway
   a. Acceptable Product: ETC CSR60-15A/4-15X-X-134
   b. Provide with Hanger Bracket - ETC HB CATWALK 134
6. TV Studio Outlet Box
   a. Acceptable Product: ETC 9102A-DMX

D. LIGHTING FIXTURES AND ACCESSORIES
1. Auditorium Fixture Types:
   a. Type A
2. TV Studio Fixture Types:
   a. Type A

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PART 3 EXECUTION

3.01 INSTALLATION

A. It shall be the responsibility of the Electrical Contractor to receive and store the necessary materials and equipment for installation of the dimmer system. It is the intent of these contract documents to include everything required for proper and complete installation and operation of the dimming system, even though every item may not be specifically mentioned. The contractor shall deliver on a timely basis to other trades any equipment that must be installed during construction.

B. The Electrical Contractor shall be responsible for field measurements and coordinating physical size of all equipment with the architectural requirements of the spaces into which they are to be installed.

C. Install components in accordance with manufacturer's instructions and approved shop drawings.

D. All branch load circuits shall be live tested before connecting the loads to the dimmer system load terminals.

3.02 MANUFACTURER'S SERVICES

A. Upon completion of the installation, including testing of load circuits, the contractor shall notify the dimming system manufacturer that the system is available for formal checkout.

B. Notification shall be provided in wriring, a minimum of 14 days prior to the time factory-trained personnel are needed on the job site.

C. No power is to be applied to the dimming system unless specifically authorized by written instructions from the manufacturer.

D. The purchaser shall be liable for any return visits by the factory engineer as a result of incomplete or incorrect wiring.

E. Upon completion of the formal check-out, the factory engineer shall demonstrated operation and maintenance of the system to the owner's representatives. Training shall not exceed four working hours. Addit

3.03 WARRANTY

A. Manufacturer shall warrant products under normal use and service to be free from defects in materials and workmanship for a period of 2 years from date of delivery.

B. Warranty shall cover repair or replacement of such parts determined defective upon inspection.

C. Warranty does not cover any product or part of a product subject to accident, negligence, alteration, abuse or misuse. Warranty does not cover any accessories or parts not supplied by the manufacturer.

D. Warranty shall not cover any labor expended or materials sused to repair any equipment without manufacturer's prior written authorization.

END OF SECTION 265561

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SECTION 265568
EXTERIOR ATHLETIC LIGHTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Sports lighting system using an LED lighting source for the following:
   1. Stadium football/soccer field.

1.02 REFERENCE STANDARDS

A. AASHTO LTS - Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

B. ASCE 7-10 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

E. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.

F. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

G. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.

H. IES LM-5-04 - IESNA Guide for Photometric Measurements of Area and Sports Lighting Installments.

I. IES RP-6 - Recommended Practice: Lighting Sports and Recreational Areas.

J. NECA 1 - Standard for Good Workmanship in Electrical Construction.

K. NFPA 780 - Standard for the Installation of Lightning Protection Systems.

L. UL 96 - Lightning Protection Components.

M. UL 96A - Standard for Installation Requirements for Lightning Protection Systems.

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1.03 SUBMITTALS

A. Product Data: For each type of lighting product.
   1. Include data on features, accessories, and finishes.
   2. Include physical description and dimensions of the luminaires.
   3. Include data on drivers, UL listing and recognition, ANSI certification, and Energy Independence and Security Act of 2007 compliance.
   4. Include data on LEDs, including life, output (lumens, CCT, and CRI), and energy-efficiency.

B. Shop Drawings:
   1. Include plans, elevations, sections, and mounting and attachment details.

2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and LED light sources.

D. Coordination Drawings: Plans drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Luminaires.
2. Luminaire support structures.
3. Limits of athletic fields.
4. Proposed underground utilities and structures.
5. Existing underground utilities and structures.
6. Athletic field support structures.

E. Foundation Drawings: Stamped by a registered engineer in the State of Maryland. The foundation drawings shall list the moment, shear (horizontal) force, and axial (vertical) force at ground level for each pole.

F. Glare Control: Environmental glare impact scans showing the maximum candela from the field edge on a map of the surrounding area until 500 candelas or less is achieved.

G. Spill Scans: Indicating the amount of horizontal and vertical footcandles along the specified lines. Light levels shall be taken at 30-foot intervals along the boundary line. Readings shall be taken with the meter orientation at both horizontal and aimed towards the most intense bank of lights. Illumination level shall be measured in accordance with the IESNA LM-5-04 after 1 hour warm up.

H. Photometric Report: For luminaire types proposed showing horizontal and vertical axial candle power to demonstrate the capability of achieving the specified performance. Reports shall be certified by a qualified independent testing laboratory with a minimum of five years' experience or by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products. A summary of the horizontal and vertical aiming angles for each luminaire shall be included with the photometric report.

I. Life-Cycle Costs: 25-year life cycle cost calculation based on energy cost, lamp replacement cost, and general maintenance.

J. Field quality-control test reports.

K. Sample Warranty: For manufacturer's maintenance warranty and light levels warranty.

L. Operation and maintenance data.

M. LEED Submittal:
1. Product data:
a. Energy and Atmosphere (EA), Prerequisite "Minimum Energy Performance": For minimum energy performance.
b. Sustainable Sites (SS), Credit "Light Pollution Reduction": For light pollution reduction.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this project.

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B. System components shall be UL listed for the appropriate application.

1.05 WARRANTY

A. Special Warranties:
   1. Maintenance Warranty: Manufacturer shall monitor the performance of the lighting system, including on/off status, hours of usage, and luminaire outage for 25 years from the date of equipment shipment. Warranty shall include preventative and spot maintenance, including parts and labor for 25 years from the date of equipment shipment. Parts and labor shall be covered such that individual luminaire outages will be repaired when the usage of any field is materially impacted. Owner agrees to check fuses in the event of a luminaire outage.
      a. Communication Costs: Maintenance warranty shall include communication costs for operating the controls and monitoring system for a period of 25 years.
   2. Light Levels Warranty: Manufacturer shall supply a signed warranty covering the entire system for 25 years from the date of shipment. Warranty shall guarantee that specified light levels do not drop below specified target values for a period of 25 years. Manufacturer shall maintain specifically-funded financial reserves to assure fulfillment of the warranty for the full term. Warranty shall not cover weather conditions and events such as lightning or hail damage, improper installation, vandalism or abuse, unauthorized repairs or alterations, or products made by other manufacturers.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Exterior Athletic Lighting Manufacturers:
   1. Basis-of-Design: Musco; Light-Structure System, with TLC for LED products.
   2. Sportsbeams Lighting, Inc.

2.02 LIGHTING PERFORMANCE

A. Illumination Levels and Design Factors: Playing surfaces shall be lit to an average target illumination level and uniformity as specified in the chart below. Lighting calculations shall be developed and field measurements taken on the grid spacing with the minimum number of grid points specified below. Appropriate light loss factors shall be applied and submitted for the basis of design. Average illumination level shall be measured in accordance with **<<IES LM-5-04>>**. Illumination levels shall not drop below desired target values in accordance to **<<IES RP-6>>** Page 2, "Maintained Average Illuminance" and shall be guaranteed for the full warranty period.

Area of Lighting	Average Target Illumination Levels	Maximum to Minimum Uniformity Ratio	Grid Points	Grid Spacing
Football/Soccer	50 footcandles	2.0 : 1.0	72 football 96 soccer	30' x 30'

B. Hours of Usage: Designs shall be based on the following hours of usage:

Area of Lighting	Annual Usage Hours	25-Year Usage Hours
Football/Soccer	300	7,500

C. Color: The lighting system shall have a minimum color temperature of 5700K and a CRI of 65.

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D. Mounting Heights: To ensure proper aiming angles for reduced glare and to provide better playability, minimum mounting heights shall be as described below. Higher mounting heights may be required based on photometric report and ability to ensure the top of the field angle is a minimum of 10 degrees below horizontal. Please refer to published plans for mounting heights.

2.03 SYSTEM DESCRIPTION

A. Sports lighting system shall consist of the following:
   1. Galvanized steel poles and cross-arm assembly.
      a. Direct bury steel poles which utilize the extended portion of the steel shaft for their foundation will not be accepted due to potential for internal and external corrosive reaction to the soils and long term performance concerns.
   2. Concrete foundations:
      a. For a foundation using a pre-stressed concrete base embedded in concrete backfill, the concrete shall be air-entrained and have minimum compressive design strength of 3,000 PSI at 28 days. 3,000 PSI concrete specified for early pole erection; actual required minimum allowable concrete strength is 1,000 PSI. Piers and concrete backfill must bear on and against firm undisturbed soil.
      b. For anchor bolt foundations or foundations using a pre-stressed concrete base in a suspended pier or reinforced pier design, pole erection may occur after 7 days, or after a concrete sample from the same batch achieves certain strength.
   3. Drivers and Supporting Electrical Equipment:
      a. Remote drivers and supporting electrical equipment shall be mounted approximately 10 feet above grade in aluminum enclosures. The enclosures shall be touch-safe and include drivers and fusing with indicator lights on fuses to notify when a fuse is to be replaced for each luminaire. Disconnect per circuit for each pole structure will be located in the enclosure.
      b. Alternate: Integral drivers mounted at the top of the pole will require a pole mounted enclosure approximately 10 feet above grade. The enclosure shall include a disconnect per circuit and surge protection.
   4. Manufacturer shall provide surge protection at the pole equal to or greater than 40 kA for each line to ground (Common Mode) as recommended by **<<IEEE C62.41.2>>**.
   5. Wire harness complete with an abrasion protection sleeve, strain relief and plug-in connections for fast, trouble-free installation.
   6. Luminaires, visors, and cross-arm assemblies shall withstand 150 mph winds and maintain luminaire aiming alignment.
   7. Control cabinet to provide remote on-off control and monitoring of the lighting system. See Article below for further details.
   8. Manufacturer shall provide lightning protection grounding as defined by **<<NFPA 780>>** and be UL Listed per **<<UL 96>>** and **<<UL 96A>>**.
      a. Provide integrated grounding via concrete encased electrode grounding system.
      b. If grounding is not integrated into the structure, the manufacturer shall supply grounding electrodes, copper down conductors, and exothermic weld kits. Electrodes and conductors shall be sized as required by **<<NFPA 780>>**. The grounding electrode shall be minimum size of 5/8-inch diameter and 8 feet long, with a minimum of 10 feet embedment. Grounding electrode shall be connected to the structure by a grounding electrode conductor with a minimum size of 2 AWG for poles with 75 feet mounting height or less, and 2/0 AWG for poles with more than 75 feet mounting height.

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B. Light Control Luminaires: Luminaires shall utilize spill light and glare control devices including, but not limited to, internal shields, louvers and external shields.

C. Criteria:

1. Environmental Light Control: Minimize spill light to adjoining properties and glare to the players, spectators, and neighbors.
2. Control and Monitoring: Provide remote on/off control for the sports lighting system. Fields shall be proactively monitored to detect luminaire outages over a 25-year life cycle. Communication and monitoring costs for 25-year period shall be included in the bid.

2.04 SYSTEM CONSTRUCTION

A. Manufacturing Requirements: Components shall be designed and manufactured as a system. Luminaires, wire harnesses, drivers and other enclosures shall be factory assembled, aimed, wired and tested.

B. Durability: Exposed components shall be constructed of corrosion resistant material and/or coated to help prevent corrosion. Exposed carbon steel shall be hot dip galvanized per **<<ASTM A123/A123M>>**. Exposed aluminum shall be powder coated with high performance polyester or anodized. Exterior reflective inserts shall be anodized, coated, and protected from direct environmental exposure to prevent reflective degradation or corrosion. Exposed hardware and fasteners shall be stainless steel of 18-8 grade or better, passivated and coated with aluminum-based thermosetting epoxy resin for protection against corrosion and stress corrosion cracking. Structural fasteners may be carbon steel and galvanized meeting **<<ASTM A153/A153M>>** and ISO/EN 1461 (for hot dipped galvanizing), or **<<ASTM B695>>** (for mechanical galvanizing). Wiring shall be enclosed within the cross-arms, pole, or electrical components enclosure.

2.05 ELECTRICAL

A. Electric Power Requirements for Exterior Athletic Lighting:

1. Electric Power: 480 volts, 3-phase.
2. Maximum Total Voltage Drop: Voltage drop to the disconnect switch located on the poles shall not exceed three percent of the rated voltage.

2.06 STRUCTURAL PARAMETERS

A. Wind Loads: Wind loads shall be based on the applicable version of the Maryland Building Code. Wind loads to be calculated using **<<ASCE 7-10>>**, with ultimate design wind speed and exposure category as indicated on Drawings.

B. Pole Structural Design: The stress analysis and safety factor of the poles shall conform to **<<AASHTO LTS>>**.

C. Foundation Design: The foundation design shall be based on soil parameters as outlined in the geotechnical report.

2.07 LIGHTING CONTROL

A. Instant On/Off Capabilities: System shall provide for instant on/off of luminaires.

B. Lighting contactor cabinet(s) shall be constructed of NEMA Type 4 aluminum, designed for easy installation with contactors, and labeled to match field diagrams and electrical design. Manual off-on-auto selector switches shall be provided.

C. Remote Monitoring System: System shall monitor lighting performance and notify manufacturer if individual luminaire outage is detected so that appropriate maintenance can be scheduled.

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The controller shall determine switch position (manual or auto) and contractor status (open or closed).

D. Management Tools: Manufacturer shall provide a web-based database and dashboard tool of actual field usage and provide reports by facility and user group. Dashboard shall also show current status of luminaire outages, control operation and service. Mobile application shall be provided suitable for iOS and Android devices.

E. Hours of Usage: Manufacturer shall provide a means of tracking actual hours of usage for the field lighting system that is readily accessible to the owner.
   1. Cumulative hours: shall be tracked to show the total hours used by the facility.
   2. Report hours saved by using early off and push buttons by users.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

B. Examine roughing-in for luminaire electrical and communications conduit to verify actual locations of connections before pole or luminaire installation.

C. Examine foundations for suitable conditions where luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with **<<NECA 1>>**.

B. Wiring Method: Install cables in raceways, except when cables are installed within boxes and poles. Conceal raceways and cables.

C. Coordinate layout and installation of luminaires with other construction.

D. Install poles and other structural units level, plumb, and square.

E. Install luminaires at height and aiming angle as indicated on drawings.

F. Except for embedded structural members, grout void between pole base and foundation. Use **<<ASTM C1107/C1107M>>** non-shrinking or expanding concrete grout firmly packed in entire void space. Use a short piece of 1/2-inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

3.03 SOIL QUALITY CONTROL

A. Notify the Owner if soil conditions exist other than those on which the foundation design is based, or if the soil cannot be readily excavated.
   1. Submit engineered foundation embedment design by a registered engineer in the State of Maryland for soils other than specified soil conditions.
   2. Submit additional materials required to achieve alternate foundation; include excavation and removal of materials other than normal soils, such as rock, caliche, etc.

3.04 FIELD QUALITY CONTROL

A. Illumination Measurements: After installing sports lighting system and after electrical circuits have been energized, in the presence of the Owner or Owner's representative, perform proof-of-performance illumination field measurements and analysis for compliance with requirements.
   1. Football Fields: Measure a minimum of 90 points, equally spaced.

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2. Make field measurements at established test points in areas of concern for spill light and glare.
3. Perform analysis to demonstrate correlation of field measurements with specified illumination quality and quantity values and corresponding computer-generated values that were submitted with engineered design documents. Submit a report of the analysis. For computer-generated values, use manufacturer's lamp lumens that are adjusted to lamp age at time of field testing.
4. The illumination field measurements shall be conducted in accordance with **<<IES LM-5-04>>**.

B. Correction of illumination deficiencies for playing areas: Make corrections to illumination quality or quantity, measured in field quality-control tests, that varies from specified illumination criteria by plus or minus 10 percent.
1. Add or replace luminaires; change mounting height and aiming; or install louvers, shields, or baffles.
2. If luminaires are added or mounting height is changed, revise aiming and recalculate and modify or replace support structures if indicated.
3. Do not replace luminaires with units of higher or lower wattage without Architect's approval.
4. Retest as specified above after repairs, adjustments, or replacements are made.
5. Report results in writing.

C. Correction of excessive illumination in spill-light-critical areas: If measurements indicate that specified limits for spill light are exceeded, make corrections to illumination quantity, measured in field quality-control tests that reduce levels to within specified maximum values.
1. Replace luminaires; change mounting heights and revise aiming; or install louvers, shields, or baffles.
2. Obtain Architect's approval to replace luminaires with units of higher or lower wattage.
3. If mounting height is changed, revise aiming and recalculate and modify or replace support structures if indicated.
4. Retest as specified above after repairs, adjustments, or replacements are made.
5. Report results in writing.

D. Sports lighting will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Field Light Level Accountability:
1. Light levels shall be guaranteed not to fall below the target maintained light levels for the entire warranty period of 25 Years.
2. Perform similar illumination field measurements one year from the date of commissioning of the sports lighting system in the presence of the Owner or Owner's representative.
3. The contractor/manufacturer will be held responsible for changes needed to bring these fields back to compliance for light levels and uniformities. Contractor/manufacturer will be held responsible for any damage to the fields during these repairs.
4. Report results in writing.

END OF SECTION 265568

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SECTION 265600
EXTERIOR LIGHTING

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section **<< 033000 - Cast-in-Place Concrete>>**: Materials and installation requirements for concrete bases for poles.

B. Section **<< 260526 - Grounding and Bonding for Electrical Systems>>**.

C. Section **<< 260529 - Hangers and Supports for Electrical Systems>>**.

D. Section **<< 260534 - Boxes for Electrical Systems>>**.

E. Section **<< 260923 - Lighting Control Devices>>**.

F. Section **<< 262726 - Wiring Devices>>**.

1.02 REFERENCE STANDARDS

A. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing.

B. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code).

C. IEEE C2 - National Electrical Safety Code(R) (NESC(R)).

D. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.

E. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information.

F. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products.

G. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources.

H. NECA 1 - Standard for Good Workmanship in Electrical Construction.

I. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems.

J. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts.

K. NFPA 70 - National Electrical Code.

L. UL 844 - Luminaires for Use in Hazardous (Classified) Locations.

M. UL 1598 - Luminaires.

N. UL 1598C - Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits.

O. UL 1993 - Self-Ballasted Lamps and Lamp Adapters.

P. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

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1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.
2. Notify **<<Architect>>** of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.04 SUBMITTALS

A. Shop Drawings:
1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Provide photometric calculations where luminaires are proposed for substitution**<< upon request; for substitutions; or None - N/A>>**.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
1. LED Luminaires:
a. Include estimated useful life, calculated based on **<<IES LM-80>>** test data.
b. Include **<<IES LM-79>>** test report**<< upon request; where indicated; for proposed substitutions; _____; or None - N/A>>**.
c. Arrange in order of luminaire designation.
d. Include data on features, accessories, and finishes.
e. Include physical description and dimensions of luminaire.
f. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
g. Photometric data and adjustment factors based on laboratory tests,
h. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
i. Confirmation of compliance with Design Lighting Consortium (DLC) or ENERGY STAR product requirements.
2. Provide electronic files of photometric data**<< certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency; certified by an independent testing agency; _____; or None - N/A>>** in **<<IES LM-63>>** standard format**<< upon request; where indicated; for proposed substitutions; _____; or None - N/A>>**.
3. Source: Include rated life and initial and mean lumen output.
4. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.

C. Samples:
1. Provide **<< one; or _____>>** sample(s) of each**<< specified; _____; or None - N/A>>** luminaire**<< where indicated; upon request; _____; or None - N/A>>**.

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D. Certificates for Poles and Accessories: Manufacturer's documentation that products are suitable for the luminaires to be installed**<< and comply with designated structural design criteria; _____; or None - N/A>>**.

E. Field Quality Control Reports.
   1. Include test report indicating measured illumination levels.
   2. Include emergency lighting test reports.

F. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

G. Maintenance Materials: Furnish the following for **<<Owner>>**'s use in maintenance of project.
   1. See Section **<< 016000 - Product Requirements>>**, for additional provisions.
   2. Extra Drivers: **<< Two; or _____>>** percent of total quantity installed for each type, but not less than **<< one; or _____>>** of each type.
   3. Extra Fuses: **<< Five; or _____>>** percent of total quantity installed for each type, but not less than **<< two; or _____>>** of each type.

H. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

1.05 QUALITY ASSURANCE

A. Comply with requirements of **<<NFPA 70>>**.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum **<< three; five; or _____>>** years**<< documented; _____; or None - N/A>>** experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, handle, and store products according to **<<NECA/IESNA 501>>** and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

C. Receive, handle, and store wood poles in accordance with **<<ANSI O5.1>>**.

1.07 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Manufacturer's standard form in which manufacturer agrees to repair or replace components that fail in materials or workmanship or from transient voltage surges, and the Contractor agrees to provide associated electrical work within the specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure equipment to operate, or to operate reliably.
      b. Damage of electronic components due to transient voltage surges.
   2. Warranty Period: Five years from date of Final Acceptance for material and labor.

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1.08 SUBSTITUTIONS

A. In Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
   1. Basis of Design Product: The design of each luminaire and its support is based on the first product named. Subject to compliance with requirements, provide either the named product or a comparable product by another manufacturer.

B. The lighting fixture layout indicated in the Contract Documents is based upon photometric data, quality, construction and appearance of fixtures listed in the lighting fixture schedule. Substitutions of listed fixtures are allowed provided the following is provided:
   1. Substitution package shall be submitted to Architect no later than fifteen (15) days prior to bid for review and approval.
   2. Provide all data for the substitution package in a table similar in format to the lighting fixture schedule on the drawings.
   3. Provide cut sheets of substitute fixtures with the various features highlighted.
   4. Architect has final functional and aesthetic approval on all substituted fixtures.
   5. Pre-bid approved will still be subject to the usual post bid submittal process and review.

PART 2 PRODUCTS

2.01 LUMINAIRES

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. UL Compliance: Comply with UL 1598 and listed for wet location.

D. CRI of minimum 70, CCT of 4100 K

E. L70 life of 50,000 hours.

F. ~~Lamps~~ Dimmable from 100 percent to 10 percent of maximum light output.

G. Internal driver.

H. Nominal Operating Voltage: Provide Universal Voltage (120V-277V) driver where possible. Otherwise provide per the drawings.

I. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.02 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

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1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

2.03 POLES

A. All Poles:
1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.
2. Structural Design Criteria:
a. Comply with **<< AASHTO LTS; or _____>>**.
b. Wind Load: Include effective projected area (EPA) of luminaire(s) and associated supports and accessories to be installed.
1) Design Wind Speed: **<< 110 miles per hour>><< , with gust factor of 1.3; , _____; or None - N/A>>**.
c. Dead Load: Include weight of proposed luminaire(s) and associated supports and accessories.
d. Include structural calculations demonstrating compliance with submittals.
3. Material, shape, finish, and height as indicated on the drawings.
4. Mounting: **<< Install on concrete foundation, height as indicated on the drawings; Install on _____ high concrete foundation; Direct bury; or _____>>**, unless otherwise indicated.
5. Unless otherwise indicated, provide with the following features/accessories:
a. Handhole located 18" above pole base unless otherwise indicated.
b. Anchor bolts with **<< leveling nuts; leveling shims; or _____>>**.
c. **<< Anchor base cover; Anchor bolt covers; or _____>>**.
d. Provision for pole-mounted weatherproof GFI receptacle**<< where indicated; _____; or None - N/A>>**.
e. Brackets where indicated.
f. Internal chain vibration dampener for poles over 25'-0" in height.

B. Metal Poles: Provide ground lug, accessible from **<< handhole; transformer base; or _____>>**.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with **<<NFPA 70>>**.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

F. Verify existing and proposed utility structures prior to the start of wor

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section **<< 260534>>** as required for installation of luminaires provided under this section.

B. Perform work in accordance with **<<NECA 1>>** (general workmanship).

C. Install products in accordance with manufacturer's instructions.

D. Install luminaires in accordance with **<<NECA/IESNA 501>>**.

E. Provide required support and attachment in accordance with Section **<< 260529>>**.

F. Fasten luminaire to structural support.

G. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on the drawings.

H. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artifical light sources, favoring a north orientation.

I. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

J. Recessed Luminaires:

1. Install trims tight to mounting surface with no visible light leakage.
2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.

K. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to **<< center; bottom; or _____>>** of luminaire.

L. Pole-Mounted Luminaires:

1. Maintain the following minimum clearances:
   a. Comply with **<<IEEE C2>>**.
   b. Comply with utility company requirements.
2. Foundation-Mounted Poles:
   a. Provide cast-in-place concrete foundations for poles as indicated, in accordance with Section **<< 033000>>**.

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1) Install anchor bolts plumb per template furnished by pole manufacturer.
2) Position conduits to enter pole shaft.

b. Install foundations plumb.

c. Install poles plumb, using **<< leveling nuts; shims; or _____>>** as required to adjust to plumb.

d. Tighten anchor bolt nuts to manufacturer's recommended torque.

e. Install non-shrink grout between pole anchor base and concrete foundation, leaving small channel for condensation drainage.

f. Install **<< anchor base covers; anchor bolt covers; or _____>>** as indicated.

3. Embedded Poles: Install poles plumb as indicated.

4. Grounding:

a. Bond **<< luminaires; metal accessories; metal poles; foundation reinforcement; and _____>>** to branch circuit equipment grounding conductor.

b. Provide **<< supplementary ground rod electrode; or _____>>** as specified in Section **<< 260526>>** at each pole bonded to grounding system as indicated.

5. Install separate service conductors**<< , 12 AWG copper,; , size as indicated on drawings,; , _____ ,; or None - N/A>>** from each luminaire down to handhole for connection to branch circuit conductors.

M. Bollard Luminaires:

1. Align units for optimum directional alignment of light distribution.
2. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth.

N. Corrosion Prevention:

1. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
2. Steel Conduits: In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

O. Individual Ground-Mounted Luminaires:

1. Aim as indicated on Drawings.
2. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in **<< 033000>>**

P. Install accessories furnished with each luminaire.

3.04 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Inspect each product for damage, defects, and overall cleanliness. All components shall be fully installed/secured, all lenses shall be free from debris.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy drivers as determined by **<<Architect>>**.

E. Measure illumination levels at night with calibrated meters**<< to verify compliance with performance requirements; _____; or None - N/A>><< . Record test results in written report to be included with submittals; _____; or None - N/A>>**. Test

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emergency lighting units and power supplies. Interrupt power supply for amount of time luminaire is rated for to demonstrate proper operation upon loss of normal power. Verify transfer from normal power to emergency power and re-transfer to normal power. Prepare test report.

3.05 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by **<<Architect>>**. Secure locking fittings in place.

B. Luminaires with Field-Rotatable Optics: Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by **<<Architect>>**.

3.06 CLEANING

A. Clean surfaces according to **<<NECA/IESNA 501>>** and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. See Section **<< 017800 - Closeout Submittals>>**, for closeout submittals.

B. See Section **<< 017900 - Demonstration and Training>>**, for additional requirements.

C. Demonstration: Demonstrate proper operation of luminaires to **<<Architect>>**, and correct deficiencies or make adjustments as directed.

3.08 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

END OF SECTION 265600

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SECTION 265613
LIGHTING POLES AND STANDARDS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Poles and accessories for support of luminaires.

1.03 DEFINITIONS

A. EPA: Equivalent projected area.

B. Luminaire: Complete lighting fixture.

C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.

D. Standard: See "Pole."

1.04 REFERENCE STANDARDS

A. AASHTO LTS - Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

D. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

F. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

G. SSPC-SP 1 - Solvent Cleaning.

H. SSPC-SP 5/NACE No.1 - White Metal Blast Cleaning.

1.05 ACTION SUBMITTALS

A. Product Data: For each pole, accessory, and luminaire-supporting and -lowering device, arranged as indicated.
   1. Include data on construction details, profiles, EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
   2. Include finishes for lighting poles and luminaire-supporting devices.
   3. Manufactured pole foundations.

B. Shop Drawings:
   1. Include plans, elevations, sections, and mounting and attachment details.

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2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of poles and pole accessories.
4. Foundation construction details, including material descriptions, dimensions, anchor bolts, support devices, and calculations, signed and sealed by a professional engineer licensed in the state of installation.
5. Anchor bolt templates keyed to specific poles and certified by manufacturer.
6. Method and procedure of pole installation. Include manufacturer's written installations.

1.06 INFORMATIONAL SUBMITTALS

A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements according to **<<AASHTO LTS>>**-6-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations signed and sealed by a professional engineer.

B. Qualification Data: For Installer.

C. Source quality-control reports.

D. Field quality-control reports.

E. Sample Warranty: Manufacturer's standard warranty.

F. Soil test reports

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For poles to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include pole inspection and repair procedures.

1.08 MAINTENANCE MATERIAL SUBMITTALS

A. Pole repair materials.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant skids at least **<< 12 inches>>** above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of pole(s) that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within a specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.
   2. Warranty Period for Corrosion Resistance: Five years from date of Substantial Completion.

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3. Warranty Period for Color Retention: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Structural Characteristics: Comply with **<<AASHTO LTS>>**-6-M.

B. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, andIce Load: Load of 3 lbf/sq. ft., applied according to **<<AASHTO LTS>>**-6-M for applicable areas on the Ice Load Map.

C. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to **<<AASHTO LTS>>**-6-M.
   1. Basic wind speed for calculating wind load for poles **<< 50 feet>>** high or less is 100 mph.
      a. Wind Importance Factor: 1.0.
      b. Minimum Design Life: 25 years.
      c. Velocity Conversion Factor: 1.0.

D. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA to be used in pole selection strength analysis.

E. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

2.02 STEEL POLES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products shall be as indicated on the drawings.

B. Source Limitations: Obtain poles from single manufacturer or producer.

C. Poles: Comply with **<<ASTM A240/A240M>>**, stainless steel with a minimum yield of **<< 55,000 psig>>**; one-piece construction up to **<< 40 feet>>** in height with access handhole in pole wall.
   1. Shape: Square, straight.
   2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

D. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

E. Fasteners: Stainless steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
   1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
   2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

F. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.

G. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by **<< 5 inches>>**, with cover secured by stainless-steel captive screws.

H. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported load multiplied by a 5.0 safety factor.

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I. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

J. Galvanized Finish: After fabrication, hot-dip galvanize according to **<<ASTM A123/A123M>>**.

K. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces according to **<<SSPC-SP 1>>** to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to **<<SSPC-SP 5/NACE No.1>>** or SSPC-SP 8.
2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high gloss, high-build polyurethane enamel.
   a. Color: As selected by Architect from manufacturer's full range.

2.03 ALUMINUM POLES

A. Manufacturers: Subject to compliance with requirements, provide products as indicated on the drawings.

B. Poles: Seamless, extruded structural tube complying with **<<ASTM B221>>**, Alloy 6061-T6, with access handhole in in pole wall.

1. Shape: Square, straight.
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

D. Grounding and Bonding Lugs: Bolted 1/2-inch threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

E. Fasteners: Stainless steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.

1. Materials: Compatible with poles and standards as well as to substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

F. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by **<< 5 inches>>**, with cover secured by stainless-steel captive screws.

G. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

H. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.

I. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

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1. Surface Preparation: Clean surfaces to comply with **<<SSPC-SP 1>>** to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to **<<SSPC-SP 5/NACE No.1>>** or SSPC-SP 8.
2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
   a. Color: As selected by Architect from manufacturer's full range.

2.04 POLE ACCESSORIES

A. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.

2.05 MOUNTING HARDWARE

A. Anchor Bolts: Manufactured to **<<ASTM F1554>>**, Grade 55, with a minimum yield strength of **<< 55,000 psi>>**.
   1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
   2. Threading: Uniform National Coarse, Class 2A.

B. Nuts: ASTM A 563, Grade A, Heavy-Hex
   1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
   2. Four nuts provided per anchor bolt, shipped with nuts pre-assembled to the anchor bolts.

C. Washers: ASTM F 436, Type 1.
   1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
   2. Two washers provided per anchor bolt.

2.06 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine poles, luminaire-mounting devices, lowering devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.

C. Examine roughing-in for foundation and conduit to verify actual locations of installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 POLE FOUNDATION

A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with **<<ASTM A36/A36M>>** and hot-dip galvanized according to

<<ASTM A123/A123M>>; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

B. Pre-Cast Foundations: Factory fabricated, with structural steel complying with **<<ASTM A36/A36M>>** and hot-dip galvanized according to **<<ASTM A123/A123M>>**; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

C. Direct-Buried Poles with Concrete Backfill: Set poles in augered holes to depth below finished grade indicated on Drawings, but not less than as indicated. To ensure a plumb installation, continuously check pole orientation with plumb bob while tamping.
   1. Make holes **<< 6 inches>>** in diameter larger than pole diameter.
   2. Fill augered hole around pole with air-entrained concrete having a minimum compressive strength of **<< 3000 psi>>** at 28 days and finish in a dome above finished grade.
   3. Use a short piece of 1/2-inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
   4. Cure concrete a minimum of 72 hours before performing work on pole.

D. Anchor Bolts: Install plumb using manufacturer-supplied steel template, uniformly spaced.

3.03 POLE INSTALLATION

A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on drawing.
   1. Fire Hydrants and Water Piping: **<< 60 inches>>**.
   2. Water, Gas, Electric, Communications, and Sewer Lines: **<< 10 feet>>**.
   3. Trees: **<< 15 feet>>** from tree trunk.

C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 033000 "Cast-in-Place Concrete."

D. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.
   1. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
   2. Install base covers unless otherwise indicated.
   3. Use a short piece of 1/2 -inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of the adjacent concrete slab. Fill unpaved ring with pea gravel. Insert material to a level **<< 1 inch>>** below top of concrete slab.

F. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.04 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum using insulating fittings or treatment.

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B. Steel Conduits: Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

3.05 GROUNDING

A. Ground Metal Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
   1. Install grounding electrode for each pole unless otherwise indicated.
   2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

B. Ground Nonmetallic Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
   1. Install grounding electrode for each pole.
   2. Install grounding conductor and conductor protector.
   3. Ground metallic components of pole accessories and foundation.

3.06 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.07 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
   1. Inspect poles for nicks, mars, dents, scratches, and other damage.
   2. System function tests.

END OF SECTION 265613

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SECTION 270533.13
CONDUIT FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 REFERENCE TO OWNER'S GENERAL CONDITIONS

A. The Owner's/Project General Conditions shall be considered as part of this Specification. Unless this Section contains statements, which are more definitive or more restrictive than those contained in the Owner's General Conditions, this Specification shall not be interpreted as waiving or overruling any requirements expressed in the General Conditions documentation.

1.02 SECTION INCLUDES

A. Conduit.

B. Outlet boxes.

C. Floor boxes.

D. Galvanized steel rigid metal conduit (RMC).

1.03 RELATED REQUIREMENTS

A. General: Comply with all contract documents.

B. The Contractor shall coordinate with Electrical Contractor on raceway / junction box locations for equipment and routing of cables / raceway from equipment as well as terminal and pull boxes to system equipment racks and/or wall fields.

C.

D. Equipment and materials provided and installed by others, unless otherwise shown in this Section or the Drawings shall include, but are not limited to:

E. Section **<< 078400 - Firestopping>>**.

F. Section **<< 260533 - Conduit for Electrical Systems>>**.

G. Section **<< 270529 - Hangers and Supports for Communications Systems>>**.

H. Section 260526 - Grounding and Bonding for Electrical Systems #.

1.04 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC).

B. BICSI ITSIMM - Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition.

C. BICSI TDMM - Telecommunications Distribution Methods Manual, 15th Edition.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction.

E. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.

F. NFPA 70 - National Electrical Code.

G. NFPA 101 - Life Safety Code.
   1. NFPA 72 - National Fire Alarm and Signaling Code.

H. NFPA 72 - National Fire Alarm and Signaling Code.

I. TIA-568.0 - Generic Telecommunications Cabling for Customer Premises.

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J. TIA-569 - Telecommunications Pathways and Spaces.

K. UL 6 - Electrical Rigid Metal Conduit-Steel.

L. UL 514B - Conduit, Tubing, and Cable Fittings.

1.05 ADMINISTRATIVE REQUIREMENTS

A. General Scope of Work Requirement: The Contractor shall provide box and conduit systems to support audiovisual connectivity as outlined in this Specification and the Contract Documents.
   1. Provide raceway and outlet box system suitable for installation of Audio, Video, Voice and Data-based systems equipment and cabling by others.

B. Coordination:
   1. Coordinate minimum sizes of conduits with actual type and quantity of cables to be installed.
   2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts.
   3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
   4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
   5. Notify **<<Architect>>** of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

C. Sequencing:
   1. Do not begin installation of communications cables until installation of conduit between termination points is complete.

1.06 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits, fittings and floor boxes to be used on this project.

1.07 QUALITY ASSURANCE

A. Documents at Project Site: Maintain at project site one copy of **<< manufacturer's instructions; shop drawings; reference standard documents containing execution requirements; and _____>>**.

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PART 2 PRODUCTS

2.01 MATERIALS

A. General: Conduits, raceways and boxes shall be constructed of the manufacturer's standard materials, as listed in published product information; types and sizes shall be as indicated or as required for both the installation and for NEC compliance.

B. Conduit and Raceways:
   1. Empty conduit, raceway, and outlet box system shall comply with both this Section as well as applicable electrical and telecommunications specification sections.
   2. Conduits shall be marked to identify the intended use. Color coding is acceptable while conduit numbering is preferred.
   3. Conduits shall be metallic EMT and/or IMC unless otherwise approved in writing.
   4. Conduits used for audiovisual shall not be less than 3/4" interior diameter.

5. All conduits shall have pull strings.
6. All conduit stub ups shall be reamed and have protective bushings installed.
7. Provide conduit sizes and connectivity as indicated on the audiovisual drawings.
8. Manufacturers:
   a. Allied Tube and Conduit.Wh
   b. Wheatland Tube.
   c. Republic Conduit.
   d. Wiremold.

C. Outlet Boxes:

D.

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7.
8.
9.
   a.
   b.
   c.

E.

F.

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2.02 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by **<<NFPA 70>>**, **<<TIA-569>>**, **<<BICSI ITSIMM>>**, **<<BICSI TDMM>>**, manufacturers' instructions, and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, **<< comply with most restrictive requirements; or _____>>**. Where conduit type for particular application is not specified, **<< use galvanized steel rigid metal conduit; or _____>>**.

2.03 CONDUIT - GENERAL REQUIREMENTS

A. Comply with **<<NFPA 70>>** and **<<TIA-569>>**.

B. Provide conduit, fittings, supports, and accessories required for complete communications pathway.

C. Provide products listed, classified, and labeled as suitable for purpose intended.

D. Where conduit size is not indicated, size to comply with **<<NFPA 70>>**, **<<TIA-569>>**, and **<<BICSI TDMM>>**, but not less than applicable minimum size requirements specified. Where specified standards differ, comply with most stringent.

2.04 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Description: **<<NFPA 70>>**, Type RMC galvanized steel rigid metal conduit complying with **<<ANSI C80.1>>** and listed and labeled as complying with **<<UL 6>>**.

B. Fittings:

1. Nonhazardous Locations: Use fittings complying with **<<NEMA FB 1>>** and listed and labeled as complying with **<<UL 514B>>** or **<<UL 6>>**.
2. Material: Use **<< steel; malleable iron; die cast zinc; or _____>>**.
3. Connectors and Couplings: Use **<< threaded fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted; or _____>>**.
4. Conduit Bodies: Use only conduit bodies specifically designed for communications cabling. Standard conduit bodies designed for electrical raceways are not permitted.
   a. Comply with **<<TIA-568.0>>** minimum bend radius requirements for fiber optic cables.

END OF SECTION 270533.13

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SECTION 270536
CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal cable tray systems:
   1. Metal ladder cable tray.
   2. Metal wire mesh/basket cable tray.

1.02 RELATED REQUIREMENTS

A. Section **<< 078400 - Firestopping>>**.

B. Section 260533 - Hangers and Supports for Communications Systems #.

C. Section **<< 270529 - Hangers and Supports for Communications Systems>>**.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

B. ASTM A1008/A1008M, Grade 33, Type 2.

C. ASTM A1011/A1011M, HSLAS, Grade 50, Class 1.

D. ASTM A510/A510M, Grade 1008.

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

F. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

G. BICSI ITSIMM - Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition.

H. NECA/BICSI 607 - Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings.

I. NEMA BI-50016 - Cable Tray Installation Guidelines.

J. NEMA BI 50015 - Metal Cable Tray Systems.

K. NFPA 70 - National Electrical Code.

L. TIA-607 - Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

1.04 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cable tray system components and accessories. Include dimensions, materials, fabrication details, finishes, and span/load ratings.

C. Shop Drawings: Include dimensioned plan views and sections indicating proposed cable tray routing, required clearances, and locations and details of supports, fittings, building element penetrations, and equipment connections.

D. Project Record Documents: Record actual routing of cable tray and locations of supports.

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1.05 QUALITY ASSURANCE

A. Comply with **<<NFPA 70>>**.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum **<< three; or _____>>** years**<< documented; _____; or None - N/A>>** experience.

1. Manufacturer shall be a member of NEMA.
2. Trays shall conform to NEMA Metal Cable Tray Standard Publication VE-1.
3. Manufacturer shall provide test reports witnessed by an independent testing laboratory of the "worst case" loading conditions outline in this specification and peformed in accordance with the latest revision of NEMA VE-1.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cope/Atkore International.

B. Eaton B-Line, Inc.

C. Cablofil/Legrand.

D. Chalfant Manufacturing Company.

E. Mono-Systems, Inc.

F. M.P. Husky Corporation.

G. PW/Legrand.

2.02 CABLE TRAY SYSTEM - GENERAL REQUIREMENTS

A. Provide **<< new; modifications and additions to existing; or _____>>** cable tray system consisting of required components, fittings, supports, and accessories, as necessary for complete system.

B. Provide products listed, classified, and labeled as suitable for purpose intended.

C. Do not use cable tray for applications other than as permitted by **<<NFPA 70>>** and product listing/classification.

D. Provide cable tray system and associated components suitable for use at indicated span/load ratings under service conditions at installed location.

E. Unless otherwise indicated, specified span/load ratings are based on safety factor of 1.5 and working load only (i.e., no additional concentrated static load), with ratings for metal cable tray systems in accordance with **<<NEMA BI 50015>>**.

F. Unless otherwise indicated, specified load/fill depths and inside widths are nominal values, with values for metal cable tray systems in accordance with **<<NEMA BI 50015>>** including applicable allowable tolerances.

G. Source Limitations: Furnish cable tray system and associated components and accessories produced by **<< single manufacturer; same manufacturer as existing cable tray system; or _____>>** and obtained from single supplier.

2.03 METAL CABLE TRAY SYSTEMS

A. Comply with **<<NEMA BI 50015>>**.

B. Class Designation: Comply with NEMA VE 1, Class 12B.

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C. Material/Finishes:
   1. Zinc Electroplated Steel: Comply with **<<ASTM B633>>**.
   2. Mill-Galvanized Before Fabrication (Pre-Galvanized) Steel: Comply with **<<ASTM A653/A653M>>**, G90 coating.

D. Metal Ladder Cable Tray**<< Type _____; _____; or None - N/A>>**:
   1. Material:
      a. Steel
         1) Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A1008/A1008M, Grade 33, Type 2.
         2) Steel Tray Splice Plates: ASTM A1011/A1011M, HSLAS, Grade 50, Class 1.
         3) Fasteners: Steel complies with the minimum mechanical properties of ASTM A510/A510M, Grade 1008.
         4) Finish: Hot-dipped galvanized after fabrication, comply with ASTM A123/A123M, Class B2.
         5) Hardware: Galvanized, ASTM B633.
      b. Aluminum
         1) Materials: Alloy 6063-T6 according to ANSI H35.1/H35.1M for extruded components, and Alloy 5052-H32 according to ANSI H35.1/H35.1M for fabricated parts.
         2) Hardware: Chromium-zinc-plated steel, ASTM F1136.
   2. Load/Fill Depth: 4 inches.
   3. Span/Load Rating: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb concentrated load, when tested according to NEMA VE 1.
   4. Rung Spacing: 9 inches on center for straight lengths.
   5. Inside Width: 24 inches, unless otherwise indicated on the drawings.
   6. Inside Radius of Fittings: 24 inches.

E. Metal Wire Mesh/Basket Cable Tray**<< Type _____; _____; or None - N/A>>**:
   1. Material: Galvanized steel wire mesh, complying with NEMA VE 1.
      a. Straight Sections and Fittings: Steel complies with the minimum mechanical properties of ASTM A1008/A1008M, Grade 33, Type 2.
      b. Steel Tray Splice Plates: ASTM A1011A/A1011M, HSLAS, Grade 50, Class 1.
      c. Fasteners: Steel complies with the minimum mechanical properties of ASTM A510/A510M, Grade 1008.
      d. Finish: Hot-dipped galvanized after fabrication, complying with ASTM A123/A123M, Class B2.
      e. Hardware: Galvanized, ASTM B633.
   2. Tray Depth: 4 inches.
   3. Span/Load Rating: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb concentrated load, when tested according to NEMA VE 1.
   4. Mesh Spacing: **<< 2 by 4 inches; _____ by _____ inches; or _____>>**.
   5. Tray Width: 12 inches minimum, unless otherwise indicated on drawings.

F. Hanger system:
   1. Ladder Cable Tray: Trapeze channel and threaded rods.
      a. Channel: Approximately 1.60 inches square and provided with appropriate fittings for attaching to the bottom of the cable tray and to the supporting rods.

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b. Rods: Minimum 0.375 inch diameter with fittings to attach to the structure above.

2. Wire Mesh Cable Tray: Supports shall be center support hangers, trapeze hangers, or wall brackets.
   a. Trapeze hangers or center support hangers shall be supported by 0.25 inch or 0.375 inch diameter rods.

2.04 ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Barrier strips: Same materials and finishes as cable tray.

C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.05 SOURCE QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

B. Metal Cable Tray: Perform factory design tests in accordance with **<<NEMA BI 50015>>**, including electrical continuity and load testing.

C. Test and inspect cable trays according to NEMA VE 1.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install cable tray system in accordance with the following. Where requirements differ, comply with most stringent.
   1. **<<NEMA BI-50016>>** (cable tray).

C. Unless otherwise indicated, arrange cable tray to be parallel or perpendicular to building lines.

D. Arrange cable tray to provide required clearances and maintain cable access.

E. Install cable tray plumb and level, with sections aligned and with horizontal runs at specified elevation.

F. Metal Wire Mesh/Basket Cable Tray: Field fabricate fittings in accordance with manufacturer's instructions, using only manufacturer-approved connectors classified for bonding.
   1. Inside Radius of Fittings: **<< 12 inches; 24 inches; 36 inches; As indicated on drawings; _____ inches; or _____>>**.

G. Cable Tray Movement Provisions:
   1. Provide expansion fittings where cable tray is subject to movement, including but not limited to:
      a. Where cable tray crosses structural joints intended for expansion.
      b. Long straight cable tray runs in accordance with **<<NEMA BI-50016>>**.
   2. Use expansion guides in lieu of hold-down clamps where prescribed in **<<NEMA BI-50016>>**.
   3. Set gaps for expansion fittings in accordance with **<<NEMA BI-50016>>**.

H. Cable Provisions:
   1. Use fixed barrier strips to maintain separation of cables as indicated and as required by **<<NFPA 70>>**.

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2. Use drop-out fittings or bushings where cables exit cable tray as required to maintain minimum cable bending radius.
3. Use cable support fittings for long vertical cable tray runs with heavy cables.

I. Provide end closures at unconnected ends of cable tray runs.

J. Cable Tray Support:
1. Use manufacturer's recommended hangers and supports, located in accordance with **<<NEMA BI-50016>>**, **<<BICSI ITSIMM>>**, and manufacturer's requirements, but not exceeding specified span**<< unless otherwise approved by Engineer; _____; or None - N/A>>**. Provide required support and attachment where not furnished by cable tray manufacturer.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

K. Grounding and Bonding Requirements:
1. Install cable tray grounding in accordance with the following. Where requirements differ, comply with the most stringent.
a. **<<NECA/BICSI 607>>** (telecommunications bonding and grounding).
b. **<<NEMA BI-50016>>** (cable tray).
c. **<<TIA-607>>** (generic telecommunications bonding and grounding).
d. NFPA 70.
e. Section 260526 - Grounding and Bonding #.
2. Metal Cable Tray Systems: Use suitable bonding jumpers or classified cable tray connectors to provide electrical continuity. Do not use classified cable tray connectors where cable tray sections have been modified, such as being bent, cut, or reshaped.

L. Penetrations: Install firestopping to preserve fire resistance rating of building elements.

M. Identification Requirements:

N. Install cable tray covers **<< where indicated.; where indicated and as follows:; or _____>>**

3.02 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

B. Inspect cable tray system for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective cable tray system components.

END OF SECTION 270536

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SECTION 275123
INTERCOMMUNICATIONS AND PROGRAM SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish and install a centrally controlled complete and satisfactorily operating sound and intercommunications system within the building and around the building's perimeter as shown on the drawings and herein specified for: the pick-up, amplifcation, reproductino, and distribution of voice and/or music; intercommunications between areas; the distribution of program signals.

B. Intercom cable.

C. Provide an additional minimum of three gateways or 30% of the total system, whichever is greater, for all systems to account for future expansion.

1.02 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>**, for submittal procedures.

B. Product Data: For each item of equipment.

C. Manufacturer's Installation Instructions.

D. Project Record Documents: Accurately record actual locations of devices and wiring.

E. Maintenance Data: Include instructions for minor troubleshooting, preventive maintenance, and cleaning.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this Section with minimum ten years of**<< documented; _____; or None - N/A>>** experience.

B. Supplier Qualifications: Company **<< authorized; or franchised>>** by manufacturer and specializing in supplying products specified in this Section with minimum five years**<< documented; _____; or None - N/A>>** experience.

C. Installer Qualifications: Company specializing in installing the products specified in this Section with minimum five years**<< documented; _____; or None - N/A>>** experience.

1.04 TRAINING

A. The Contractor shall furnish a minimum of 8 hours of technical service training to the Owner's technical staff uisng the factory service manuals previously specified.

B. The Contractor shall furnish 24 hours of operating and programming training to Owner's operating staff which shall be delivered in six, 4 hour sessions to be scheduled at the Owner's convenience over the warranty period.

C. Training specified herein shall be performed by a factory certified technician.

D. Provide all necessary materials, laptop, programs, and service tools for the PA system with training(s). The Owner must have access to TechSupport for the life of the materials.

1.05 DESCRIPTION OF OPERATION

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A. Furnish and install a microprocessor-controlled voice communication system with low voltage wiring and equipment as shown on the drawings, and as herein specified to furnish a complete sound, program, distribution, and intercommunication system in the building.

B. System Capacity:
   1. It shall be possible to field program any Owner furnished telephone instrument to function as part of the sound and intercommunications system.
   2. Furnish and install one desk mounted Administrative Control Station (ACS) in the Communications Room.
   3. Provide a minimum of one conversation path for each programmed telephone instrument and/or Adminstrative Control Station (ACS).
   4. Room stations reporting to different programmed telephone instruments and/or an ACS shall be capable of calling simultaneously without interference.
   5. Programmed telephone instruments and/or an ACS calling to assigned rooms shall be capable of calling simultaneously without interference.
   6. The system shall be configured for ICB dial in access.

C. System Configuration:
   1. Programmed telephone instruments and/or an ACS shall receive calls from classrooms and other indicated areas as shown on the drawings.
   2. Classrooms and other areas indicated on the drawings shall contain a flush, wall mounted callback switch to signal the designated programmed telephone instrument and/or ACS.
   3. Classrooms, corridors, and other areas indicated on the drawings shall contain flush ceiling mounted speakers.
   4. Mechanical rooms and other similar type ares, and the building exterior shall contain surface mounted horn type speakers as indicated on the drawings.
   5. A hand-held microphone and a flush mounted microphone outlet shall be furnished and installed by this Contractor at the bus loading area. Keying this microphone shall automatically annunciate over the ALL CALL system without the assistance of an operator. Field verify exact location at bus loading area, prior to rough-in and installation.
   6. Desk-type microphones shall be furnished where shown on the drawings. keying one of these microphones shall automatically annunciatoe over the ALL CALL system without the assistance of an operator.

D. Calling sequence of operation:
   1. Classroom station calls shall initiate manually a preset status of call to the designated programmed telephone instrument and/or ACS.
   2. Programmed telephone instrument and/or ACS to classroom calls shall establish two-way voice communication with classrooms and/or any or other areas equipped with a loudspeaker.
   3. ACS to ACS, or programmed telephone instrument to ACS, or programmed telephone instrument to programmed telephone instrument calls shall establish a two-way telephone conversation.

1.06 SYSTEM PARAMETERS

A. The system central equipment shall provide at least two simultaneous open voice speech paths between programmed telephone instruments and/or administrative control stations and remote speakers within a sixteen-line group. Systems not providing multiple, simultaneou, unrestricted, amplified voice channels or systems offering multi-speech paths which are restrictive to less than simultaneous conversations per sixteen-line group shall be unacceptable.

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1. The system shall provide user programmable room number assignment. Room number assignments shall be based on the actural room number assigned by the Owner, **NOT** the room numbers shown on the drawings.
2. The system shall provide for two, three, four, or five-digit alphanum

B. The basic system shall be capable of modular expansion to sixteen simultaneous open voice speech paths to a minimum of five hundered twelve stations.

C. The system shall provide at least two program distribution channels, each programmed and distributed from a programmed telephone instrument and/or an ACS.

D. The system shall have thirty-two user assigned groups of stations for zoned audio paging, class change signals, or program distributino with any station belonging to all zones, some zones or no zone.

E. The system shall allow for preselective access to ZONE and ALL CALL functions. This feature shall prevent unauthorized paging from programmed telephone instruments and/or an ACS.

F. The system shall be expandable in groups of sixteen stations and two simultaneous speech paths. The total basis system shall provide a minimum of twelve speech paths (links) total.

G. The system shall incorporate necessary circuitry to prevent monitoring of any classroom who call origination switch is in the privacy mode. The system shall be designed to operate with the most current types of privacy networks.

H. The system shall be capable of being programmed as directed by the Owner so that programmed telephone instrument and/or an ACS cannot monitor an activity within a room (regardless to whether that room is equipped with a privacy switch) over the loudspeaker. This programming shall **NOT** defeat the operation of the handset. Each of the room loudspeakers shall be programmed individually to allow or defeat monitoring of loudspeaker or group of loudspeakers.

I. The system shall provide remote program selection that shall allow a classroom to select or cancel program source. Intercom or paging functionsshall have priority over this function.

J. The sytem shall provide a "call announce" tone. This feature, if preselected by the user, shall provide a tone signal at the classroom speaker when called by a programmed telephone instrument and/or an ACS.

K. The system shall automatically provide a "pre-announce" tone. This feature, if preselected by the user, shall provide a repetitive tone signal at the classroom speaker when called by a programmed telephone instrument and/or an ACS to indicate the room is being monitored (supervisory tone).

L. The system shall provie the facilities so that a calling station can be placed in a HOLD status, freeing the progammed telephone instrument and/or ACS to perform other functions.

M. The system shall provide priority override capability to remote independent sound systems (auxiliary, auditorium, gymnasium, etc.) located inside the building. Independent sound systems located outside the building (baseball, football, stadium, etc.) shall not require priority override capabilities.

N. The system shall have the capability to operate with external paging amplifiers to increase audio output available for paging.

O. The system shall be equipped with control points outputs for activating outboard devices such as priority override relays on remote sound systems. These control point outputs shall be activated when the system is placed in the ALL PAGE mode.

P. The system shall provide a unique "pre-alert" tone to sound prior to the normal class change signal. This tone shall be programmable and may be repositioned, time wise as desired.

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Q. The system shall contain an integral master clock and programmer which shall generate and distribute class change and/or program signals to **ALL** loudspeaker zones and be capable of performing the following functions:
   1. Provide 500 discrete time event entries for programming functions based upon:
      a. The time of day in hours and minutes.
      b. The day or combination of 7 days of the week on which the event is to occur.
      c. The selection of any one or any combination of 32 zones or 8 outputs to be activated.
      d. The selection of any one or combination of 16 schedules to allow for maximum flexibility due to special circumstances or seasonal changes.
      e. The selection of 16 user-progammable Event Tones. Event Tones are programmable from a library of 25 Tone Types.
      f. System shall have capabilities of visual aid for hearing impaired.
   2. Provide for Automatic Daylight Savings Time adjustment with Leap Year programming.
   3. Provide momentary contact closures for external device operation. Provide four inputs, four outputs, and four flex-puts.
      a. Inputs shall be programmable by the user to initiate any desired system activity (e.g. Page, Tone, Program, Event, System Reset, etc.).
      b. Outputs shall be programmable by user to activate during any desired system activity (e.g. Page, Tone, Program, Time of Day, etc.).
   4. Display the time of day in either twelve or twenty-four hour format at each Administrative Telephone.
   5. The system shall provide for an editing and review routine to permit the user to change and edit time events, zones, and schedules.
   6. The system shall allow pre-selected program material to be distributed according to pre-programmed schedules (i.e. March to Music, National Anthem, etc.).

R. The system shall be configured to provide optional music distributino during class change periods.

S. The system shall provide reception of AM or FM radio broadcasts and reproduction of recorded music or other program material from a built-in tuner, or compact disc player and shall provide distribution to any and or all speakers.

T. The systemshall reproduce standard compact disc recordings and distribute them to any or all speakers.

U. The system shall accept both input and output of an external tape recorder.

V. The system shall include individual bass and treble controls.

W. The system shall provide for a minimum of 16 spare loudspeaker zones.

X. The system shall accept a priority override signal to mute the system when the fire detection system activates the priority override function.

1.07 SYSTEM TEST AND ACCEPTANCE

A. Prior to final site visitation, and acceptance of each construction phase, conduct an operating test of the complete sound and intercommunications systems. The system shall test free from grounds, shorts, and other faults. Connections shall be thoroughly checked for mechanical and electrical connections. Equipment shall be demonstrated to operate in accordance with the requirements set forth in these specifications and as shown on the drawings.

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B. Peform tests in the prescence of the Architect/Engineer and Owner. Furnish personnel and test instruments for use in the test. Test the sound level (dB) for each room for the appropriate room use. Test at the center of the room.

C. When the work on the entire sound and intercommunications system has been completed, and is ready for final review, demonstrate that the requirements of the Contract as it applies to this work have been carried out and that the system has been adjusted and operated in accordance therewith.

1.08 FIELD CONDITIONS

A. The existing sound and intercommunications, and program system shall remain in operation during the construction period, until the new system has been installed, tested, and ready for operation. After the new system has been placed in operation, the existing system shall be removed, as shown on the drawings.

1.09 WARRANTY

A. Deliver the work described herein in a first-class operating condition in every respect. Warrant the material, equipment, and workmanship furnished to be entirely free from defects. Any materials, equipment, or workmanship in which defects may develop before or during the warranty period shall be reparied or replaced at the Contractor's own expense. Refer to Division 01 for the start of the warranty period. Further warrant material, equipment and workmanship used in the installation, but not specifically mentioned in the contract documents, is the best of their respective kinds and that the construction and installation was performed in accordance with the best acceptabed standard practices in all details.

B. The manufacturer shall be prepared to offer a service contract for the maintenance of the system after the warranty period.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. CareHawk/Dukane "StarCall" - basis of design.

B. Rauland; Telecenter U.

2.02 ADMINISTRATIVE CONTROL STATION

A. The Administrative Control Station (ACS) shall be desk mounted and contain a matching telephone handset with retractable coiled cord and conductive rubber button switches with clearly designated touch points. The housing shall be constructed of high impact flame-retardant plastic and shall terminate using RJ-45 modular telephone type jack. Additional features shall include:

1. Conductive rubber moisture sealed buttons.
2. 16-character alphanumeric LCD display.
3. Menu driven display.
4. Handset and hands-free intercom with a "Push-to-Talk" button for manual audio direction control in the hands-free mode.
5. Alphanumeric three, four or five-digit dialing.
6. Distinctive electronic ring signals.
7. 12 button keypad.
8. SPEAKER PHONE, TALK, ringer VOLUME UP/DOWN, EMERGENCY, TONE, PAGE, PROGRAM, MENU, and 8 additional user-programmable special functino keys.

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9. Telephone type modular connector.
10. Sensitive loudspeaker.
11. Built-in condenser microphone.
12. Queing.
13. Data communications; local operating networks (LON), RS-485.
14. Telephone style headset with dynamic receiver and electret transmitter.
15. HOLD button.

B. The ACS shall provide the following functions and features:
1. User programmable two, three, four, or five-digit alphanumeric direct dialing assignment to the following locations: ACS to classroom speaker(s); ACS to programmed telephone instrument; or ACS to ACS.
2. The ACS shall employ membrane switches that shall provie the user with a positive feel of switch activation.
3. The ACS shall be equipped with a large 16 character LCD alphanumeric readout which shall provide the following:
a. Queuing of calling room numbers and telephones.
b. Sequential displays of calls "waiting" with no limit to the number of calls.
c. EMERGENCY, PRIORITY, and NORMAL calls shall be displayed in order received and according to their priority.
d. Display of the alphanumeric room number or location of the calling station.
e. Display of current time in 12 or 24 hour format in idle state.
f. Full menu driven display of operator function dialing.
g. Full menu driven display of menu prompting.

C. The ACS shall provide two modes of communicatino of classroom loudspeakers. Communications shall be via handset or microphone/speaker, activated by a hands-free speakerphone or built-in talk/listen switch.

D. Answering calls from loudspeaker locaitons shall be accomplished by picking up the handset or depressing the SPEAKERPHONE button.

E. Call-in from an ACS, programmed telephone instrument,or callback switch shall be displayed in the following manner:
1. The firstt call entered shall appear in the display window of the ACS that shall display the dial number of the calling station.
2. Any number of calls shall be stored in memory, up to the total capacity of the system with the quantity of those calls waiting displayed at the ACS.
3. NORMAL and lower level calls shall annunciate with the slower, repetitive rate, audio tone than EMERGENCY calls. Calls shall sort and stack automatically according to the preprogrammed priority level assignments. Each incoming call shall be automatically registered first in order of priority and then by order placed.
4. Calls that have been upgraded by the caller shall automatically move to the EMERGENCY level and appear in proper sequence.
5. EMERGENCY calls shall be distinguishable from NORMAL calls by designation and unique tone pattern. It shall be possible to visually or audibly determine whether the call-in is an emergency or normal call-in.
6. The ACS shall have the ability to forward its call-in coverage to another ACS or programmed telphone instrument. This shall be a manual operation or at a predetermined time, automatically forwarded.

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7. It shall be possible to manually activate and sound the time tone event signal to any of the 32 multi-purpose zones from any ACS and/or programmed telephone instrument.
8. The ACS shall include a PROGRAM button for selection and distribution of each of the program channels to loudspeaker zones. The program channels shall be distributed via the ACS to a loudspeaker zone, a group of loudspeaker zones or all loudspeaker zones. it shall be possible to initiate changes to the distribution of the programs while program distribution is already in progress without haing to first defeat the curent distribution.

F. The ACS shall be provided with an interconnecting cord set with modular connectors at each end.

G. The system shall provide for transferring a call form the ACS to any other ACS and/or programmed telephone instrument.

H. The system shall be equipped with the necessary ports that shal allow diagnostics via any standard computer terminal and modem interface that shall allow remote engineering assistance from the system manufacturer.

I. The ACS shall provide for review of call-in coverage assignments to an ACS including review of identification numbers of remote stations assigned to either of the two programmed channels and review of which ACS is forwarding coverage.

J. An ACS which will meet this specification is DUKANE Model No. 7A1110.

2.03 CENTRAL EQUIPMENT

A. Furnish and install standard 19-inch floor mounted equipment rack(s) for housing central equipment. Furnished and install the central equipment in the rack(s). The central equipment shall consist of the following items of equipment in the quantities required to perform the specified functions:

1. DUKANE Model No. 110-3592 floor mounted equipment rack(s) of the quantity required to house all of the equipment listed herein. Each rack shall be complete with locking back door and pair of flush side panels.
2. DUKANE Model No. 110-3521A expanded central microprocessor card(s).
3. DUKANE Model No. 110-3524B basic audio routing card(s).
4. DUKANE Model No. 110-3527 and/or 110-3528 ACS card(s).
5. DUKANE Model No. 110-3530 and/or 110-3531 standard telephone card(s).
6. DUKANE Model No. 110-3544C intercom amplifier module.
7. DUKANE Model No. 110-3533A and/or 110-3534 16-line audio switching card(s). The quantity of boards to be provided shall provide for a minimum of 16 spare zones.
8. DUKANE Model No. 1A4125 125 watt power amplifier(s) and/or DUKANE Model No. 1A4250 250 watt power amplifier(s)
9. DUKANE Model No. 77A1000 communications modem.
10. ATLAS SOUNDOLIER Model No. ACS-1 power strip.

2.04 MICROPHONE PRE-AMPLIFIER

A. Furnish and install a remote microphone pre-amplifier for each desk mounted microphone. A remote microphone pre-amplifer that meets this specificaition is DUKANE Model No. 1A881, suitable for flush or surface mounting in a two-gang outlet box. Internal pre-amps located in head end shall be acceptable providing they have the capacity to handle microphone inputs shown on the drawings.

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2.05 SYSTEM INTEGRITY AND MEMORY

A. The user programmable functions of the sound and intercommunicaitons ssytem shall be protected by a manufacturer supplied lithium battery with a life expectancy of at least 10 years.

2.06 TELEPHONE INTERFACE

A. The PBX/KSU interface shall be provided through a trunk interface card (TIC) and a standard telephone card. Each TIC shall support up to four trunks with sixteen trunks maximum. Each trunk shall be programmable as either incoming or outgoing or both. For incoming trunks, the system shall be able to direct a call to a user defined attendant telephoen or provide dial tone. For outgoing trunks, the system shall provide access to the trunk by dialing "8", "9" or both. If digit "9" is used to access an outgoing trunk, the system shall be able to automatically dial a second "9". Each trunk shall be the loop start type.

B. The interface connection to a PBX/KSU shall be made from the TIC trunk to a PBX/KSU extension to allow any system telephone to have access to all of the extension functionaliy of the PBX/KSU.

C. The interface connection from the PBX/KSU shall be made from the PBX/KSU trunk to an extension. This feature shall allow PBX/KSU telephones to have access to system extension features and shall aslo allow call-ins to be made from the loudspeaker zones to the PBX/KSU attendant console.

D. Connections to the telephone interface shall be the standard modular type USOC RJ11C connectors, one per line, and signal and data connections to the host system shall be multiple pin type connectors.

E. The telephone interface shall be FDD Part 68 registered for connection to the telephone network. The ringer equivalency shall be 0.70 db, for each line.

2.07 EQUIPMENT LOCATIONS

A. Furnish and install where shown on the drawings, wall mounted main and sub-distribution equipment locations consisting of fire resistant 3/4-inch thick plywood backboards and LEVITON Cat. No. 40066-M50 fifty pair "66" clip connecting blocks as detailed on the drawings.

2.08 ADMINISTRATIVE CONTROL STATION RECEPTACLES

A. Furnish and install where shown on the drawings....

2.09 CLASSROOM CALLBACK SWITCHES

A. Furnish and install where shown on the drainwgs, wall mounted callback switches for flush or surface mounting in a single gang outlet box, as noted on the drawings. The callback switches shall have the following features: one SPST momentary (spring-ation return push button) designated PUSH TO CALL; terminations shall be screw terminal type; and satin finished stainless steel cover plate. A classroom callback switch that meets this specification is DUKANE Model No. 9A1765.

2.10 FLUSH CEILING MOUNTED SPEAKER ASSEMBLIES

A. Furnish and install where shown on the drawings, flush 1 by 2 feet drop-in ceiling speaker assemblies consisting of a loudspeaker, backbox, and baffl. A speaker assembly that meets this specification is ATLAS SOUNDOLIER Model No. IS125SYS complete with 2 feet T-Bar.

B. For drywall type ceiling construction, furnish and install a flush ceiling mounted speaker assmbly. A speaker assembly that meets this specification is BOGEN Model No. CSD 1X2VRU.

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2.11 SURFACE CEILING MOUNTED SPEAKER ASSEMBLIES

A. Furnish and install where shown on the drawings, surface mounted speaker assemblies consisting of an ATLAS SOUNDOLIER Model No. C5A-T72 loudspeaker and an ATLAS SOUNDOLIER Model No. Q428-SA backbox complete with regressed speaker grille and a matte white finish.

2.12 SURFACE WALL MOUNTED SPEAKER ASSEMBLIES

A. Furnish and install where shown on the drawings, surface mounted speaker/transformer/baffle assemblies (vandal resistant). With durable 14 gauge steel construction, impermeable security grille, 8-inch diameter speaker with a frequency response of 50HZ to 18kHz, factory wired 25/70.7-volt transformer with mutli power taps. An assembly that meets this specification is ATLAS SOUND Model No. VP14.

2.13 HORN TYPE SPEAKERS

A. Furnish and install where shown on the drawings, horn type speakers.

B. Horn type speakers shall be wall mounted and have the following characteristics: a full range power rating of 15 watts; frequency response of 600-14,000 Hz; 95 degree dispersion; power taps at .48, .94, 1.8, 7.5, and 15 watts, and grey baked expoxy finish. A horn type speaker that meets this specification is ATLAS SOUND Model APF-15T with VP161-APTF vandalproof square grille and 193-8-6 square recessed enclosure.

2.14 VOLUME CONTROLS

A. Furnish and install where shown on the drawings, wall mounted speaker volume controls.

B. Volume controls shall provide for control of area speaker volume on 25-volt or 70-volt speaker distribution lines controlling up to 10 watts of audio power. Attenuation shall be accomplished in 11 steps, including "0". The switch shall be a 12-position rotary type. Volume controls shall be complete with a stain finished, stainless steel coverplate and the know shall have a clearly visible white indicator line. The volume control shall mount in a single gang outlet box, flush or surface mounted as noted on the drawings. A volume control that meets this specification is ATLAS SOUND Model AT-10.

2.15 MICROPHONES

A. Furnish one unidirectional, dynamic, dual impedance microphone with the following features: freqency respons of 80 to 13,000 Hz; uniform cardioid polar pattern; built-in windscreen; shock mount; on-off switch with lockplate; and swivel adapter. A microphone that meets this specification is AKG Model No. D77S/XLR dynamic cardioid microphones. Furnish this microphone complete with a 25-foot connector cable with CANNON XLR connectors, and an ATLAS SOUNDOLIER Model MS-20 floor stand.

B. Furnish one dual impedance, controlled magnetic, desk mounted microphone with the following features; frequency response of 100 to 10,000 HZ; omni-directional polar pattern; high/low impedance selector switch; touch-to-talk control bar with lock-on operation; height adjustment; and a nondetachable,7-foot long, four conductor cable having two conductors shielded.

C. Furnish one bus call station hand-held communications type, noise-canceling, dynamic microphone with the following features: frequency response of 100 to 7,500 Hz; double pole, double throw touch-to-talk switch with spring return; wall clip; and a 6-foot lon, four conductor cable having two conductors shielded. A microphone that meets this specification is ASTATIC Model No. 611L complete with Model No. 40-315 mounting bracket.

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2.16 MICROPHONE OUTLETS

A. Furnish and install whre shown on the drawings, wall mounted microphone outlets suitable for flush or surface mounting in single gang outlet box. Microphone outlets shall consist of a CANNON "XLR" series audio jacks of the type required so as to be compatible with the type of microphone cable connector furnished, and a stainless steel coverplate. A microphone outlet that meets this specification is CONQUEST AUDIO Cat. No. HP1-DF complete with a three-pin XLR.

2.17 SOUND AND INTERCOMMUNICATIONS SYSTEM CABLE

A. Furnish and install one, four conductor, No. 20 AWG stranded plenum rated cable with a temperature range for dry locations of -10 degrees C to 60 degrees C for each speaker zone having two twisted conductors shielded and two twisted conductors unshielded. A cable that meets this specification is WEST PENN Cat. No. 25359B or equal as manufactured by CONSULIDATED WIRE, GENERAL CABLE, PAIGE or TAPPAN.

B. Furnish and install stranded, No. 20 AWG, shielded, single twisted pair plenum rated cable with a temperature range for dry locations -10 degrees C to 60 degrees C for each microphone outlet. A cable that meets this specification is WEST PENN Cat. No. 25292B or equal as manufactured by CONSULIDATED WIRE, GENERAL CABLE, PAIG or TAPPAN.

C. Furnish and install three stranded, two pair, twisted, shielded, No. 22 AWG plenum rated cables with a temperature range for dry locations of -10 degrees C to 75 degrees C for each ACS. A cable that meets this specification is WEST PENN Cat. No. D253652 or equal as manufactured by CONSULIDATED WIRE, GENERAL CABLE, PAIGE or TAPPAN.

D. Furnish and install one, four conductor, No. 20 AWG stranded plenum rated cable having two twisted conductors, shielded (loudspeakers) and two twisted conductors unshielded (switch) with a temperature range for dry locations of -10 degrees C to 60 degress C for each callback switch. A cable that meets this specification is WEST PENN Cat. No. 25359B or equal as manufactured by CONSULIDATED WIRE, GENERAL CABLE, PAIGE or TAPPAN.

E. Furnish and install four conductor, No. 20 AWG stranded plenum rated cables with a temperature range for dry locations of -10 degrees C to 60 degrees C to each volume control having two twisted conductors shielded and two twisted conductors unshielded. A cable that meets this specification is WEST PENN Cat. No. 25359B or equal as manufactured by CONSULIDATED WIRE, GENERAL CABLE, PAIGE or TAPPAN.

F. Furnish and install the following cables for priority override for each independent sound system (i.e. auxiliary, auditorium, gymnasium, etc.) within the building:

1. One, two conductor No. 14 AWG stranded, plenum rated cable, unshield (contact or voltage trigger) with a temperature range for dry locations of -10 degrees C to 60 degrees C. A cable that meets this specification is WEST PENN Cat. No. 25226B or equal as manufactured by CONSULIDATED WIRE, GENERAL CABLE, PAIGE or TAPPAN.
2. One stranded, No. 18 AWG, shielded, single twisted pair, plenum rated (voice) with a temperature range for dry locations of -10 degrees C to 60 degrees C. A cable that meets this specificaiton is CONSULIDATED WIRE, GENERAL CABLE, PAIGE or TAPPAN.

2.18 AM/FM ANTENNA

A. Furnish and install a BLONDER-TONGUE Model No. BTY-FM-2 FM antenna with an AM whip and mixing circuit to augment the antenna built into the tuner. Furnish and install a weatherhead, rigid steel conduit mast, and two RG-59 plenum rated cables from antennas to the tuner located in the sound and intercommunications system equipment rack. Each antenna cable shall be installed complete with a PICO MACOM Cat. No. GRB-1HRL grounding block. Ground antenna in accordance with Section 260526 # and NFPA 70.

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2.19 SOUND AND INTERCOMMUNICATIONS SYSTEM

PART 3 EXECUTION

3.01 RACK MOUNTED EQUIPMENT

A. Install with proper adapters, rack mounting kits, brackets, and closure panels for unused spaces. Interconnecting wiring shall be labeled, bundled, secured, and terminated in a neat and professional manner.

B. Plug in rack mounted equipment AC power cords into the mounted power strips.

3.02 ADMINISTRATIVE CONTROL STATIONS

A. ACS shall be wired to locations shown on the drawings and in specificaitons, provided with 12 feet of slack cable from the outlet point to the ACS.

3.03 ADMINISTRATIVE TELEPHONE RECEPTACLES

A. ACS receptacles shall be assembled and installed at mounting heights and locations indicated on the drawings, in outlet boxes appropriate for their location, wired ready for use.

3.04 SPEAKERS

A. Support flush ceiling mounted speaker assemblies from the building structure with a minimum of two steel wires. Ceiling baffles shall be finished flush with ceiling. The T-Bar shall be securely attached to the ceiling grad with pop-rivets at both ends. Flush ceiling mounted speakers shall be tapped at 0.5 watts, unless otherwise indicated.

B. Surface mounted speaker assemblies shall be securely fastened to the building structure with threaded rod or bolts as appropriate for the application. Surface mounted speakers shall be tapped for 0.5 watts, unless otherwise indicated.

C. Surface wall mounted speaker assemblies shall be securely fastened to the building structure with bolts appropriate for the application. Surface mounted speakers shall be tapped for 0.4 watts, unless otherwise indicated.

D. Horn type speakers shall be securely fastend to the building structure with threaded rods, bolts and/or bridging as required for the mounting location. Horn type speakers shall be tapped as directed by the Owner.

3.05 MICROPHONES

A. Unpack each microphone and assemble with cables and stands, and connect ready for operation. Microphones shown for permanent installatino shall be mounted in accordance with the drawings in a manner appropriated for the location.

3.06 MICROPHONE OUTLETS

A. Assemble microphone outlets and install, connect, and label as shown on the drawings.

3.07 CALL-BACK SWITCHES

A. Install callback switches at mounting heights and locations shown on the drawings, in outlet boxes appropriate for their location, wired ready for

3.08 FIELD WIRING

A. Sound and Intercommunications System:

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1. Install vertical low voltage field wiring in conduit and/or surface metal raceway as indicated on drawings and specifcations. Conduit fill shall **not** exceed the conduit space capacity.
2. Install horizontal cables in areas without a ceiling or in areas without an accessible ceiling in 1/2-inch conduit. Conduit is **not** required in areas designated on the drawings as "Electrical/Communications" rooms or closets.
3. Install horizontal low voltage field wiring in areas with an accessible ceiling bundled together and run exposed above the ceilings. Bundles shall be supported by "J" hooks mounted **not** more than four feet on center. "J" hooks to be dedicated to the wiring specified in this specification section.
4. Horizontal low voltage field wiring shall be run at right angles to the building structure.
5. Horizontal low voltage field wiring shall be installed below the roof/floor structural supports (joists, beams, girders, etc.). Wiring installed between structural supports mentioned above and the roof or floor deck will not be acceptable.
6. Horizontal low voltage field wiring penetrations through new and/or existing walls shall be sleeved. Minimum sleeve size shall be 3/4-inch. Sleeves shall have bushings on both sides.
7. Low voltage field wiring shall be installed, terminated and labeled. Cables shall not be nicked, strained, or damaged during the pulling operation. Splices shall be permitted at equipment enclosures and junction boxes only. Splices shall utilize insulated crimp type connectors. Junction box covers shall be stenciled for distinct identification.
8. Microphone cabling shall be installed in accordance with the requirements of special cables, however terminations at connectors shall be solder connected.
9. Low voltage wiring shall be checked and tested, to ensure the system is free from grounds, opens, and shorts.
10. All work peformed shall be under the supervision of a factory accredited sound engineer. It shall be the responsibility of the sound engineer and Contractor to check and inspect the installation to the Owner's and Architect/Engineer's approval.

3.09 ANTENNA INSTALLATION

A. Bracket mount antenna above the roof at a location approved by the Architect or shown on the drawings. Install antenna cable back to the equipment rack and connect ready for operation.

B. Ground antenna to the secondary building ground system with one No. 10 AWG in 1/2-inch conduit.

3.10 ON-SITE AS-BUILT DRAWINGS

A. Provide one set of the sound and intercommunications systems supplier's as-built drawings for permanent use onsite. Laminate each page of these drawings; provide a rigid means for mounting such as a 1/4-inch thick by 2-inch wide x width of the drawings through bolted wood along the left edge of the drawings. Furnish and intsall hanging hooks on the back of the Communications Room door; and hang the bound set of drawings. Provide a full as-built set of drawings in PDF format on USB thumb drive to Owner at the completion of the project.

3.11 INSTALLATION

A. Install in accordance with manufacturer's instructions.

END OF SECTION 275123

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SECTION 275129
RESCUE ASSISTANCE SIGNAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Area of rescue assistance emergency communication system and associated call stations, control stations, and accessories.
   1. Includes area of rescue assistance signage.

1.02 RELATED REQUIREMENTS

A. Section **<< 078400 - Firestopping>>**.

B. Section **<< 260526 - Grounding and Bonding for Electrical Systems>>**.

C. Section **<< 260533 - Conduit for Electrical Systems>>**.

D. Section **<< 260553 - Identification for Electrical Systems>>**: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines.

B. ADA Standards - 2010 ADA Standards for Accessible Design.

C. ICC (IBC) - International Building Code.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction.

E. NFPA 70 - National Electrical Code.

F. NFPA 72 - National Fire Alarm and Signaling Code.

G. NFPA 101 - Life Safety Code.

H. UL 924 - Emergency Lighting and Power Equipment.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment or other potential obstructions within the spaces dedicated for area of rescue assistance system components.
   2. Coordinate the work with other installers to provide communication lines required for control station timed automatic connection to designated constantly attended monitoring location.
   3. Notify **<<Architect>>** of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install call stations and control station(s) until final surface finishes and painting are complete.

1.05 SUBMITTALS

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A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each system component. Include configurations, standard wiring diagrams, dimensions, finishes, service condition requirements, and installed features.
   1. Design Data: Include standby battery calculations.
   2. Evidence of qualifications for installer.
   3. Evidence of qualifications for maintenance contractor (if different entity from installer).
   4. Specimen Warranty: Submit sample of manufacturer's warranty.

B. Field quality control test reports.

C. Operation and Maintenance Data: Include detailed information on system operation, equipment setup, replacement parts, and recommended maintenance procedures and intervals.
   1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.

D. Executed Warranty: Submit documentation of final executed warranty completed in **<<Owner>>**'s name and registered with manufacturer.

E. Maintenance contracts.

F. Project Record Documents: Record actual locations of system components and installed wiring arrangements and routing.

1.06 QUALITY ASSURANCE

A. Comply with the following:
   1. **<<ADA Standards>>**.
   2. **<<ICC (IBC)>>** (International Building Code).
   3. **<<NFPA 70>>** (National Electrical Code).
   4. **<<NFPA 72>>** (National Fire Alarm and Signaling Code).
   5. **<<NFPA 101>>** (Life Safety Code).
   6. Applicable TIA/EIA standards.

B. Manufacturer Qualifications: Company engaged in manufacturing the products specified in this section with minimum **<< three; or _____>>** years**<< documented; _____; or None - N/A>>** experience.

C. Installer Qualifications: Company with minimum **<< three; or _____>>** years**<< documented; _____; or None - N/A>>** experience with similar area of rescue assistance systems and providing contract maintenance service as a regular part of their business**<< ; manufacturer's authorized installer; ; _____; or None - N/A>>**.
   1. Contract maintenance office located within **<< 200 miles; or ___ miles>>** of project site.

D. Maintenance Contractor Qualifications: **<< Same entity as installer; Same entity as installer or different entity with specified qualifications; or _____>>**.

E. Products: Listed, classified, and labeled as suitable for the purpose intended.

F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

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1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>**, for additional warranty requirements.

B. Provide minimum **<< one; or _____>>** year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer: Talk-A-Phone

1. Source Limitations: Furnish system components and accessories produced by single manufacturer and obtained from single supplier.

2.02 AREA OF RESCUE ASSISTANCE COMMUNICATION SYSTEM

A. **<< Provide; Design and provide; or _____>> << new; modifications and additions to existing; or _____>>** area of rescue assistance communication system consisting of all required equipment, conduit, boxes, wiring, connectors, hardware, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. System Description:

1. Call Stations: Located at each designated area of rescue assistance**<< as indicated on drawings, unless otherwise directed by authorities having jurisdiction; as directed by authorities having jurisdiction; _____; or None - N/A>>**.
2. Master Control Station: **<< New; Existing; or _____>>**, located **<< as indicated on drawings, unless otherwise directed by authorities having jurisdiction; as directed by authorities having jurisdiction; or _____>>**.
3. Provide secondary control stations **<< located as indicated on drawings.; in the following locations:; in locations to be determined. Provide allowance for _____ secondary control stations; or _____>>**
4. System battery backup is **<< required; not required; or _____>>**.
   a. Capacity: **<< _____; or 24 hours standby, 90 minutes full operation>>**.
5. Timed automatic connection to designated constantly attended monitoring location is **<< required; not required; or _____>>**.

C. System Operation:

1. When a call for assistance is initiated at call station:
   a. Provide audible and visual notification at call station to confirm that call has been placed.
   b. Provide audible and visual notification at control station(s) that call has been placed and annunciate the location of the call station/zone that initiated a call.
   c. Maintain visual notification of each call location at control station(s) until manually reset by control station operator.
   d. Maintain audible notification at control station(s) that call(s) have been placed until call is acknowledged by control station operator.

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e. Maintain visual notification at call station until manually reset by control station operator.

2. When a call for assistance is acknowledged at control station:
   a. Provide visual notification at control station that call has been acknowledged.
   b. Provide visual notification at call station that call has been received.
   c. Establish two-way voice communication between call station and control station.
3. When a call has not been acknowledged during a programmed time delay to allow for local response, automatically initiate call **<< to listed remote monitoring station under contract with facility; or _____>>**, send signal identifying specific building, and establish two-way voice communication.

D. Call Stations:
1. Suitable for the environment where installed.
2. Finish: **<< Painted steel or stainless steel; Stainless steel; or _____>>**.
3. Mounting: **<< As indicated on drawings; Surface or flush-mounted; Surface-mounted; Flush-mounted; or _____>>**.
4. Provides means to initiate call for assistance.
5. Provides for distinct audible and visual notification to confirm that call has been placed and for distinct visual notification that call has been acknowledged.
6. Following initial call for assistance, provides for hands-free two-way communication with control stations.

E. Control Stations:
1. Suitable for the environment where installed.
2. Mounting: **<< As indicated on drawings; Surface or flush-mounted; Surface-mounted; Flush-mounted; or _____>>**.
3. Provides visual notification that system is operational.
4. Provides for distinct audible and visual notification of calls with annunciation of call station/zone locations.
5. Provides for two-way communication with selected call stations.
6. Provides for supervision of system wiring and provides distinct audible and visual notification of faults.
7. Audible Notification Sound Level: Not less than **<< 90 dB; or _____>>**.

F. Accessories:
1. Provide components as indicated or as required for a complete operating system.
2. Wiring: Provide manufacturer's recommended cables as indicated or as required for connections between system components, and in accordance with wiring methods indicated.
3. Signage:
   a. Illuminated Area of Rescue Assistance Signs: Complying with **<<NFPA 101>><< and all applicable state and local codes; _____; or None - N/A>>**, and listed and labeled as complying with **<<UL 924>>**.
   b. Call Station Instruction Signs: Raised character and Braille instructions complying with **<<ADA Standards>>**.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that characteristics of system components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive system components.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with **<<NECA 1>>** (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Mounting Heights:

1. Call Stations: **<< As indicated on drawings; Not exceeding _____ for forward reach and _____ for side reach in accordance with accessibility requirements; Comply with applicable accessibility requirements; or _____>>**.
2. Control Stations: **<< As indicated on drawings; Not exceeding _____ for forward reach and _____ for side reach in accordance with accessibility requirements; Comply with applicable accessibility requirements; or _____>>**

D. Wiring Method:

1. Installed in conduit in accordance with **<<NFPA 72>>** Level 2/Level 3 pathway survivability requirements.
   a. Exception: Buildings of less than 2-hour fire-rated construction that are fully protected by an automatic sprinkler system, where cables are installed in metal raceway or metal armored cables are utilized in accordance with **<<NFPA 72>>** Level 1 pathway survivability requirements.
2. Provide **<< Class A; Class B; Class N; or Class X>>** system wiring in accordance with **<<NFPA 72>>** pathway performance requirements.
3. Use listed plenum rated cables in spaces used for environmental air.
4. Conduit: Comply with Section **<< 260533; or _____>>**.
5. Conceal all cables unless specifically indicated to be exposed.

E. Provide grounding and bonding in accordance with Section **<< 260526; or _____>>**.

F. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section **<< 078400; or _____>>**.

G. Identify system wiring and components in accordance with Section **<< 260553; or _____>>**.

H. Identify zones at control station(s) to indicate call station locations.

I. Provide required instructional signage at each call station.

3.03 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>**, for additional requirements.

B. Test to verify wiring is free of shorts and grounds.

C. Prepare and start system in accordance with manufacturer's instructions.

D. Test system for proper operation.

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E. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 CLOSEOUT ACTIVITIES

A. See Section **<< 017800 - Closeout Submittals>>**, for closeout submittals.

B. Demonstration: Demonstrate proper operation of system to **<<Owner>>**, and correct deficiencies or make adjustments as directed.

C. Training: Train **<<Owner>>**'s personnel on operation, adjustment, and maintenance of system.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

3.06 PROTECTION

A. Protect installed system components from subsequent construction operations.

3.07 MAINTENANCE

A. Provide to **<<Owner>><< , a proposal as an alternate to the base bid,; , at no extra cost,; , _____ , ; or None - N/A>>** a separate maintenance contract for the service and maintenance of area of rescue assistance system for **<< one year; or _____>>** from date of Substantial Completion: Include a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.

B. Provide trouble call-back service upon notification by **<<Owner>>**:

1. Include allowance for call-back service during normal working hours at no extra cost to **<<Owner>>**.
2. **<<Owner>>** will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

C. Maintain an on-site log listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced.

END OF SECTION 275129

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SECTION 275129.17
TWO-WAY RADIO COMMUNICATION ENHANCEMENT SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Emergency responder communication enhancement system (ERCES) and associated components, including active equipment, battery secondary power source, passive components, and remote annunciator.

1.02 RELATED REQUIREMENTS

A. Section **<< 078400 - Firestopping; or _____>>**.

B. Section **<< 260526 - Grounding and Bonding for Electrical Systems; or _____>>**.

C. Section **<< 260553 - Identification for Electrical Systems; or _____>>**.

D. Section **<< 284600 - Fire Detection and Alarm; or _____>>**.

1.03 ABBREVIATIONS AND ACRONYMS

A. AHJ: Authorities having jurisdiction.

B. BDA: Bi-directional amplifier.

C. DAS: Distributed antenna system.

D. ECS: Emergency communications systems.

E. ERCES: Emergency responder communication enhancement system.

F. RF: Radio frequency.

G. UHF: Ultra high frequency.

H. VHF: Very high frequency.

1.04 DEFINITIONS

A. Bi-Directional Amplifier (BDA): Active RF-emitting device, wired with coaxial cables, for amplification of band-selective or multi-band RF signals via uplink to base station and via downlink from base station to portable two-way radios for enhanced signals and improved coverage; also referred to as analog or digital signal boosters.

B. Downlink: Transmission of signals from external source into building.

C. Fiber Distributed Antenna System (DAS) Master/Remote: Active RF-emitting device, wired with fiber-optic backbone, for distributing band-selective or multi-band RF signals via uplink to master/remote station and via downlink from master/remote station to portable two-way radio for enhanced signals and improved coverage.

D. Emergency Responder Communication Enhancement System (ERCES): In-building two-way communication system installed to enhance effective operation of radio communications systems for fire, emergency medical services, or law enforcement agencies within building or structure. System used by firefighters, police, and other emergency services personnel.

E. Public Safety/First Responder: Public safety or first responder agencies charged with responsibility of responding to emergency situations, including law enforcement departments, fire departments, and emergency medical services.

F. Uplink: Transmission of signals from inside building to external source.

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1.05 REFERENCE STANDARDS

A. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition.

B. ICC (IBC) - International Building Code.

C. ICC (IFC) - International Fire Code.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction.

E. NECA 90 - Standard for Commissioning Building Electrical Systems.

F. NECA/BICSI 607 - Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings.

G. NECA/FOA 301 - Standard for Installing and Testing Fiber Optic Cables.

H. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

I. NFPA 70 - National Electrical Code.

J. NFPA 72 - National Fire Alarm and Signaling Code.

K. NFPA 101 - Life Safety Code.

L. NFPA 780 - Standard for the Installation of Lightning Protection Systems.

M. NFPA 1225 - Standard for Emergency Services Communications.

N. UL 2524 - Emergency Responder Communication Enhancement Systems.

1.06 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Project Site:
    a. Coordinate with **<<Owner>>** to allow testing agency to enter property at reasonable time for field testing to confirm required level of radio coverage.
    b. Coordinate technical and operational criteria for design with AHJ and license holders, including required frequencies, radio site locations, effectiveness to radiate power from radio sites, maximum propagation delay in microseconds, and application types being used.
    c. Store technical and operational criteria with date marked, included with design documents at location approved by AHJ.
2. Installation Locations:
    a. Coordinate arrangement of communications equipment with dimensions and clearance requirements of equipment.
    b. Coordinate sizes and arrangement of supports and bases with equipment and components.
    c. Coordinate work to provide additional framing and materials required for installation.
    d. Coordinate work with placement of supports and anchors required for mounting.
    e. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
    f. Notify **<<Architect>>** of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
3. Coordinate minimum sizes of conduits with actual type and quantity of cables.
4. Coordinate for power branch circuit protection and identification.
5. Coordinate listing requirements for fire-rated cables or assemblies.

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6. Coordinate work to provide power for equipment at required locations.
7. Coordinate work to avoid placement of ductwork, piping, equipment, or other potential obstructions within spaces dedicated for ERCES components.
8. Coordination work with other sections, including fire alarm systems and associated communications cabling.
9. Coordinate roof component locations and pathway work with **<<Architect>>**. Provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
10. Coordinate integrated fire protection and life safety system tests in accordance with **<<NFPA 1225>>**.

B. Preinstallation Meetings: Require attendance of affected installers.
1. Convene **<< one week; or _____>>** prior to commencing work of this section. Review proposed routing, sequence of installation, and protection requirements for system.
2. Conduct preinstallation meetings to review design and operation of ERCES.
a. Highlight importance of proper authorizations, operation, and performance to avoid interfering with public safety radio networks.

Overview criteria for when equipment's transmitted power output is sufficient to require certification of frequency-licensing authority and associated restriction of installing or energizing prior to obtaining simultaneous written authorizations.

C. Sequencing:
1. Conduct meeting with facility representative to review equipment locations.
2. Obtain permits necessary for installation prior to commencement of work. Include permit costs and inspection fees.
3. Do not install active RF-emitting devices until AHJ and license holders concurrently provide prior written authorization.
4. Do not energize active RF-emitting devices until AHJ and license holders concurrently provide prior written authorization.
5. Verify naming convention for equipment identification prior to creation of final drawings, reports, and warning labels, where applicable.
6. Sequence work with affected installers to protect cabling (e.g., overspray painting, physical stress, and insulation damage or covering markings).
7. Do not connect cables on terminals before insulation resistance testing.

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1.07 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. See Section **<< 016000 - Product Requirements>>** for additional provisions.

C. Include names of installers, **<<Owner>>**, and system classification information.

D. Product Data: Manufacturer's detailed product data sheet for each component, including wiring diagrams, and cabling or communications wiring length limitations. Catalog pages and product descriptions include ratings, dimensions, finishes, service conditions, and included features.

E. Shop Drawings: Submit installation documentation required for plan review and permitting by AHJ and frequency license holders, including floor plans showing locations of fire alarm system or other interconnects, enlarged drawn to identified scale plan view, and riser diagrams.
1. Show locations of components, circuits, and raceways; mark components with identifiers used in control unit programming.
2. Include elevations and details of proposed equipment arrangements.

3. Include system interconnection schematic riser diagram showing proposed and approved cable size and type; coordinated with floor plans and describing circuit class, survivability, and application-specific information required by **<<NFPA 72>>**.
4. Include typical wiring diagrams for devices, annunciators, and related ERCES equipment.
5. Include requirements and control diagrams for interfacing with other systems.
6. Detailed drawing of annunciators.

F. Certifications:
1. Certification by **<<Contractor>>** that system design complies with Contract Documents.

G. Design Documents: Submit information required for plan review and permitting by AHJ and frequency license holders, including floor plans, riser diagrams, and description of operation.
1. Include complete listing of software required.

H. Design Data:
1. Power supply calculations demonstrating adequate battery power.

I. RF Survey for ERCES:
1. Include RF measurement drawings for coverage areas and indicate relative RF field strength for each frequency band required.
2. Indicate passed or failed by area based on required technical parameters.

J. Signal booster registry for FCC requirements.

K. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

L. Inspection and Test Reports:
1. Submit inspection and test plan prior to closeout demonstration.
2. Submit documentation of satisfactory inspections and tests.

M. Operating and Maintenance Data:
1. Original copy of **<<NFPA 72>>** and **<<NFPA 1225>>**.
2. Complete set of specified design documents, as approved by AHJ and frequency license holders.
3. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
4. Contact information for firm providing contract maintenance and trouble call-back service.
5. List of recommended spare parts, tools, and instruments for testing.
6. Replacement parts list with current prices, and source of supply.
7. Detailed troubleshooting guide.
8. Preventive maintenance, inspection, and testing schedule complying with **<<NFPA 1225>>** and **<<ICC (IFC)>>**; provide printed copy and computer format acceptable to **<<Owner>>**.
9. Detailed but easy-to-read explanation of procedures requires recording of system trouble events by qualified personnel (e.g., when routine testing is being conducted for fire drills and when entering into contracts for building renovations).

N. Executed warranty.

1.08 QUALITY ASSURANCE

A. Comply with the following:
1. **<<ICC (IBC)>>**.

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2. **<<ICC (IFC)>>**.
3. **<<NFPA 70>>**.
4. **<<NFPA 72>>**.
5. **<<NFPA 101>>**.
6. Code of Federal Regulations.

B. Unless Otherwise Approved by AHJ, Qualifications:
1. Provide qualifications as required by AHJ and frequency license holders.
2. Designer Qualifications:
a. Designer personnel maintains valid FCC-issued general radio operators license (GROL).
b. ERCES design performed by RF system designer.
c. Designer personnel certified and authorized by in-building active RF-emitting equipment manufacturer in requirements for installation and operation of their equipment.
3. Product Evaluation and Listing Organization Qualifications: Organization engaged in evaluation of products and services, including those recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL), and acceptable to AHJ and frequency license holders.
a. Register signal booster specified Class A or Class B for applicable FCC requirements and provide proof in submittals:
4. Installer Qualifications: Company specializing in performing work of type specified and with at least **<< three; or _____ >>** years of**<< documented; _____; or None - N/A>>** experience and:
a. Installer personnel maintains valid FCC-issued general radio operators license (GROL).
b. Supervisors and Installers: Factory-certified by manufacturers of products.
c. Installer personnel certified and authorized by in-building active RF-emitting equipment manufacturer in accordance with requirements for installation and operation of their equipment.
5. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.
a. Testing personnel certified and authorized by active RF-emitting equipment manufacturer in requirements for installation and operation of their equipment.

C. Approved ERCES and Related Cabling:
1. Provide system type as required by AHJ and frequency license holders.
2. Automatically Activated ERCES: Where negative impact to normal operations of facility occurs, automatic activation requires AHJ approval.
3. Permits: Provide construction and operational permits for active equipment.
4. Obtain written approval from frequency license holders that may be adversely impacted by ERCES, resulting in noise interference.

1.09 WARRANTY

A. See Section **<< 017800 - Closeout Submittals>>** for additional warranty requirements.

B. Manufacturer Warranty: Provide **<< 1-year; 2-year; or _____>>** manufacturer warranty. Complete forms in **<<Owner>>**'s name and register with manufacturer.

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PART 2 PRODUCTS

2.01 TWO-WAY RADIO COMMUNICATION ENHANCEMENT SYSTEMS

A. General Requirements:
   1. Provide **<< new; modifications and extensions to existing; or _____>>** ERCES consisting of equipment, conduit, cabinets, outlet boxes, wiring, connectors, hardware, supports, accessories, components, software, and system programming as required for complete operating system.
   2. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
      a. Requirements of AHJ.
      b. Applicable local codes.
      c. RF system design documents.
      d. Contract Documents.
      e. **<< _____>>**.
   3. Provide products listed, classified, and labeled as suitable for intended purpose.
   4. Monitor primary and secondary power sources for integrity in accordance with **<<NFPA 72>>**, **<<NFPA 1225>>**, and **<<ICC (IFC)>>**. For each RF-emitting device and active system component:
      a. Include monitoring for communications links.
      b. Provide automatic supervisory signals for malfunctions.
   5. Include integrated, remote, real-time monitoring and control capabilities.
   6. Provide repeaters, transmitters, optical-to-RF and RF-to-optical converters, and external filters contained in **<<NEMA EN 10250>>**, **<< Type 4; Type 4X; or _____>>** enclosures.

B. System Performance:
   1. Minimum Signal Strength:
      a. Entire Building: 95 percent.
      b. Designated Critical Areas: 99 percent.
      c. Downlink and Uplink Capability:
         1) Provide design for usable voice communication throughout coverage areas.
         2) Provide design to meet technical requirements of applications utilized by public safety system.
         3) Provide minimum delivered audio quality (DAQ) of 3.0 using narrowband analog, digital, or wideband LTE signals, or equivalent bit error rate (BER) or signal-to-interference-plus-noise ratio (SINR) applicable to technology for analog or digital signals.
   2. Communication Antenna Density: Design to minimize near-far effect and include ability to reduce gain conditions.

C. Capabilities:
   1. Capable of operating on frequencies licensed to public safety agencies in accordance with **<<ICC (IFC)>>**.
   2. Design system capable of modification or expansion if frequency changes are required by FCC or other frequency-licensing authorities or AHJ.

D. Nonpublic Amplification Safety Systems:

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1. Design system for passive components to maintain 20 dB above system gain under operating conditions; maintain minimum 20 dB isolation of donor antenna from other inside antennas.
2. Suspend and correct systems that reduce performance or cause interference with ERCES. Obtain approved resolution from AHJ and frequency license holders.

E. Provide ERCES circuits and interconnects in accordance with **<<NFPA 70>>**.
   1. Comply with methods of interconnecting FACUs for automatic supervision in accordance with **<<NFPA 1225>>**, **<<NFPA 72>>**, and **<<NFPA 70>>**.
   2. Power Sources:
      a. Comply with requirements for power supplies of emergency systems in accordance with **<<NFPA 70>>**.
      b. Primary: **<< Dedicated branch circuits from facility power distribution system; or _____>>**.
      c. Secondary: Storage batteries with capacity to operate system for period specified by **<<ICC (IFC)>>**.
         1) Provide 12-hour standby for 100 percent system capacity or 2-hour standby when connected to site standby generator.
   3. Wiring and Wiring Methods:
      a. General Requirements:
         1) Comply with requirements for wiring and wiring methods in accordance with **<<NFPA 70>>**.
         2) Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum-rated, listed, and labeled as suitable for use in return air plenums.
         3) Special Occupancies: Comply with **<<NFPA 70>>**.
         4) Comply with **<<NFPA 70>>** for wire and cable for plenum, riser, general-purpose, limited-use, and underground applications.
      b. Fire-Rated Cables and Cable Systems:
         1) Performance alternative approved by AHJ.
         2) Provide cable fastening and listing requirements in accordance with **<<NFPA 70>>**. Provide indication of application, use cases, and product make and model for which listing applies.
         3) Provide additional classification suffix marking on cable system; observable by AHJ.

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2.02 ACTIVE EQUIPMENT

A. Provide equipment listed and labeled as complying with agency listings and approval requirements as follows:
   1. Federal Communications Commission (FCC).
   2. Frequency license holders.
   3. Other radio licensing authorities.
   4. **<<ICC (IFC)>>**.
   5. **<<NFPA 70>>**.
   6. **<<NFPA 72>>**.
   7. **<<NFPA 1225>>**.
   8. **<<UL 2524>>**.

B. Enclosure: **<<NEMA EN 10250>>**, **<< Type 4; Type 4X; or _____>>**.

C. Provide modular design capable of scaling for future expansions. Utilize coax and **<< analog; digital; or _____>>** BDA or**<< single-mode; multi-mode; _____; or None - N/A>>** fiber optic and master-remote DAS design, or design utilizing combination with centralized control, for ERCES.

D. Support Multi-Band Operation:
   1. Provide **<< dedicated; dual-band (VHF/UHF); or _____>>** equipment for each frequency range indicated.

E. Active RF-Emitters and Repeaters: Provide devices that support associated FCC requirements for Class A or Class B operation, compatible for intended use in accordance with related ERCES equipment listings and manufacturer requirements.

F. Include built-in oscillation detection, interference protection, and gain control circuitry to reduce gain and maintain operation.
   1. Transmit supervisory signal when oscillations are detected.
   2. Automatic shutdown when uncorrectable oscillations occur.

2.03 BATTERY SECONDARY POWER SOURCE

A. Provide batteries, charger, circuit protection, and related components as complete system.

B. Provide equipment listed and labeled as complying with agency listings and approval requirements:
   1. Federal Communications Commission (FCC).
   2. Frequency license holders.
   3. Other radio licensing authorities.
   4. **<<ICC (IFC)>>**.
   5. **<<NFPA 70>>**.
   6. **<<NFPA 72>>**.
   7. **<<NFPA 1225>>**.
   8. **<<UL 2524>>**.

C. Enclosure Type:
   1. Batteries Requiring Venting: **<<NEMA EN 10250>>**, **<< Type 3R; or _____>>**.
   2. Batteries Not Requiring Venting: **<<NEMA EN 10250>>**, **<< Type 3R; Type 4; Type 4X; or _____>>**.

D. Provide battery secondary power source compatible for intended use and in accordance with related ERCES equipment listings and manufacturer requirements.

E. Provide power in accordance with **<<NFPA 70>>**, Chapter 7, (i.e., 10 seconds maximum) when primary power is outside of programmed settings.

2.04 PASSIVE COMPONENTS

A. Description: Provide passive component requirements in RF system design as required for complete system, including passive RF-emitters, design frequency range, gain values, radiation patterns or heat maps, voltage standing wave ratio, polarization, power handling, impedance, connector types, environmental ratings, device losses, isolation characteristics, signal rejection, component size, form factor, attenuation values, output accuracy, and thermal stability.

B. Provide passive components compatible for intended use in accordance with related ERCES equipment listings and manufacturer requirements for RF system design, including quantities necessary:

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1. Donor antennas.
2. Service antennas.
3. Antenna discharge units as required by **<<NFPA 780>>** and **<<ICC (IFC)>>**.
4. Duplexers.
5. Notch filters.
6. Jumpers and connectors.
7. Tappers and splitters.

C. Enclosure Type:
1. External Filters: **<<NEMA EN 10250>>**, **<< Type 4; Type 4X; or _____>>**.

2.05 REMOTE ANNUNCIATOR

A. Provide equipment listed and labeled as complying with agency listings and approval requirements:
1. Federal Communications Commission (FCC).
2. Frequency license holders.
3. Other radio licensing authorities.
4. **<<ICC (IFC)>>**.
5. **<<NFPA 70>>**.
6. **<<NFPA 72>>**.
7. **<<NFPA 1225>>**.
8. **<<UL 2524>>**.

B. Provide remote annunciators or operational consoles with status of active equipment.

C. Include visual and labeled indications for system components and devices in accordance with **<<ICC (IFC)>>** and **<<NFPA 1225>>**.

D. Include necessary modules for monitoring communications link between in-building ERCES and fire alarm control unit (FACU) for integrity.

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PART 3 EXECUTION

3.01 INSTALLATION

A. Concurrent Approvals Required:
1. Provide prior written approval from AHJ and frequency license holders of systems being enhanced.
2. Meet to review their established criteria for installation prior to beginning work.
3. Only frequency license holders have authority to permit powering and operating ERCES. Do not energize system before obtaining additional written approvals.
4. Include expiration date on written approvals, coincident with annual maintenance requirements.

B. Install products in accordance with **<<NFPA 1225>>**, **<<ICC (IFC)>>**, state and local codes, manufacturer's instructions, and as indicated on drawings and RF design documents.

C. Comply with the following:
1. **<<BICSI N1>>**.
2. **<<NECA 1>>**.
3. **<<NECA/FOA 301>>**.
4. **<<NECA/BICSI 607>>**.

5. **<<NFPA 70>>**; including requirements for mechanical execution of work.
6. **<<NFPA 72>>**.

D. ERCES Components:
1. **<<UL 2524>>** Listed and Labeled Equipment: Do not drill holes or field fabricate openings. Mark equipment front with identifier DO NOT DRILL INTO THIS CABINET label.
2. Donor Antenna Mounting:

E. Interconnects and Branch Circuits:
1. Provide grounding and bonding in accordance with **<<NFPA 70>>** Article 250, Chapter 8 Communications Systems, and manufacturer's recommendations.
2. Provide dedicated branch circuit for each battery system.
3. Identify system wiring, components, and overcurrent protective devices for branch circuits serving ERCES and related equipment.
4. Provide systems integration and interfacing with other work as required for complete ERCES.
5. Install firestopping to preserve fire resistance rating of partitions and other elements.

F. Troubleshooting and Installer Checks:
1. Field test connectivity periodically during installation process to avoid unexpected troubleshooting.
2. Do not energize system until deficiencies have been corrected.

3.02 FIELD QUALITY CONTROL

A. See Section **<< 014000 - Quality Requirements>>** for additional requirements.

B. Approval Required Before Installation, Energizing, and Startup; Minimum **<< Two Weeks; or _____>>** Notice:
1. Frequency license holders.
2. **<<Architect>>**.
3. **<<Owner>>**.
4. AHJ.

C. Manufacturer Services: Provide services of manufacturer's field representative to **<< perform; observe and approve; direct; or _____>>** systems startup.

D. Prepare and start equipment and systems in accordance with manufacturers' instructions and recommendations.

E. Coordination of Other Tests and Inspections: Provide **<< access; and _____>>** to accommodate tests and inspections by independent testing agency employed by **<<Owner>>**.

F. Perform tests for cable insulation resistance and acceptance testing procedures in accordance with **<<ICC (IFC)>>** and **<<NFPA 1225>>**.
1. Use NICET-certified test equipment for system verifications.
2. Use calibrated portable radios of same make and latest model used by AHJ.
3. Use spectrum analyzer or similar for monitoring oscillations from RF-emitting or other system active equipment.
4. Measure gain values of every ERCES amplifier and review test results against baseline data kept on file for annual testing.
5. Test building coverage for emergency communication systems, inside and outside, to and from the building, for minimum radio coverage indicated in TWO-WAY RADIO COMMUNICATION ENHANCEMENT SYSTEMS under PART 2.

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6. Divide Coverage For Testing, Options:
   a. Maximum **<< 20; 40; or _____>>** equal areas, per building floor. From center of area, use two-way communications to and from outside of building for interfacing with AHJ's public system.
      1) Comply with **<<NFPA 1225>>** and **<<ICC (IFC)>>** maximum square footage per area.
      2) Failing to communicate in more than one test area is failed acceptance test.
   b. Use radios for simultaneous voice quality checks; subjective by testing personnel. Position one radio within **<< 10 ft>>** to indoor antenna and second radio distance farthest away from indoor antenna. Both radios select different frequencies within same band for testing.
      1) Signal strength less than delivered audio quality (DAQ) of 3.0 is failed acceptance test.
7. Nonconforming Work:
   a. Repositioning test location for better test results not allowed.
   b. Alter system to meet coverage requirements and reacceptance test for compliance.

END OF SECTION 275129.17

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SECTION 275140
GYMNASIUM SOUND REINFORCEMENT SYSTEM

PART 1 - GENERAL

1.01 SCOPE

A. The work covered under this section shall include furnishing and installing locally controlled complete and satisfactorily operating auxiliary stereo sound reinforcement system in the Gymnasium for the pickup, amplification, and reproduction of voice and/or music to associated loudspeakers.

1.02 SUBMITTALS

A. Product Data and Shop Drawings:
   1. Submit a complete list of equipment indicating the specific quantities to be provided by Contractor. The catalog or model number for each module of the system(s) shall be listed next to the quantities. This information shall be furnished in the front of the submittal.
   2. Submit a specific description of the system(s) describing each module and how it shall function in the system.
   3. Submit a specific drawing furnished of the (each) equipment rack. Each module shall be shown in its proper location with its terminal designations shown.
   4. Submit a data sheet for each module and device. The information shall be highlighted that applies to the particular module or device to be furnished.
   5. Submit a detailed diagram showing how to connect each device, indicating the exact final connection information.
   6. Submit a detailed set of floor plans for the area(s) where the (each) auxiliary sound system(s) is (are) to be installed. The plans shall show the locations of all equipment, loudspeakers, and devices and their required interconnections. The interconnections shown shall indicate the number, size, and type of wires as described in this specification. Loudspeakers shall be zoned as shown on the drawings. The layout of all auxiliary sound reinforcement system(s) equipment, devices, and conduit routing shall closely follow that shown on the drawings.

1.03 QUALITY ASSURANCE

A. All equipment specified herein shall be the product of a manufacturer of established reputation and experience who shall have produced similar apparatus for a period of at least ten years and who shall be able to refer to similar installations now rendering satisfactory service.

B. The auxiliary sound reinforcement system(s) shall be furnished by a factory authorized distributor certified to design, program, and service the system. The distributor must show evidence of successfully furnishing systems specified for at least five years

C. All equipment for this system shall be listed by Underwriters Laboratories, Inc. (UL), bear the UL label and shall be installed in accordance with all requirements of the National Electrical Code (NEC), state and local codes, and these Specifications.

D. The auxiliary sound reinforcement system(s) shall be furnished and installed by Contractor as shown on the drawings and as specified herein.

1.04 DOCUMENTATION

A. Contractor shall furnish to the Contractor, one set of "As Built" drawings depicting the complete field wiring system and component interconnections in the system equipment rack.

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B. Contractor shall furnish to the Contractor four sets of factory operation and maintenance manuals. These manuals shall include factory service manuals with complete parts lists, wiring and component schematics including circuit diagrams, and all other information necessary for the proper operation and service maintenance of the system.

1.05 TRAINING

A. Contractor shall furnish eight hours of technical service training to the Owner's technical staff using the factory operation manuals previously specified.

B. Contractor shall furnish eight hours of operating and programming training to the Owner's operating staff which shall be delivered in two separate four hour sessions to be scheduled at the Owner's convenience over the two year warranty period.

C. All training specified herein shall be performed by a factory certified technician.

1.06 DESCRIPTION OF OPERATION

A. Each system shall provide for the distribution of voice and music to all associated loudspeakers.

B. Each system shall provide for the reproduction of MP3 and compact disc recordings and distribute them to all associated loudspeakers.

C. Each system shall provide for the input and output of an MP3 Player via two 0.14-inch jacks. One is to be mounted at the equipment rack and one is to be mounted remotely in a wallplate with a microphone jack.

D. Each system shall provide for individual bass and treble controls.

E. Each system shall provide a personal listening system for use by hearing impaired listeners.

F. Each Auxiliary sound reinforcement system shall accept a priority override signal to mute the system when the main building Sound and Intercommunications System activates the priority override function.

1.07 SYSTEM TEST AND ACCEPTANCE

A. Prior to the final site visitation, and acceptance of each construction phased spaces, ts Contractor shall conduct an operating test of each complete auxiliary sound reinforcement system. Each system shall test free from grounds, shorts, and other faults. All connections shall be checked for mechanical and electrical connection. All equipment shall be demonstrated to operate in accordance with the requirements set forth in these specifications and as shown on the drawings.

B. Contractor shall perform all tests in the presence of the Architect/Engineer. Contractor shall furnish all personnel and test instruments required for use in the test.

1.08 WARRANTY

A. Contractor shall deliver the work described herein in a first class operating condition in every respect. Contractor shall also warrant that the material, equipment, and workmanship shall be entirely free from defects. Any materials, equipment, or workmanship in which defects may develop before or during the warranty period shall be repaired or replaced at the Contractors own expense. Refer to Division 01 for the start of the warranty period. The contractor shall further warrant that all material, equipment, and workmanship used in the installation, but not specifically mentioned in the drawings and Specifications, is the best of their respective kinds and that the construction and installation was performed in accordance with the best accepted standard practices in all details.

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B. The manufacturer shall be prepared to offer a service contract for the maintenance of the system beyond the warranty period.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The auxiliary sound reinforcement system(s) equipment shall be manufactured by SOUNSPHERE, CROWN, PASO, BTX, ATLAS SOUND, WILLIAM SOUND, DENON, and SHURE, as listed.

2.02 AUXILIARY SOUND REINFORCEMENT SYSTEM EQUIPMENT RACKS

A. Contractor shall furnish and install sectional wall mounted auxiliary sound system equipment racks as shown on the drawings and herein specified. Each rack shall be ATLAS SOUND Model No. WMA24-23 with locking front door providing a minimum of forty-two vertical inches of standard nineteen inch wide rack mounting space. Each rack shall be complete with a cylinder lock and textured black finish. The following equipment shall be furnished and installed by Contractor in each rack:

1. One PASO Model No. DMS260P ten channel, digital mixer/preamplifier with 27/3501 Rack Mount Kit. One PASO Model No. PM01ML Mic/Line input module. The mixer shall be complete with treble and bass controls and shall be capable of phantom power service for condenser microphones.
2. One Denon Model No. DN-C615 rack mountable CD/MP3 Player. Contractor shall provide a wall-mounted controller adjacent to the auxiliary sound system rack for the CD/MP3 player specified above.
3. One CROWN Model No. COi 1000 dual channel amplifier with two hundred and seventy-five watts per channel at eight ohms. Amplifier shall be suitable for rack mounting.
4. One Atlas Sound Model No. ACRL-291 rack mountable power panel complete with eight switched outlets and surge protection.
5. Two Shure Model No. ULXS124/85-M1 complete wireless microphone systems, two Shure Model No. UA820C Remote Antennas, and one UA844US Wideband (470-900 MHz) Four-Way Active Antenna Splitter and Power distribution system.
6. One WILLIAMS SOUND Model No. PPA T35 personal listening system base station transmitter complete with WILLIAMS SOUND Model No. RPK 005 rack mounting kit and ANT 005 coaxial antenna.
7. Contractor shall furnish to the Owner's representative, twelve WILLIAMS SOUND Model No. PPA R35-8N, eight channel personal listening system receivers each complete with WILLIAMS SOUND Model No. EAR 013 single earbud, rechargeable batteries, and belt clip. Receiver shall be set to operating frequencies of 72.1 MHz (receiver channel 1).
8. Contractor shall furnish to the Owner's representative, one WILLIAMS SOUND Model No. CHG 3512 - Twelve-charger units for the personal listening system receivers.
9. One (1) Shure Model No. UA507 Rack Mount Kit for double receiver and two (2) UA820C Remote Antennas.

2.03 MICROPHONES

A. Contractor shall furnish a total of four Shure Model No. SM58S dynamic cardioid microphones. Each microphone shall be furnished by Contractor complete with a twenty five foot connector cord with CANNON XLR connectors.

B. Provide one Shure desk type 450 series 2.

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2.04 MICROPHONE FLOOR STANDS

A. Contractor shall furnish a total of four Atlas Sound Model No. MS-20 adjustable microphone floor stands for each system.

2.05 MICROPHONE OUTLETS

A. Contractor shall furnish and install where shown on the drawings, flush or surface wall and/or ceiling mounted microphone outlets consisting of CANNON "XLR" series audio jack of the type required so as to be compatible with the type of microphone cable connector furnished, and a stainless steel coverplate. A microphone outlet, which meets this specification, is BTX Model No. PL-103F with 3 pin XLR. At least one microphone outlet shall also have, mounted to the faceplate, a 3.5 mm Stereo Input Jack.

2.06 LOUDSPEAKERS

A. Contractor shall furnish two Soundsphere speakers Model No. Q-8 with all required hardware for a complete installation. A TX100 line-matching transformer shall be provided for the Gymnasium speakers. Speakers shall be tapped at 70.7V and 100W.

2.07 FIELD WIRING

A. Contractor shall furnish and install field wiring for auxiliary sound systems loudspeakers as shown on the drawings. Wiring shall be two conductor, No. 16 AWG stranded cable. A cable that meets this specification is WEST PENN Cat. No.25225B or equal as manufactured by CONSOLIDATED ELECTRONIC WIRE AND CABLE, GENERAL CABLE, PAIGE, or TAPPAN.

B. Contractor shall furnish and install field wiring for microphone outlets as shown on the drawings. Wiring shall be two conductor, No. 20 AWG stranded and shielded cable. A cable that meets this specification is WEST PENN Cat. No. 25292 or equal as manufactured by CONSOLIDATED ELECTRONIC WIRE AND CABLE, GENERAL CABLE, PAIGE, or TAPPAN.

PART 3- EXECUTION

3.01 INSTALLATION

A. All low voltage wiring for the auxiliary sound reinforcement systems shall be installed by Contractor in 1/2-inch conduit as hereinbefore specified. All junction box covers shall be stenciled by Contractor for distinct identification. All conduits, device mounting boxes, junction boxes, and enclosures shall be securely fastened with appropriate fittings to insure a positive ground throughout each entire system.

B. All low voltage wiring connections shall be made by Contractor as directed by the manufacturer. Splices for circuits shall be made only in junction boxes and shall be crimp connected.

C. All wiring for the auxiliary sound reinforcement systems shall be checked and tested by Contractor to ensure the system is free from grounds, opens, and shorts.

D. All work shall be under the direct supervision of an accredited factory sound engineer. It shall be the responsibility of the sound engineer and Contractor to check and inspect this installation to the Architect/Engineer's approval.

3.02 RACK MOUNTED EQUIPMENT

A. The auxiliary sound reinforcement system(s) rack mounted equipment shall be installed by Contractor with the proper adapters, rack mounting kits, brackets, and closure panels for unused spaces. All interconnecting wiring shall be labeled, bundled, secured, and terminated by Contractor in a neat and professional manner.

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B. All rack mounted equipment AC power cords shall be plugged into the mounted power strip by Contractor.

3.03 SPEAKER

A. Speaker assemblies shall be supported by Contractor from the building structure with a minimum of two steel wires.

3.04 MICROPHONES

A. Contractor shall unpack each microphone and assemble with cables and stands and connect ready for operation.

3.05 MICROPHONE OUTLETS

A. Contractor shall assemble microphone outlets and install, connect, and label as shown on the drawings.

END OF SECTION 275140

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SECTION 275141
STUDENT DINING SOUND REINFORCEMENT SYSTEM

PART 1 - GENERAL

1.01 SCOPE

A. The work covered under this section shall include furnishing and installing locally controlled complete and satisfactorily operating auxiliary stereo sound reinforcement system in student dining for the pickup, amplification, and reproduction of voice and/or music.

1.02 SUBMITTALS

A. Product Data and Shop Drawings:
   1. Submit a complete list of equipment indicating the specific quantities to be provided by Contractor. The catalog or model number for each module of the system(s) shall be listed next to the quantities. This information shall be furnished in the front of the submittal.
   2. Submit a specific description of the system(s) describing each module and how it shall function in the system.
   3. Submit a specific drawing furnished of the (each) equipment rack. Each module shall be shown in its proper location with its terminal designations shown.
   4. Submit a data sheet for each module and device. The information shall be highlighted that applies to the particular module or device to be furnished.
   5. Submit a detailed diagram showing how to connect each device, indicating the exact final connection information.
   6. Submit a detailed set of floor plans for the area(s) where the (each) auxiliary sound system(s) is (are) to be installed. The plans shall show the locations of all equipment, loudspeakers, and devices and their required interconnections. The interconnections shown shall indicate the number, size, and type of wires as described in this specification. Loudspeakers shall be zoned as shown on the drawings. The layout of all auxiliary sound reinforcement system(s) equipment, devices, and conduit routing shall closely follow that shown on the drawings.

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1.03 QUALITY ASSURANCE

A. All equipment specified herein shall be the product of a manufacturer of established reputation and experience who shall have produced similar apparatus for a period of at least ten years and who shall be able to refer to similar installations now rendering satisfactory service.

B. The auxiliary sound reinforcement system(s) shall be furnished by a factory authorized distributor certified to design, program, and service the system. The distributor must show evidence of successfully furnishing systems specified for at least five years

C. All equipment for this system shall be listed by Underwriters Laboratories, Inc. (UL), bear the UL label and shall be installed in accordance with all requirements of the National Electrical Code (NEC), state and local codes, and these Specifications.

D. The auxiliary sound reinforcement system(s) shall be furnished and installed by Contractor as shown on the drawings and as specified herein.

1.04 DOCUMENTATION

A. Contractor shall furnish one set of "As Built" drawings depicting the complete field wiring system and component interconnections in the system equipment rack.

B. Contractor shall furnish four sets of factory operation and maintenance manuals. These manuals shall include factory service manuals with complete parts lists, wiring and component schematics including circuit diagrams, and all other information necessary for the proper operation and service maintenance of the system.

1.05 TRAINING

A. Contractor shall furnish eight hours of technical service training to the Owner's technical staff using the factory operation manuals previously specified.

B. Contractor shall furnish eight hours of operating and programming training to the Owner's operating staff which shall be delivered in two separate four hour sessions to be scheduled at the Owner's convenience over the two year warranty period.

C. All training specified herein shall be performed by a factory certified technician.

1.06 DESCRIPTION OF OPERATION

A. Each system shall provide for the distribution of voice and music to all associated loudspeakers.

B. Each system shall provide for the reproduction of MP3 and compact disc recordings and distribute them to all associated loudspeakers.

C. Each system shall provide for the input and output of an MP3 Player via two **<< 0.14 inch>>** jacks. One is to be mounted at the equipment rack and one is to be mounted remotely in a wallplate with a microphone jack.

D. Each system shall provide for individual bass and treble controls.

E. Each system shall provide a personal listening system for use by hearing impaired listeners.

F. Each Auxiliary sound reinforcement system shall accept a priority override signal to mute the system when the main building Sound and Intercommunications System activates the priority override function.

1.07 SYSTEM TEST AND ACCEPTANCE

A. Prior to the final site visitation, and acceptance of each construction phased spaces, Contractor shall conduct an operating test of each complete auxiliary sound reinforcement system. Each system shall test free from grounds, shorts, and other faults. All connections shall be checked for mechanical and electrical connection. All equipment shall be demonstrated to operate in accordance with the requirements set forth in these specifications and as shown on the drawings.

B. Contractor shall perform all tests in the presence of the Architect/Engineer. Contractor shall furnish all personnel and test instruments required for use in the test.

1.08 WARRANTY

A. Contractor shall deliver the work described herein in a first class operating condition in every respect. Contractor shall also warrant that the material, equipment, and workmanship shall be entirely free from defects. Any materials, equipment, or workmanship in which defects may develop before or during the warranty period shall be repaired or replaced at the Contractors own expense. Refer to Division 01 for the start of the warranty period. The contractor shall further warrant that all material, equipment, and workmanship used in the installation, but not specifically mentioned in the drawings and Specifications, is the best of their respective kinds and that the construction and installation was performed in accordance with the best accepted standard practices in all details.

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B. The manufacturer shall be prepared to offer a service contract for the maintenance of the system beyond the warranty period.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The auxiliary sound reinforcement system(s) equipment shall be manufactured by CROWN, PASO, BTX, ATLAS SOUND, DENON, ELECTRO-VOICE, and SHURE, as listed.

2.02 AUXILIARY SOUND REINFORCEMENT SYSTEM EQUIPMENT RACKS

A. Contractor shall furnish and install sectional wall mounted auxiliary sound system equipment racks as shown on the drawings and herein specified. Each rack shall be ATLAS SOUND Model No. WMA24-23 with locking front door providing a minimum of forty-two vertical inches of standard nineteen inch wide rack mounting space. Each rack shall be complete with a cylinder lock and textured black finish. The following equipment shall be furnished and installed by Contractor in each rack:

1. One PASO Model No. DMS260P ten channel, digital mixer/preamplifier with 27/3501 Rack Mount Kit. One PASO Model No. PM01ML Mic/Line input module. The mixer shall be complete with treble and bass controls and shall be capable of phantom power service for condenser microphones.
2. One Denon Model No. DN-C615 rack mountable CD/MP3 Player.
3. One CROWN Model No. CDI 1000 dual channel amplifier with two hundred and seventy-five watts per channel at eight ohms. Amplifier shall be suitable for rack mounting.
4. One Atlas Sound Model No. ACRL-291 rack mountable power panel complete with eight switched outlets and surge protection.
5. One Williams Sound Model No. PPA T35 personal listening system base station transmitter complete with Williams Sound Model No. RPK 005 rack mounting kit and ANT 005 coaxial antenna.
6. Contractor shall furnish to the Owner's representative, twelve Williams Sound Model No. PPA R35-8N, eight channel personal listening system receivers each complete with Williams Sound Model No. EAR 013 single earbud, rechargeable batteries, and belt clip. Reciver shall be set to operating frequencies of 72.1 MHz (receiver channel 1).
7. Contractor shall furnish to the Owner's representative, one WILLIAMS SOUND Model No. CHG 3512 - Twelve-charger units for the personal listening system receivers.
8. Two Shure Model No. ULXS124/85-M1 complete wireless microphone systems, two Shure Model No. UA820C Remote Antennas, and one UA844US Wideband (470-900 MHz) Four-Way Active Antenna Splitter and Power distribution system.
9. One (1) Shure Model No. UA507 Rack Mount Kit for double receiver and two (2) UA820C Remote Antennas.

2.03 MICROPHONES

A. Contractor shall furnish a total of four Shure Model No. SM58S dynamic cardioid microphones. Each microphone shall be furnished by Contractor complete with a twenty five foot connector cord with CANNON XLR connectors.

2.04 MICROPHONE FLOOR STANDS

A. Contractor shall furnish a total of four Atlas Sound Model No. MS-20 adjustable microphone floor stands for each system.

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2.05 MICROPHONE OUTLETS

A. Contractor shall furnish and install where shown on the drawings, flush or surface wall and/or ceiling mounted microphone outlets consisting of CANNON "XLR" series audio jack of the type required so as to be compatible with the type of microphone cable connector furnished, and a stainless steel coverplate. A microphone outlet, which meets this specification, is BTX Model No. PL-103F with 3 pin XLR. At least one microphone outlet shall also have a 3.5 mm Stereo Input Jack mounted to faceplate.

2.06 LOUDSPEAKERS

A. Contractor shall furnish two Electro-Voice speakers Model No. SX100 with all required hardware for a complete installation. Color shall be selected by the Architect.

2.07 FIELD WIRING

A. Contractor shall furnish and install field wiring for auxiliary sound system loudspeakers as shown on the drawings. Wiring shall be two conductor, No. 14 AWG stranded cable. A cable that meets this specification is WEST PENN Cat. No.25226B or equal as manufactured by CONSOLIDATED ELECTRONIC WIRE AND CABLE, GENERAL CABLE, PAIGE, or TAPPAN.

B. Contractor shall furnish and install field wiring for microphone outlets as shown on the drawings. Wiring shall be two conductor, No. 20 AWG stranded and shielded cable. A cable that meets this specification is WEST PENN Cat. No. 25292 or equal as manufactured by CONSOLIDATED ELECTRONIC WIRE AND CABLE, GENERAL CABLE, PAIGE, or TAPPAN.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All low voltage wiring for the auxiliary sound reinforcement systems shall be installed by Contractor in 1/2-inch conduit as hereinbefore specified. All junction box covers shall be stenciled by Contractor for distinct identification. All conduits, device mounting boxes, junction boxes, and enclosures shall be securely fastened with appropriate fittings to insure a positive ground throughout each entire system.

B. All low voltage wiring connections shall be made by Contractor as directed by the manufacturer. Splices for circuits shall be made only in junction boxes and shall be crimp connected.

C. All wiring for the auxiliary sound reinforcement systems shall be checked and tested by Contractor to ensure the system is free from grounds, opens, and shorts.

D. All work shall be under the direct supervision of an accredited factory sound engineer. It shall be the responsibility of the sound engineer and Contractor to check and inspect this installation to the Architect/Engineer's approval.

3.02 RACK MOUNTED EQUIPMENT

A. The auxiliary sound reinforcement system(s) rack mounted equipment shall be installed by Contractor with the proper adapters, rack mounting kits, brackets, and closure panels for unused spaces. All interconnecting wiring shall be labeled, bundled, secured, and terminated by Contractor in a neat and professional manner.

B. All rack mounted equipment AC power cords shall be plugged into the mounted power strip by Contractor.

3.03 SPEAKER

A. Speaker assemblies shall be supported by Contractor from the building structure with a minimum of two steel wires.

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3.04 MICROPHONES

A. Contractor shall unpack each microphone and assemble with cables and stands and connect ready for operation.

3.05 MICROPHONE OUTLETS

A. Contractor shall assemble microphone outlets and install, connect, and label as shown on the drawings.

END OF SECTION 275141

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SECTION 275142
MUSIC ROOMS SOUND REINFORCEMENT SYSTEM

PART 1 - GENERAL

1.01 SCOPE

A. The work covered under this section shall include furnishing and installing a locally controlled complete and satisfactorily operating auxiliary stereo sound reinforcement system in each music room for the pickup, amplification, reproduction, and distribution of voice and/or music to associated speakers within each room.

1.02 SUBMITTALS

A. Product Data and Shop Drawings:
   1. Submit a complete list of equipment indicating the specific quantities to be provided by Contractor. The catalog or model number for each module of the system(s) shall be listed next to the quantities. This information shall be furnished in the front of the submittal.
   2. Submit a specific description of the system(s) describing each module and how it shall function in the system.
   3. Submit a specific drawing furnished of the (each) equipment rack. Each module shall be shown in its proper location with its terminal designations shown.
   4. Submit a data sheet for each module and device. The information shall be highlighted that applies to the particular module or device to be furnished.
   5. Submit a detailed diagram showing how to connect each device, indicating the exact final connection information.
   6. Submit a detailed set of floor plans for the area(s) where the (each) auxiliary sound system(s) is (are) to be installed. The plans shall show the locations of all equipment, loudspeakers, and devices and their required interconnections. The interconnections shown shall indicate the number, size, and type of wires as described in this specification. Loudspeakers shall be zoned as shown on the drawings. The layout of all auxiliary sound reinforcement system(s) equipment, devices, and conduit routing shall closely follow that shown on the drawings.

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1.03 QUALITY ASSURANCE

A. All equipment specified herein shall be the product of a manufacturer of established reputation and experience who shall have produced similar apparatus for a period of at least ten years and who shall be able to refer to similar installations now rendering satisfactory service.

B. The Choral and Instrumental Music Rooms sound reinforcement systems shall be furnished by a factory authorized distributor certified to design, program, and service the system. The distributor must show evidence of successfully furnishing systems specified for at least five years.

C. All equipment for this system shall be listed by Underwriters Laboratories, Inc. (UL), bear the UL label and shall be installed in accordance with all requirements of the National Electrical Code (NEC), state and local codes, and these specifications.

D. The auxiliary sound reinforcement system(s) shall be furnished and installed by Contractor as shown on the drawings and as specified herein.

1.04 DOCUMENTATION

A. Contractor shall furnish one set of "As Built" drawings depicting the complete field wiring system and component interconnections in the system equipment rack.

B. Contractor shall furnish four sets of factory operation and maintenance manuals. These manuals shall include factory service manuals with complete parts lists, wiring and component schematics including circuit diagrams, and all other information necessary for the proper operation and service maintenance of the system.

1.05 TRAINING

A. Contractor shall furnish eight hours of technical service training to the Owner's technical staff using the factory operation manuals previously specified.

B. Contractor shall furnish eight hours of operating and programming training to the Owner's operating staff which shall be delivered in two separate four hour sessions to be scheduled at the Owner's convenience over the two year warranty period.

C. All training specified herein shall be performed by a factory certified technician.

1.06 DESCRIPTION OF OPERATION

A. Contractor shall furnish and install Choral and Instrumental Music Rooms sound reinforcement systems with all conduit, cable, outlets, devices, and equipment as shown on the drawings and as herein specified to furnish complete systems.

B. Each Choral and Instrumental Music Rooms sound reinforcement system shall provide for hte amplification and recording of music and voice, and the reproduction of recorded music or other program materials, and their distribution to all associated speakers within each Choral and Instrumental Music Room.

C. Each Choral and Instrumental Music Room sound reinforcement system shall accept both the input and output of an MP3 Player via DI Box.

D. Each Choral and Instrumental Music Room sound reinforcement system shall accept a priority override signal to mute the system when the main building Sound Intercommunications System and Fire Alarm System activates the priority override function.

1.07 SYSTEM TEST AND ACCEPTANCE

A. Prior to the final site visitation, and acceptance of each construction phased spaces, Contractor shall conduct an operating test of each complete auxiliary sound reinforcement system. Each system shall test free from grounds, shorts, and other faults. All connections shall be checked for mechanical and electrical connection. All equipment shall be demonstrated to operate in accordance with the requirements set forth in these specifications and as shown on the drawings.

B. Contractor shall perform all tests in the presence of the Architect/Engineer. Contractor shall furnish all personnel and test instruments required for use in the test.

1.08 WARRANTY

A. Contractor shall deliver the work described herein in a first class operating condition in every respect. Contractor shall also warrant that the material, equipment, and workmanship shall be entirely free from defects. Any materials, equipment, or workmanship in which defects may develop before or during the warranty period shall be repaired or replaced at the Contractor

B. s own expense. Refer to Division 01 for the start of the warranty period. The contractor shall further warrant that all material, equipment, and workmanship used in the installation, but not specifically mentioned in the drawings and Specifications, is the best of their respective kinds and that the construction and installation was performed in accordance with the best accepted standard practices in all details.

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C. The manufacturer shall be prepared to offer a service contract for the maintenance of the system beyond the warranty period.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The auxiliary sound reinforcement system(s) equipment shall be manufactured by AKG, CROWN, TASCAM, BTX, ATLAS SOUND, DENON, SHURE, and ELECTRO-VOICE, as listed.

2.02 AUXILIARY SOUND REINFORCEMENT SYSTEM EQUIPMENT RACKS

A. This Contractor shall furnish and install sectional wall mounted auxiliary sound system equipment racks as shown on the drawings and herein specified. Each rack shall be ATLAS SOUND Model No. WMA24-23 with locking front door providing a minimum of 42 vertical inches of standard 19 inch wide rack mounting space. Each rack shall be complete with a cylinder lock and textured black finish. The following equipment shall be furnished and installed by this Contractor in each rack:

1. One E-8 Soundcraft mixer with: eight mic/line and two stereo auxiliary inputs; three band equalization at low (63 Hz), mid (2.5 kHz), and high (12.5 kHz); trim and pan control; phantom power switch; left and right stereo output; subwoofer output; monitor output; effects input and output; left and right stereo tape outputs; headphone jack; and one Soundcraft Model No. P-S20001D-01 rack mounting kit.
2. One TASCAM Model No. CD-RW900SL rack mountable CD-R/RW player/recorder and MP3 player.
3. One Atlas Sound Model No. ACRL-291 rack mountable power panel complete with eight switched outlets and surge protection.
4. One Shure Model No. ULXS124/85-M1 complete wireless microphone system and one Shure Model No. UA820C Remote Antenna.
5. One Shure Model No. UA506 Rack Mount Kit for single receiver and one UA820C Remote Antenna.
6. IR Remote.

2.03 WALL MOUNTED STEREO SPEAKERS

A. Contractor shall provide, in each Choral and Instrumental Music Room where shown on Drawings, JBL Model No. EON510 enclosed wall mounted stereo speakers. The stereo speakers shall be internal bi-amplified crossover type with: 300 watt low frequency amp and 100 watt high frequenty (bi-amplified) amp; 15 inch low frequency transducer with neodymium magnet; 1.75 inch titanium compression driver; and a 90 x 60 directivity horn frequency range of 47 Hz to 18 kHz. Each stereo speaker shall be complete with on-stage stands SS7322B adjustable wall mounting bracke.

2.04 MICROPHONES

A. Contractor shall furnish two AKG Model No. D77S/XLR dynamic cardioid microphones for each Choral and Instrumental Music Room sound reinforcement system. Each microphone shall be furnished complete with a 25 foot connector cord with Cannon XLR connectors.

B. In the Choral Room, Contractor shall provide two AKG Model No. CHM21 hanging micropones at locations shown on the Drawings.

2.05 MICROPHONE FLOOR STANDS

A. Contractor shall furnish four Atlas Soundolier Model No. MS-20 microphone floor stands for each Choral and Instrumental Music Room sound reinforcement system.

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B. Contractor shall provide four Atlas Soundolier Model No. PB15 microphone booms for each Choral and Instrumental Music Room sound reinforcement system.

2.06 MICROPHONE OUTLETS

A. Contractor shall provide, where shown on the drawings, flush or surface wall and/or ceiling mounted microphone outlets consisting of CANNON "XLR" series audio jack of the type required so as to be compatible with the type of microphone cable connector furnished, and a stainless steel coverplate. A microphone outlet, which meets this specification, is BTX Model No. PL-103F with 3 pin XLR. At least one microphone outlet shall also have a 3.5 mm Stereo Input Jack mounted to faceplate.

2.07 FIELD WIRING

A. Contractor shall provide one two-conductor, No 14 AWG strandad plenum rated cable with a temperature range for dry locations of minus 10 degrees C to 60 degrees C for each stereo speaker. A cable that meets this specification is WEST PENN Cat. No. 25226B or equal as manufactured by CONSOLIDATED ELECTRONIC WIRE AND CABLE, GENERAL CABLE, PAIGE, or TAPPAN.

B. Contractor shall provide one stranded No. 20 AWG, shielded, single twisted pair plenum rated cable with a temperature range for dry locations of minus 10 degrees C to 60 degrees C for each microphone outlet. A cable that meets this specification is WEST PENN Cat. No. 25292B or equal as manufactured by CONSOLIDATED ELECTRONIC WIRE AND CABLE, GENERAL CABLE, PAIGE, or TAPPAN.

2.08 DI BOX

A. Contractor shall furnish one DI Box equal with multi-input with one XLR output equal to Art AV Direct.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All vertical low-voltage field wiring shall be installed by this Contractor in 1/2-inch conduit and/or surface metal raceway as shown on Drawings. Conduit fill shall not exceed the conduit space capacity.

B. All horizontal low-voltage field wiring to be installed in areas without a ceiling or in areas without an accessible ceiling shall be installed by Contractor in 1/2-inch conduit.

C. All horizontal low-voltage field wiring to be installed in areas with accessible ceilings shall be installed by Contractor bundled together and run exposed above the ceilings. Bundles shall be supported by "J" hooks mounted not more than four feet on center. "J" hooks shall be dedicated to the wiring specified in this specification section.

D. All horizontal low-voltage field wiring shall be run at right angles to the building structure.

E. All horizontal low-voltage field-wiring shall be installed below the roof/floor structural supports (joist, beams, girders, etc.). Wiring installed between the structural supports mentioned above and the roof or floor deck will not be acceptable.

F. All horizontal low-voltage field wiring penetrations through new and/or existing walls shall be sleeved. Minimum sleeve size shall be 3/4-inch. All sleeves shall be bushed both sides.

G. All low-voltage field wiring for the Choral and Instrumental Music Room sound reinforcement systems shall be furnished and installed by Contractor. All junction box covers shall be stenciled for distinct identification.

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H. Contractor shall make all wiring connections as directed by the equipment manufacturer. Splices for circuits shall be made only in junction boxes and shall be crimp connected.

I. All Choral and Instrumental Music Room sound reinforcement system wiring shall be checked and tested by Contractor to ensure the system is free from grounds, opens, and shorts.

J. All work shall be under the supervision of a factory accredited sound engineer. It shall be the responsibility of the sound engineer and Contractor to check and inspect this installation to the Owner's and Architect/Engineer's approval.

3.02 RACK MOUNTED EQUIPMENT

A. Each Choral and Instrumental Music Room sound reinforcement system's rack mounted equipment shall be installed by Contractor with the proper adapters, rack mounting kits, brackets, and closure panels for unused spaces. All interconnecting wiring shall be labeled, bundled, secured, and terminated by Contractor in a neat and professional manner.

B. All rack mounted equipment AC power cords shall be plugged into the mounted power strip by Contractor.

3.03 SPEAKER

A. Wall mounted stereo speakers shall be securely fastened to the wall with adjustable wall brackets as specified.

B. Contractor shall provide a NEMA 5-20R duplex receptacle (as hereinbefore specified) at each stereo speaker location wheter shown on the drawings or not. Duplex receptacles shall be on their own circuit.

3.04 MICROPHONES

A. Contractor shall unpack each microphone and assemble with cables and stands and connect ready for operation. Microphones shown for permanent installation shall be installed by Contractor in accordance with drawings in manner appropriate for indicated locations.

3.05 MICROPHONE OUTLETS

A. Contractor shall assemble microphone outlets and install, connect, and label as shown on the drawings.

END OF SECTION 275142

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SECTION 275143
WRESTLING, WEIGHT, AND FITNESS ROOMS SOUND REINFORCEMENT SYSTEM

PART 1 - GENERAL

1.01 SCOPE

A. The work covered under this section shall include furnishing and installing locally controlled complete and satisfactorily operating auxiliary stereo sound reinforcement system in Wrestling, Weight, and Fitness Rooms for the pickup, amplification, and reproduction of voice and/or music at remote locations.

1.02 SUBMITTALS

A. Product Data and Shop Drawings:
   1. Submit a complete list of equipment indicating the specific quantities to be furnished by this Contractor. The catalog or model number for each module of the system(s) shall be listed next to the quantities. This information shall be furnished in the front of the submittal.
   2. Submit a specific description of the system(s) describing each module and how it shall function in the system.
   3. Submit a specific drawing furnished of the (each) equipment rack. Each module shall be shown in its proper location with its terminal designations shown.
   4. Submit a data sheet for each module and device. The information shall be highlighted that applies to the particular module or device to be furnished.
   5. Submit a detailed diagram showing how to connect each device, indicating the exact final connection information.
   6. Submit a detailed set of floor plans for the area(s) where the (each) auxiliary sound system(s) is (are) to be installed. The plans shall show the locations of all equipment, loudspeakers, and devices and their required interconnections. The interconnections shown shall indicate the number, size, and type of wires as described in this specification. Loudspeakers shall be zoned as shown on the drawings. The layout of all auxiliary sound reinforcement system(s) equipment, devices, and conduit routing shall closely follow that shown on the drawings.

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1.03 QUALITY ASSURANCE

A. All equipment specified herein shall be the product of a manufacturer of established reputation and experience who shall have produced similar apparatus for a period of at least ten years and who shall be able to refer to similar installations now rendering satisfactory service.

B. The auxiliary sound reinforcement system(s) shall be furnished by a factory authorized distributor certified to design, program, and service the system. The distributor must show evidence of successfully furnishing systems specified for at least five years

C. All equipment for this system shall be listed by Underwriters Laboratories, Inc. (UL), bear the UL label and shall be installed in accordance with all requirements of the National Electrical Code (NEC), state and local codes, and these Specifications.

D. The auxiliary sound reinforcement system(s) shall be furnished and installed by this Contractor as shown on the drawings and as specified herein.

1.04 DOCUMENTATION

A. This Contractor shall furnish to the Contractor, one set of "As Built" drawings depicting the complete field wiring system and component interconnections in the system equipment rack.

B. This Contractor shall furnish to the Contractor four sets of factory operation and maintenance manuals. These manuals shall include factory service manuals with complete parts lists, wiring and component schematics including circuit diagrams, and all other information necessary for the proper operation and service maintenance of the system.

1.05 TRAINING

A. This Contractor shall furnish eight hours of technical service training to the Owner's technical staff using the factory operation manuals previously specified.

B. This Contractor shall furnish eight hours of operating and programming training to the Owner's operating staff which shall be delivered in two separate four hour sessions to be scheduled at the Owner's convenience over the two year warranty period.

C. All training specified herein shall be performed by a factory certified technician.

1.06 DESCRIPTION OF OPERATION

A. Each system shall provide for the distribution of voice and music to all associated loudspeakers.

B. Each system shall provide for the reproduction of MP3 and compact disc recordings and distribute them to all associated loudspeakers.

C. Each system shall provide for the input and output of an MP3 Player via two 3.5 mm jacks. One is to be mounted at the equipment rack and one is to be mounted remotely in a wallplate with a microphone jack.

D. Each system shall provide for individual bass and treble controls.

E. Each system shall provide a personal listening system for use by hearing impaired listeners.

F. Each Auxiliary sound reinforcement system shall accept a priority override signal to mute the system when the main building Sound and Intercommunications System activates the priority override function.

1.07 SYSTEM TEST AND ACCEPTANCE

A. Prior to the final site visitation, and acceptance of each construction phased spaces, this Contractor shall conduct an operating test of each complete auxiliary sound reinforcement system. Each system shall test free from grounds, shorts, and other faults. All connections shall be checked for mechanical and electrical connection. All equipment shall be demonstrated to operate in accordance with the requirements set forth in these specifications and as shown on the drawings.

B. This Contractor shall perform all tests in the presence of the Architect/Engineer. This Contractor shall furnish all personnel and test instruments required for use in the test.

1.08 WARRANTY

A. This Contractor shall deliver the work described herein in a first class operating condition in every respect. This Contractor shall also warrant that the material, equipment, and workmanship shall be entirely free from defects. Any materials, equipment, or workmanship in which defects may develop before or during the warranty period shall be repaired or replaced at the Contractors own expense. Refer to Division 01 for the start of the warranty period. The contractor shall further warrant that all material, equipment, and workmanship used in the installation, but not specifically mentioned in the drawings and Specifications, is the best of their respective kinds and that the construction and installation was performed in accordance with the best accepted standard practices in all details.

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B. The manufacturer shall be prepared to offer a service contract for the maintenance of the system beyond the warranty period.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The auxiliary sound reinforcement system(s) equipment shall be manufactured by COMMUNITY, CROWN, PASO, BTX, ATLAS SOUND, WILLIAM SOUND, DENON, and SHURE, as listed.

2.02 AUXILIARY SOUND REINFORCEMENT SYSTEM EQUIPMENT RACKS

A. This Contractor shall furnish and install sectional wall mounted auxiliary sound system equipment racks as shown on the drawings and herein specified. Each rack shall be ATLAS SOUND Model No. WMA24-23 with locking front door providing a minimum of forty-two vertical inches of standard nineteen inch wide rack mounting space. Each rack shall be complete with a cylinder lock and textured black finish. The following equipment shall be furnished and installed by this Contractor in each rack:

1. One PASO Model No. DMS260P ten channel, digital mixer/preamplifier with 27/3501 Rack Mount Kit. One PASO Model No. PM01ML Mic/Line input module. The mixer shall be complete with treble and bass controls and shall be capable of phantom power service for condenser microphones.
2. One Denon Model No. DN-C615 rack mountable CD/MP3 Player. This contractor shall provide an IR remote controller for the CD/MP3 player specified above. The controller shall be Denon Model No. RC-U620 and shall have the sensor mounted on a wall plate.
3. Two CROWN Model No. CDI 1000 dual channel amplifiers with five hundred (500) watts per channel at 70.7V. Amplifier shall be suitable for rack mounting.
4. One Atlas Sound Model No. ACRL-291 rack mountable power panel complete with eight switched outlets and surge protection.
5. Two Shure Model No. ULXS124/85-M1 complete wireless microphone systems, two Shure Model No. UA820C Remote Antennas, and one UA844US Wideband (470-900 MHz) Four-Way Active Antenna Splitter and Power distribution system.
6. One (1) Shure Model No. UA507 Rack Mount Kit for single receiver and one UA820C Remote Antenna.

2.03 MICROPHONES

A. This Contractor shall furnish a total of two Shure Model No. SM58S dynamic cardioid microphones. Each microphone shall be furnished by this Contractor complete with a twenty five foot connector cord with CANNON XLR connectors.

2.04 MICROPHONE FLOOR STANDS

A. This Contractor shall furnish a total of two Atlas Sound Model No. MS-20 adjustable microphone floor stands for each system.

B. The Contractor shall furnish one Atlas Soundolier Model No. DS-14 microphone desk stand.

2.05 MICROPHONE OUTLETS

A. This Contractor shall furnish and install where shown on the drawings, flush or surface wall and/or ceiling mounted microphone outlets consisting of CANNON "XLR" series audio jack of the type required so as to be compatible with the type of microphone cable connector furnished, and a stainless steel coverplate. A microphone outlet, which meets this specification, is BTX

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Model No. PL-103F with 3 pin XLR. At least one microphone outlet shall also have, mounted to the faceplate, a 3.5 mm Stereo Input Jack.

2.06 LOUDSPEAKERS

A. This Contractor shall furnish and install Community speakers Model No. R.5-99TZ with all required hardware for a complete installation. Speakers shall be tapped at 70.7V and 100W.

2.07 FIELD WIRING

A. This Contractor shall furnish and install field wiring for auxiliary sound systems loudspeakers as shown on the drawings. Wiring shall be two conductor, No. 14 AWG stranded cable. A cable that meets this specification is WEST PENN Cat. No.25226B or equal as manufactured by CONSOLIDATED ELECTRONIC WIRE AND CABLE, GENERAL CABLE, PAIGE, or TAPPAN.

B. This Contractor shall furnish and install field wiring for microphone outlets as shown on the drawings. Wiring shall be two conductor, No. 20 AWG stranded and shielded cable. A cable that meets this specification is WEST PENN Cat. No. 25292 or equal as manufactured by CONSOLIDATED ELECTRONIC WIRE AND CABLE, GENERAL CABLE, PAIGE, or TAPPAN.

PART 3- EXECUTION

3.01 INSTALLATION

A. All low voltage wiring for the auxiliary sound reinforcement systems shall be installed by this Contractor in 1/2-inch conduit as hereinbefore specified. All junction box covers shall be stenciled by this Contractor for distinct identification. All conduits, device mounting boxes, junction boxes, and enclosures shall be securely fastened with appropriate fittings to insure a positive ground throughout each entire system.

B. All low voltage wiring connections shall be made by this Contractor as directed by the manufacturer. Splices for circuits shall be made only in junction boxes and shall be crimp connected.

C. All wiring for the auxiliary sound reinforcement systems shall be checked and tested by this Contractor to ensure the system is free from grounds, opens, and shorts.

D. All work shall be under the direct supervision of an accredited factory sound engineer. It shall be the responsibility of the sound engineer and this Contractor to check and inspect this installation to the Architect/Engineer's approval.

3.02 RACK MOUNTED EQUIPMENT

A. The auxiliary sound reinforcement system(s) rack mounted equipment shall be installed by this Contractor with the proper adapters, rack mounting kits, brackets, and closure panels for unused spaces. All interconnecting wiring shall be labeled, bundled, secured, and terminated by this Contractor in a neat and professional manner.

B. All rack mounted equipment AC power cords shall be plugged into the mounted power strip by this Contractor.

3.03 SPEAKER

A. Speaker assemblies shall be supported by this Contractor from the building structure with a minimum of two steel wires.

3.04 MICROPHONES

A. This Contractor shall unpack each microphone and assemble with cables and stands and connect ready for operation.

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3.05 MICROPHONE OUTLETS

A. This Contractor shall assemble microphone outlets and install, connect, and label as shown on the drawings.

END OF SECTION 275143

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SECTION 275144
ATHLETIC FIELDS SOUND REINFORCEMENT SYSTEM

PART 1 - GENERAL

1.01 SCOPE

A. The work covered under this section shall include furnishing and installing locally controlled complete and satisfactorily operating Athletic Field sound reinforcement system for the pickup, amplification, reproduction, and distribution of voice and/or music to associated loudspeakers for each of the following: Baseball Field, Football Stadium, Softball Field, and Track and Field area.

1.02 SUBMITTALS

A. Product Data and Shop Drawings:
   1. Submit a complete list of equipment for each Athletic Field area indicating the specific quantities for each area. The catalog or model number for each module of the system(s) shall be listed next to the quantities. This information shall be furnished in the front of the submittal.
   2. Submit a specific description of each Athletic Field sound reinforcement system describing each module and how it shall function in the system.
   3. Submit a detailed set of plans at each Athletic Field area. The plans shall show the locations of all equipment, loudspeakers, and devices and their required interconnections. The interconnections shown shall indicate the number, size, and type of wires as described in this specification. The layout of all auxiliary sound reinforcement system(s) equipment, devices, and conduit routing shall closely follow that shown on the drawings.
   4. Submit a specific drawing of each Athletic Field sound reinforcement system equipment rack. Each module shall be shown in its proper location with its terminal designations shown.
   5. Submit a data sheet for each module and device. The information shall be highlighted that applies to the particular module or device to be furnished.
   6. Submit a detailed diagram showing how to connect each device, indicating the exact final connection information.
   7. Submit a detailed drawing showing how to mount speakers at each Athletic Field location, including necessary hardware and mounting devices.

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1.03 QUALITY ASSURANCE

A. All equipment specified herein shall be the product of a manufacturer of established reputation and experience who shall have produced similar apparatus for a period of at least ten years and who shall be able to refer to similar installations now rendering satisfactory service.

B. The auxiliary sound reinforcement system(s) shall be furnished by a factory authorized distributor certified to design, program, and service the system. The distributor must show evidence of successfully furnishing systems specified for at least five years

C. All equipment for this system shall be listed by Underwriters Laboratories, Inc. (UL), bear the UL label and shall be installed in accordance with all requirements of the National Electrical Code (NEC), state and local codes, and these Specifications.

D. The auxiliary sound reinforcement system(s) shall be furnished and installed by Contractor as shown on the drawings and as specified herein.

1.04 DOCUMENTATION

A. Contractor shall furnish to the Contractor, one set of "As Built" drawings depicting the complete field wiring system and component interconnections in the system equipment rack.

B. Contractor shall furnish to the Contractor four sets of factory operation and maintenance manuals. These manuals shall include factory service manuals with complete parts lists, wiring and component schematics including circuit diagrams, and all other information necessary for the proper operation and service maintenance of the system.

1.05 TRAINING

A. Contractor shall furnish eight hours (total for all Athletic Fields) of technical service training to the Owner's technical staff using the factory operation manuals previously specified.

B. Contractor shall furnish eight hours (total for all Athletic Fields) of operating and programming training to the Owner's operating staff which shall be delivered in two separate four hour sessions to be scheduled at the Owner's convenience over the two year warranty period.

C. All training specified herein shall be performed by a factory certified technician.

1.06 DESCRIPTION OF OPERATION

A. Contractor shall furnish and install each Athletic Field sound reinforcement system with all conduit, wiring, outlets, and equipment as shown on the Drawings and as specified herein to provide a complete operational system.

B. Each Athletic Field sound reinforcement system shall provide for the amplification of music and voice, and the reproduction of recorded music or other program materials, and the distribution of voice and music to all associated loudspeakers.

C. Each Athletic Field sound reinforcement system shall provide a personal listening system for use by hearing impaired listeners.

1.07 SYSTEM TEST AND ACCEPTANCE

A. Prior to the final site visitation, and acceptance of each construction phased spaces, the Contractor shall conduct an operating test of each complete auxiliary sound reinforcement system. Each system shall test free from grounds, shorts, and other faults. All connections shall be checked for mechanical and electrical connection. All equipment shall be demonstrated to operate in accordance with the requirements set forth in these specifications and as shown on the drawings.

B. Contractor shall perform all tests in the presence of the Architect/Engineer. Contractor shall furnish all personnel and test instruments required for use in the test.

C. When the work on each Athletic Field sound reinforcement system has been completed and is ready for final review, this Contractor shall demonstrate that the requirements of the Contract as it applies to the work have been carried out and that each system has been adjusted and operated in accordance therewith.

1.08 WARRANTY

A. Contractor shall deliver the work described herein in a first class operating condition in every respect. Contractor shall also warrant that the material, equipment, and workmanship shall be entirely free from defects. Any materials, equipment, or workmanship in which defects may develop before or during the warranty period shall be repaired or replaced at the Contractors own expense. Refer to Division 01 for the start of the warranty period. The contractor shall further warrant that all material, equipment, and workmanship used in the installation, but not specifically mentioned in the drawings and Specifications, is the best of their respective kinds

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and that the construction and installation was performed in accordance with the best accepted standard practices in all details.

B. The manufacturer shall be prepared to offer a service contract for the maintenance of the system beyond the warranty period.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The auxiliary sound reinforcement system(s) equipment shall be manufactured by COMMUNITY, CROWN, PASO, BTX, ATLAS SOUND, WILLIAM SOUND, DENON, and SHURE, as listed.

2.02 FOOTBALL FIELD SOUND REINFORCEMENT SYSTEM

A. Equipment Rack:

1. This Contractor shall furnish and install a sectional wall mounted Football Field sound reinforcement system equipment rack as shown on the Drawings and as specified herein. The rack shall be ATLAS SOUNDOLIER Cat. No. WMA35-23 sectional wall mounting type with a textured black finish providing a minimum of sixty-one (61) inches of vertical rack mounting space. The rack shall be complete with a continuous piano hinged front door with a cylinder lock and handle. The following equipment shall be furnished and installed by this Contractor in the rack
   a. One (1) dual channel power amplifier (Home) suitable for rack mounting with a minimum rating of 2400 watts continuous sine wave per channel into a four (4) ohm output at twenty (20) Hz to twenty (20) kHz with a maximum 0.1 percent (0.1%) distortion. A power amplifier, which will meet this specification, is CROWN Model No. CTS-2000.
   b. One (1) dual channel power amplifier (Visitor) suitable for rack mounting with a minimum rating of 1200 watts continuous sine wave per channel into a four (4) ohm output at twenty (20) Hz to twenty (20) kHz with a maximum 0.1 percent (0.1%) distortion. A power amplifier, which will meet this specification, is CROWN Model No. CTS-1200.
   c. One (1) microphone mixer suitable for rack mounting with a minimum of eight (8) independently controlled microphone/line level input channels and a minimum of two (2) aux-level input mixing capability. The outputs shall be controlled by the master control. The mixer shall be complete with automatic gain control and shall be capable of phantom power service for condenser microphones. A microphone mixer which will meet this specification is SHURE Model No. SCM810.
   d. One (1) Denon Model No. DN-C615 rack mountable CD/MP3 Player. This contractor shall provide an IR remote controller for the CD/MP3 player specified above.
   e. One (1) WILLIAMS SOUND Model No. PPA T35 personal listening system base station transmitter complete with WILLIAMS SOUND Model No. RPK 005 rack mounting kit and ANT 005 coaxial antenna.
2. The Contractor shall furnish to the Owner's representative, twenty-four (24) WILLIAMS SOUND Model No. PPA-R35-8 (8) eight channel personal listening system receivers each complete with WILLIAMS SOUND Model No. EAR 013 single earbud, rechargeable batteries, and belt clip. Receiver shall be set to operating freqs. of 75.7 MHz (receiver channel 7).
   a. The Contractor shall furnish to the Owner's representative, two (2) WILLIAMS SOUND Model No. CHG 3512 twelve (12) charger unit for the personal listening system receivers.

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b. One (1) Atlas Sound Model No. ACRL-291 rack mountable power panel complete with eight (8) switched outlets and surge protection.
c. One (1) ATLAS SOUNDOLIER Model No. ACS-1 AC power strip.
d. Two (2) Shure Model No. ULXS124/85-M1 complete wireless microphone systems, two (2) Shure Model No. UA820C Remote Antennas, and one (1) UA844US Wideband (470-900 MHz) Four-Way Active Antenna Splitter and Power distribution system.
e. One (1) Shure Model No. UA507 Rack Mount Kit for double receiver and 2 UA820C Remote Antennas.

B. Speaker Systems:
1. This Contractor shall furnish and install two (2), 3-way loudspeaker system (Home) with a frequency response of 250 Hz - 4 kHz and shall include a driver. A speaker, which will meet this Specification, is Community Model No. R2-474 complete with Community model no. R2YOKE mounting yoke kit.
2. This Contractor shall furnish and install one (1), 3-way loudspeaker system (Visitor) with a frequency response of 250 Hz - 4 kHz and shall include a driver. A speaker, which will meet this Specification, is Community Model No. R2-52 complete with Community model no. R2YOKE mounting yoke kit.

C. Microphones:
1. This Contractor shall furnish to the Owner's representative, four (4) AKG Model No. D77S/XLR dynamic cardioid microphones. Each complete with an ON/OFF switch. Each microphone shall be furnished by this Contractor complete with a twenty five (25) foot connector cord with CANNON XLR connectors.
2. This Contractor shall furnish to the Owner's representative, one (1) TOA Model No. WM-4200 dynamic cardioid wireless handheld microphone, and one (1) TOA Model No. WM-4300 lapel microphone with bodypack. Each complete with an ON/OFF switch and batteries.
3. Contractor shall provide one desk type microphones, Shure 450 series 2.

D. Microphone Stands:
1. This Contractor shall furnish to the Owner's representative, two (2) ATLAS SOUNDOLIER Model No. DS-14 microphone desk stands.
2. This Contractor shall furnish to the Owner's representative, two (2) Atlas Sound Model No. MS-20 microphone floor stands.

E. Microphone Outlets:
1. This Contractor shall furnish and install where shown on the Drawings, flush or surface (as indicated on the Drawings) wall mounted microphone outlets consisting of a CANNON "XLR" series audio jack of the type required so as to be compatible with the type of microphone cable connector furnished, and a stainless steel coverplate. A microphone outlet, which meets this Specification, is BTX Model No. PL-103F.

F. Cable:
1. This Contractor shall furnish and install speaker cable consisting of one (1) twisted pair, No. 12 AWG unshielded with a temperature range for dry locations of minus twenty-five (25) degrees C to one hundred five (105) degrees C and seventy-five (75) degrees C for wet locations. A cable that meets this Specification is WEST PENN Cat. No. AQ227 or equal as manufactured by CONSOLIDATED WIRE, GENERAL CABLE, PAIGE, or TAPPAN.
2. This Contractor shall furnish and install microphone cable consisting of one (1) twisted pair, No. 20 AWG shielded with a temperature range for dry locations of minus ten (10)

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degrees C to seventy-five (75) degrees C. A cable that meets this Specification is WEST PENN Cat. No. 292 or equal as manufactured by CONSOLIDATED WIRE, GENERAL CABLE, PAIGE, or TAPPAN.

2.03 TRACK AND FIELD AREA SOUND REINFORCEMENT SYSTEM

A. Equipment Rack:

1. This Contractor shall furnish and install a sectional wall mounted Baseball Field sound reinforcement system equipment rack as shown on the Drawings and as specified herein. The rack shall be ATLAS SOUNDOLIER Cat. No. WMA24-23 sectional wall mounting type with a textured black finish providing a minimum of forty-two (42) inches of vertical rack mounting space. The rack shall be complete with a continuous piano hinged front door with a cylinder lock and handle. The following equipment shall be furnished and installed by this Contractor in the rack:
   a. Two (2) dual channel power amplifier suitable for rack mounting with a minimum rating of 800 watts continuous sine wave per channel into a 70.7V output and a twenty (20) Hz to twenty (20) kHz frequency response with a maximum 0.1 percent (0.1%) distortion at 1 watt into a 4 ohm output. A power amplifier that will meet this specification is Crown Model No. CTs 1200.
   b. One (1) microphone mixer suitable for rack mounting with a minimum of eight (8) independently controlled microphone/line level input channels and a minimum of two (2) aux-level input mixing capability. The outputs shall be controlled by the master control. The mixer shall be complete with automatic gain control and shall be capable of phantom power service for condenser microphones. A microphone mixer which will meet this specification is SHURE Model No. SCM810.
   c. One (1) Denon Model No. DN-C615 rack mountable CD/MP3 Player. This contractor shall provide an IR remote controller for the CD/MP3 player specified above.
   d. One (1) Williams Sound Model No. PPA T35 personal listening system base station transmitter complete with Williams Sound Model No. RPK 005 rack mounting kit and ANT 005 coaxial antenna.
   e. The Contractor shall furnish to the Owner's representative, four (4) Williams Sound Model No. PPA-R35-8 (8) eight channel personal listening system receivers each complete with Williams Sound Model No. EAR 013 single earbud, rechargeable batteries, and belt clip. Receiver shall be set to operating freqs. of 72.1 MHz (receiver channel 1).
   f. The Contractor shall furnish to the Owner's representative, one (1) Williams Sound Model No. CHG 3512 twelve (12) charger unit for the personal listening system receivers.
   g. One (1) Atlas Sound Model No. ACRL-291 rack mountable power panel complete with eight (8) switched outlets and surge protection.
   h. One (1) Atlas Sound Model No. ACS-1 AC power strip.

B. Speaker Systems:

1. This Contractor shall furnish and install four (4), horn type loudspeakers of the compound diffraction design rated 15W to 120 watts, 70.0 volts with a frequency response of 90 Hz - 16 kHz and shall include a driver. A horn type loudspeaker that will meet this Specification is Community Model No. R.5-66T.

C. Microphones:

1. This Contractor shall furnish to the Owner's representative, one (1) AKG Model No. D77S/XLR dynamic cardioid microphones complete with an ON/OFF switch. The microphone shall be furnished by this Contractor complete with a twenty five (25) foot connector cord with CANNON XLR connectors.

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D. Microphone Stand:
   1. This Contractor shall furnish to the Owner's representative, one (1) Atlas Sound Model No. DS-2 microphone desk stand.

E. Microphone Outlets:
   1. This Contractor shall furnish and install where shown on the Drawings, flush or surface (as indicated on the Drawings) wall mounted microphone outlets consisting of a CANNON "XLR" series audio jack of the type required so as to be compatible with the type of microphone cable connector furnished, and a stainless steel coverplate. A microphone outlet, which meets this Specification, is BTX Model No. PL-103F.

F. Cable:
   1. This Contractor shall furnish and install speaker cable consisting of one (1) twisted pair, No. 12 AWG unshielded with a temperature range for dry locations of minus twenty-five (25) degrees C to one hundred five (105) degrees C and seventy-five (75) degrees C for wet locations. A cable that meets this Specification is WEST PENN Cat. No. AQ227 or equal as manufactured by CONSULIDATED WIRE, GENERAL CABLE, PAIGE, or TAPPAN.
   2. This Contractor shall furnish and install microphone cable consisting of one (1) twisted pair, No. 20 AWG shielded with a temperature range for dry locations of minus ten (10) degrees C to seventy-five (75) degrees C. A cable that meets this Specification is WEST PENN Cat. No. 292 or equal as manufactured by CONSULIDATED WIRE, GENERAL CABLE, PAIGE, or TAPPAN.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All wiring for the Athletic Fields sound reinforcement systems shall be installed by this Contractor in conduit. All junction box covers shall be stenciled for distinct identification. All conduit, device mounting boxes, junction boxes, and enclosures shall be securely fastened with appropriate fittings to insure a positive ground throughout each entire system.

B. All wiring connections shall be made by Contractor as directed by the equipment manufacturer. Splices for circuits shall be made only in junction boxes and shall be crimp connected.

C. All wiring shall be checked and tested by Contractor to ensure the system is free from grounds, opens, and shorts.

D. All work shall be under the direct supervision of a factory accredited sound engineer. It shall be the responsibility of the sound engineer and Contractor to check and inspect this installation to the Architect/Engineer's approval.

3.02 RACK MOUNTED EQUIPMENT

A. Each Athletic Field sound reinforcement system's rack mounted equipment shall be installed by Contractor with the proper adapters, rack mounting kits, brackets, and closure panels for unused spaces. All interconnecting wiring shall be labeled, bundled, secured, and terminated by Contractor in a neat and professional manner.

B. All rack mounted equipment AC power cords shall be plugged into the rack-mounted power strip by Contractor.

3.03 SPEAKERS

A. The Contractor shall assemble and install all speakers as detailed on the Drawings.

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3.04 MICROPHONES

A. Contractor shall unpack each microphone and assemble with cables and stands and connect ready for operation.

3.05 MICROPHONE OUTLETS

A. Contractor shall assemble microphone outlets and install, connect, and label as shown on the drawings.

3.06 REMOTE ANTENNA (WIRELESS SYSTEM)

A. The Contractor shall mount the remote antenna centered on the front of the football pressbox, facing the field, above the window area.

3.07 CABLES

A. All wiring and cable for the Athletic Field sound reinforcement systems shall be pulled continuously through conduits without splices or abrasions and shall be terminated at their appropriate devices as shown on the Drawings, as specified herein, and as directed by the system supplier. All cables shall be labeled. Input and output cabling shall not be installed in the same raceway.

B. Unless otherwise indicated, all Athletic Field sound reinforcement system cable shall be installed in heavy wall schedule 40 PVC conduit, minimum size 3/4, as specified herein.

END OF SECTION 275144

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SECTION 280513
CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.02 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. EMI: Electromagnetic interference.

C. IDC: Insulation displacement connector.

D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

E. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

F. RCDD: Registered Communications Distribution Designer.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.
   1. For coaxial cable, include the following installation data for each type used:
      a. Nominal OD.
      b. Minimum bending radius.
      c. Maximum pulling tension.

B. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

C. Source quality-control reports.

D. Field quality-control reports.

E. Maintenance Data: For wire and cable to include in maintenance manuals.

1.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 50 or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a third-party agency that shall be amongst those accredited by the IBC (International Building Code) and marked for intended location and application.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

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1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical-fiber flashlight or optical loss test set.
2. Test optical fiber cable on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.
3. Test each pair of UTP cable for open and short circuits.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install UTP, optical fiber, and coaxial cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 PRODUCTS

2.01 PATHWAYS

A. Conduit and Boxes: Comply with requirements in Section **<< 260533>>**. Flexible metal conduit shall not be used.
   1. Outlet boxes shall be no smaller than **<< 2 inches>>** wide, **<< 3 inches>>** high, and **<< 2-1/2 inches>>** deep.

2.02 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by **<< 96 inches>>**. Comply with requirements for plywood backing panels in Section **<< 061000 - Rough Carpentry>>**.

2.03 RS-232 CABLE

A. Standard Cable: NFPA 70, Type CM.
   1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
   2. Polypropylene insulation.
   3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
   4. PVC jacket.
   5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
   6. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.
   1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
   2. Plastic insulation.
   3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
   4. Plastic jacket.
   5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
   6. Flame Resistance: Comply with NFPA 262.

2.04 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CM or CMG.
   1. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
   2. PVC insulation.

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3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.
1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.05 LOW-VOLTAGE CONTROL CABLE

A. Paired Lock Cable: NFPA 70, Type CMG.
1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.
1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

C. Paired Lock Cable: NFPA 70, Type CMG.
1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

D. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.
1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Plastic jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.06 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.

B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.

C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83.

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2.07 FIRE ALARM WIRE AND CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Comtran Corp.
   2. Draka USA.
   3. Genesis Cable Products; Honeywell International, Inc.
   4. Rockbestos-Suprenant Cable Corporation.
   5. West Penn Wire/CDT; a division of Cable Design Technologies.

B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

C. Signaling Line Circuits: Twisted, shielded pair, No. 18 AWG.
   1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a 2-hour rating.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
   1. Low-Voltage Circuits: No. 14 AWG, minimum.
   2. Line-Voltage Circuits: No. 12 AWG, minimum.

2.08 IDENTIFICATION PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Brady Corporation
   2. HellermannTyton.
   3. Kroy LLC.
   4. Panduit Corp.

B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Comply with requirements in Section **<< 260553 - Identification for Electrical Systems >>**

2.09 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.

E. Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.

F. Cable will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

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PART 3 EXECUTION

3.01 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.

B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

C. Comply with requirements in Section **<< 260533 - Conduit for Electrical Systems>>** for installation of conduits and wireways.

D. Install manufactured conduit sweeps and long-radius elbows whenever possible.

E. Pathway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard when entering room from overhead.
4. Extend conduits **<< 3 inches>>** above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

F. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.02 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding **<< 30 inches>>** and not more than **<< 6 inches>>** from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
9. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than **<< 1/2 inch>>** from the point of termination to maintain cable geometry.

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D. Optical Fiber Cable Installation:
   1. Comply with TIA/EIA-568-B.3.
   2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.

E. Open-Cable Installation:
   1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
   2. Suspend copper cable not in a wireway or pathway a minimum of **<< 8 inches>>** above ceilings by cable supports not more than **<< 60 inches>>** apart.
   3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Installation of Cable Routed Exposed under Raised Floors:
   1. Install plenum-rated cable only.
   2. Install cabling after the flooring system has been installed in raised floor areas.
   3. Coil cable **<< 72 inches>>** long shall be neatly coiled not less than **<< 12 inches>>** in diameter below each feed point.

G. Outdoor Coaxial Cable Installation:
   1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
   2. Attach antenna lead-in cable to support structure at intervals not exceeding **<< 36 inches>>**.

H. Separation from EMI Sources:
   1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
   2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
      a. Electrical Equipment Rating Less Than 2 kVA: A minimum of **<< 5 inches>>**.
      b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of **<< 12 inches>>**.
      c. Electrical Equipment Rating More Than 5 kVA: A minimum of **<< 24 inches>>**.
   3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
      a. Electrical Equipment Rating Less Than 2 kVA: A minimum of **<< 2-1/2 inches>>**.
      b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of **<< 6 inches>>**.
      c. Electrical Equipment Rating More Than 5 kVA: A minimum of **<< 12 inches>>**.
   4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
      a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
      b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of **<< 3 inches>>**.
      c. Electrical Equipment Rating More Than 5 kVA: A minimum of **<< 6 inches>>**.
   5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of **<< 48 inches>>**.
   6. Separation between Cables and Fluorescent Fixtures: A minimum of **<< 5 inches>>**.

3.03 FIRE ALARM WIRING INSTALLATION

A. Comply with NECA 1 and NFPA 72.

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B. Wiring Method: Install wiring in metal raceway according to Section **<< 260533 - Conduit for Electrical Systems>>**.
   1. Install plenum cable in environmental air spaces, including plenum ceilings.
   2. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.

C. Wiring Method:
   1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
   2. Fire-Rated Cables: Use of 2-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is not permitted.
   3. Signaling Line Circuits: Power-limited fire alarm cables shall not be installed in the same cable or raceway as signaling line circuits.

D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

F. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

G. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.

H. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

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3.04 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:
   1. Class 1 remote-control and signal circuits, No. 14 AWG.
   2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
   3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.05 CONNECTIONS

A. Comply with requirements in **<< 284600 - Fire Detection and Alarm>>** for connecting, terminating, and identifying wires and cables.

3.06 FIRESTOPPING

A. Comply with requirements in Section **<< 078400 - Firestopping>>**.

B. Comply with TIA/EIA-569-A, "Firestopping" Annex A.

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.07 GROUNDING

A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. For low-voltage wiring and cabling, comply with requirements in Section **<< 260526 - Grounding and Bonding for Electrical Systems>>**.

3.08 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section **<< 260553 - Identification for Electrical Systems>>**.

3.09 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Visually inspect UTP and optical fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.
    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
4. Optical Fiber Cable Tests:
    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    b. Link End-to-End Attenuation Tests:
        1) Multimode Link Measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
        2) Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table **<< 10.1 inch>>** BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

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F. Prepare test and inspection reports.

END OF SECTION 280513

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SECTION 284600
FIRE DETECTION AND ALARM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provide a complete, non-proprietary fire detection and alarm system with manual stations, detectors, notification appliances, controls and devices. ***** MCPS Standard *****

B. Costs of certification and testing, including tests required by NFPA 72, shall be included in the contract sum.

1.02 RELATED REQUIREMENTS

A. Section **<< 078400 - Firestopping>>**.

B. Section **<< 083323 - Overhead Coiling Doors>>**: Coiling fire doors for interface with fire alarm system.

C. Section **<< 083513.13 - Accordion Folding Doors>>**: Doors for interface with fire alarm system.

D. Section **<< 083513.23 - Accordion Folding Fire Doors>>**: Doors for interface with fire alarm system.

E. Section **<< 087100 - Door Hardware>>**:

1. Electrically-operated locks and electromagnetic door holders for interface with fire alarm system.
2. Fire department lock boxes with tamper switch monitored by fire alarm system.

F. Section **<< 142100 - Electric Traction Elevators>>**: For interface with fire alarm system.

G. Section **<< 142400 - Hydraulic Elevators>>**: For interface with fire alarm system.

H. Section **<< 211300 - Fire-Suppression Sprinkler Systems>>**: For interface with fire alarm system.

I. Section **<< 213000 - Fire Pumps>>**: For interface with fire alarm system.

J. Section **<< 233300 - Air Duct Accessories>>**: Smoke/fire dampers for interface with fire alarm system.

K. Section **<< 260519 - Low-Voltage Electrical Power Conductors and Cables>>**: For non-power-limited cables.

L. Section **<< 260526 - Grounding and Bonding for Electrical Systems>>**.

M. Section **<< 260534 - Boxes for Electrical Systems>>**.

N. Section **<< 275129 - Rescue Assistance Signal Systems>>**: Two-way emergency communication systems for areas of refuge/rescue assistance.

1.03 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code.

B. NFPA 72 - National Fire Alarm and Signaling Code.

C. NFPA 101 - Life Safety Code.

D. UL 864 - Control Units and Accessories for Fire Alarm Systems.

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1.04 SYSTEM DESCRIPTION

A. Control of system: By the fire alarm control panel.

B. System supervision: Automatically detect and report open circuits, shorts, and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.

C. Priority of signals: Automatic alarm response functions resulting from an alarm signal from one zone or device are not altered by subsequent alarm, supervisory, or trouble signals. An alarm signal is the highest priority. Supervisory and trouble signal shave second and third level priority. Higher priority sigals take precendence over signals of lower prior

D. Noninterference: A signal on one zone shall not prevent the receipt of signals fro

E. System reset: All zones are manuall resettable from the FACP

F. Transmission to remote alarm receiving station.

G. System alarm capability during circuit fault conditions: System wiring and circuit arrangement prevent alarm capability reduction when a single ground occurs in an initiating device circuit, signal line circuit, or notification appliance circuit.

H. Loss of primary power at the FACP initiates a trouble signal at the FACP. The FACP indicates when the fire alarm system is operating on the secondary power supply.

I. Basic alarm performance requirements: Unless otherwise indicated, operation of a manual station, automatica alarm operation of a smoke or heat detector, operation of a carbon monoxide detector, or operation of sprinkler flow switch, initiates the following:

1. Notification appliance operation.
2. Identificaiton at the FACP and the remote annunciator of the zone and device originating the alarm.
3. Release of fire and smoke doors held open by magnetic door holders. Confirm exact operation of system with Fire Marshal. There are different requirements betwen elementary, middle and high schools.
4. Operation of duct smoke detectors shall initiate a supervisory signal and shutdown of fans and other air-handling equipment serving zone where alarm was initiated.
5. Operation of carbon monoxide detector shall initiate a distinct local alarm signal and signal the BAS system.
6. Recording of the event in the system memory.
7. Initiate the transmission of alarm to the Owner's remote alarm receiving station.
8. CO2 detectors are to transmit a supervisory signal to the fire alarm system.

J. In addition to functions mentioned above, elevator smoke detectors shall perform elevator recall functions in accordance with ANSI requirements. Elevator heat detectors shall activate the shunt trip breakers.

K. Upon activation of alarm signal, the system shall override any intercommunications sound system, public address sound system, theatrical sound system, or local sound system.

L. Fire and smoke doors held open by magnetic door holders shall only be released by automatic operation of smoke detectors at the respective location. Confirm with AHJ/Fire Marshal for requirements, as they pertain to elementary, middle and high school projects.

M. Alarm silencing, system reset and indication: Controlled by switches in the FACP and the remote annunciator.

1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.

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2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset. System reset shall be controlled only at the FACP.

N. Remote detector sensitivity adjustment: Manipulation of controls at the FACP causes the selection of specific addressable, analog smoke detectors for adjustment, display of their current status and sensitivity settings, and control of changes in those settings. Same controls can be used to program repetitive, schedule, automated changes in sensitivity of specific detectors. Sensitivity adjustments and sensitivity-adjustment schedule changes are recorded in system memory.

O. Removal of an alarm-initiating device or a notification appliance initiates the following:
1. Transmission of trouble signal to remote alarm receiving station.

P. FACP alphanumeric display: Plan-English-language descriptions of alarm, supervisory, and trouble events; and addresses and locations of alarm-initiating or supervisory devices originating the report. Display monitoring actions, system and component status, system commands, programming informaiton, and data from the system's historical memory.

1.05 SUBMITTALS

A. General:
1. Comply with Division 01. When approved, no variation will be permitted except with written approval from the Architect.
2. Submit to the AHJ and to the Architect for review and approval.

B. Comply with **<<NFPA 72>>** chapter "Documentation," including noting names of installers, owners, and system classification information.

C. Shop Drawings: Submit installation documentation required for plan review and permitting by AHJ, including floor plans showing locations of fire alarm system components, enlarged drawn to identified scale plan view, and riser diagrams.
1. Floor plans indicating final equipment and device locations, along with raceway routes.
2. System operation description: Detailed description for this project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
3. Details of remote annunciator graphic display.
4. Wiring diagrams and riser diagrams.

D. Product data: Schedule and each type of system component, including dimensioned plans and elevations showing minimum clearances and installed features and devices. Include UL listings.

E. Battery calculations.

F. Provide a complete project record drawings as specified in Division 01, showing the locaitons of all the outlets, cable taps, cable routes, and other components installed. Drawings shall be made part of Operation and Maintenance Manuals.

G. Certificaitons:
1. UL Certificate of Compliance of system supplier as specified in "Quality Assurance" below
2. Fire and smoke detection system inspecition and test report, completed by the factory representative, endorsed by the Owner and the factory representative, including test data, detector locations and serial numbers, a summary of maintenance performed,

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recommendations for relocation or addition of detectors, final action regarding these recommednations, and system certification.

1.06 QUALITY ASSURANCE

A. System and equipment shall be UL listed. Each major component shall bear the manufacturer's name and catalog number.

B. UL labels and local testing (if required): As specified in *Section 280500 Common Work Results for Electronic Safety and Security*.

C. Single-source responsibility: Obtain system components from a single source that assumes responsibility for their compatibility.

D. Qualifications of system supplier and installer:
   1. Staff shall consist of at least one NICET Level III Technician or a professional enginer registered in Maryland.
   2. Has installed at least ten systems of the type specified which have performed satisfactorily for not less than two years.
   3. Maintains a facility with sufficient stock of spare parts.
   4. Shall respond within 24 hours of notification, to correct system failure or malfunction. During the project correction period as defined in General Conditions and in Section 260500, perform such corrections at no addition to the contract sum.

E. Factory-authorized service representative: Trained and certified by the manufacturer of the system, and experienced in the installation and operation of the type of system included in the work.

F. Comply with NFPA 72, applicable local codes, and regulations and requirements of the AHJ. Montgomery County is the local code authority.

1.07 INSPECTIONS AND SERVICE CONTRACT

A. During the general project correction period, every six months starting six months after substantial completion, a third party shall inspect and test the system.
   1. Submit written reports to the Owner and Architect, describing test results, including defects found and how they have been corrected, and listing components replaced.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

B. Do not exceed maximum ambient temperature requirements for batteries at any time, which reduces battery service life. Replace batteries exposed to temperatures in excess of manufacturer's requirements.

C. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than **<< 14 degrees F>>**, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify **<<Architect>>** and obtain direction before proceeding with work.

D. Existing Conditions:
   1. Existing Fire Alarm System: **<< Remove existing system completely after new system is fully operational and tested; Remove existing components indicated and incorporate remaining components into new system; or _____>>**. Comply with **<<NFPA 70>>**.

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a. Maintain existing under warranty as if new; do not take existing portions of system out of service until new portions are fully operational, tested, and connected.

2. Modifications to Existing System:
   a. Remove inactive or abandoned cables and components from existing fire alarm system**<< , except as indicated; mark "NOT IN SERVICE" for remaining; or None - N/A>>**.
   b. Remove unused existing components and materials from site and dispose according to local and federal requirements.
   c. Remove accessible portion of abandoned cables unless tagged with identification product suitable to withstand based on installed environment.

1.09 WARRANTY

A. Fire Alarm Control Units and Accessory Equipment: Provide minimum **<< 3-year; or _____>>** manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide a non-proprietary system by one of the following manufacturers:
   1. Honeywell: Fire-Lite Alarms.
   2. Honeywell: Notifier.
   3. Honeywell: Silent Knight.
   4. Carrier: Edwards EST.
   5. System Sensor.

2.02 FIRE ALARM CONTROL PANEL (FACP)

A. Fire Alarm System Interfaces and Control Functions:
   1. **<<UL 864>>** listed unless otherwise indicated.

B. Cabinet: Lockable steel enclosure. Arrange interior components so operations required for testing or normal maintenance of the system are performed from the front of the enclosure. If more than one unit is requierd to form a complete control panel, fabricate with matching modular unit enclosure to accommodate components and to allow ample gutter space for field wiring and interconnecting panels.
   1. Mounting: Surface.

C. Alarm and supervisory systems: Modules replaceable without removal of field wiring.

D. Control modules: Include types and capacities required to perform all functions of fire alarm systems.

E. Indications: Local, visible, and audible signals announce alarm, supervisory, and trouble conditions. Each type of audible alarm has a different sound.

F. Resetting controls: Prevent the resetting of alarm, supervisory, or trouble signals while the alarm or trouble condition still exists.

G. Alphanumeric display and system controls: Arranged for interface between human operator at the FACP and addressable system components, including annunciation, supervision and control.

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1. Display: A minimum of 80 characters; alarm, supervisory, and component status messages; and indicate control commands to be entered into the system for control of smoke detector sensitivity and other parameters.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
3. Provide pass code protected door holder, strobe and horn bypass. Contact Owner's electronic supervisor to coordinate pass code. *** **MCPS Standard** ***

2.03 EMERGENCY POWER SUPPLY

A. General: Components include nickel-cadmium battery, charger, and an automatic transfer switch.
   1. Battery normal life expectancy: 20 years minimum.

B. Battery capacity: a minimum of 4 hours of supervisory power with 15 minutes of general alarm capability at end of 4 hours.

C. Battery charger: Solid-state, fully automatic, variable-charging-rate type. Provide capacity for 150 percent of the connected system load while maintaining batteries at full charge. If batteries are fully discharged, the charger recharges them completely within four hours. Charger output is supervised as part of system power supply supervision.

D. Integral automatic transfer switch: Transfers the load to the battery without loss of signals or status indications when normal power fails.

2.04 ONE-WAY VOICE COMMUNICATION

A. The system shall have one-way voice communication and tone-generating capabilities. The voice messaging system shall be of the same manufacturer as the control panel.

B. Central audio control module: Alarm message or tone generation and microphone connections with continuous supervision and identification of the type of failure should a problem occur. (e.g. main microphone trouble, tone trouble). Audio outputs shall have individual gain control.

C. Hand-held, push-to-talk microphone: Recessed within a protective panel-mounted enclosure, noise-canceling communication type with a frequency range of 200 Hz to 4000 Hz, equipped with a self-winding five-foot coiled cable. An LED indicator shall indicate the microphone push-to-talk button has been pressed and speaker circuits are ready for transmission. The microphone shall be supervised for disconnection.

D. Audio control switch and indication module: To provie manual access to audio operations for authorized personnel. Include a phone page select switch, tone select switch, tape select switch, and "Audio trouble Reset switch". These switches and associated LED indicators shall be supervised for disarrangement or failure.

E. Audio power amplifiers: Furnisehd with a self-contained filtered 24 Vdc power supply, transformer, and amplifier monitor circuits. The amplifier shall provide a 25-V rms output with a frequency response of 120 Hz to 12,000 Hz. Provide sufficient amplification to operate all systems simultaneously plus 10 percent spare capacity.

F. Backup amplifier: Capable of automatically replacing any failed amplifier.

G. Speaker circuits: Capable of supplying 25-V rms audio power from the system amplifiers. Provide supervision for open, short, or ground fault conditions; individual and distinct trouble indications for each fault; and one circuit for each zone or area of distinct communication.

H. Digitized tones: For alarm (slow whoop) and auxiliary requirements (wail, horn, chime, and others).

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I. Pre-recorded digitized voice message capability: Automatically transmitted to occupants during alarm conditions.
   1. The automatic message player shall not rely on a tape or other mechanical means of transmitting the evacuation message.
   2. Provide a standard evacuation message, and message transmitter capable of transmitting a custom message up to 30 seconds long. A self-contained speaker shall provide testing of the message without disturbing the occupants of the facility. Provide system to provide up to two languages

J. Automatic voice evacuation sequence:
   1. Alarm tone shall sound for a maximum of 15 seconds, followed by automatic preselected voice evacuation messages. At the end of each voice evacuation message, the alarm tone shall resume. The alarm tones shall sound alternately until the Alarm Silence Switch at the FACP has been operated.
   2. Audible alarm operations (speaker circuit selection and alarm tone and voice messgae timing variations) shall be activated by the system software so that changes to the evacuation sequence can be made by authorized personnel without any component rewiring.

K. Manual voice paging sequence:
   1. The system shall allow voice paging. Upon activation of speaker manual control switch, attention-getting beeps shall sound over the speakers indicating an impending voice message.
   2. Voice message: Operator shall be able to make announcements via the push-to-talk paging microphone.

2.05 REMOTE ANNUNCIATOR AND GRAPHIC DISPLAY

A. Remote annunciator: Flush-mounted liquid crystal display (LCD) annunciator.
   1. Display: Supervised, back-lit, LCD with no fewer than 4 lines with 20 characters per line.
      a. Back lighting shall turn off after 4 minutes when there is no switch activity and no unacknowledged message.
      b. The first event of the highest priority shall capture the display, so that arriving firefighters can view the first alarm event immediately.
      c. Provide additional alarm supervisory trouble LED for future expansion.
      d. Descriptions below are intended to provide means for interface. See project SOOs, narrative, and input/output matrix for execution requirements.
      e. Provide initiating devices, interfaces, and control functions for emergency control function interfaces in accordance with **<<NFPA 72>>**.
   2. Key operated switched:
      a. Alarm silence.
      b. Trouble silence.
      c. Test.

B. Description: Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. Also duplicate manual switching functions of the FACP, including alarm silence, trouble silencing, and test.
   1. Mounting: Recessed cabinet, NEMA 250, Type 1.

C. Graphic display: As shown on the drawings, panel indicating the building floor plan with a "You are here" note and zone and device locations, permanently marked on panel surface.

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1. Mounting: Integral with lamp-type annunciator, with individual lamps in locations shown. Provide additional blank spaces for future expansion.
2. Dimensions: 24 inches wide by 20 inches high, minimum.

2.06 MANUAL PULL STATIONS

A. Description: Fabricated of metal or plastic, and finished in red with molded, raised-letter operating instructions of contrasting color.
   1. Dual-action mechanism initiates an alarm.
   2. Station reset: Key operated only; double pole, double throw; switch rated for the voltage and current at which it operates.
   3. Integral addressable module: Arranged to communicate manual-station status (normal, alarm, or trouble) to the fire alarm control panel.
   4. False alarm protector: Tamperproof clear polycarbonate shield in a frame that fits over the pull station. When the shield is lifted to gain access to the pull station, a warning horn shall sound. Include 9-V dc alkaline battery.

2.07 SMOKE DETECTORS

A. General: UL 268A listed. Include the following features:
   1. Operating voltage: 24-V dc, nominal.
   2. Self-restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
   3. Plug-in arrangement: Detector and associated electronic components are mounted in a module that connects in a tamper-resistant manner to a fixed based with a twist-locking plug connection. Terminals in the fixed base accept building wiring.
   4. Integral visual-indicating light: LED type. Indicates detector has operated.
   5. Sensitivity: Can be tested and adjusted in-place after installation.
   6. Integral addressable module: Arranged to communicate detector status (normal, alarm, or trouble) to the fire alarm control panel.
   7. Remote controllability: Unless otherwise indicated, detectors are analog-addressable type, individually monitored at the fire alarm control panel for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the fire alarm control panel.
      a. Detectors which will be installed in ducts or other concealed locations shall be capable of being tested from an indicating and test station specified below.

B. Photoelectric smoke detectors: Include the following features:
   1. Sensor: LED or infrared light source with matching silicon-cell receiver.
   2. Detector sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.
   3. Integral thermal detector: Fixed-temperature type with 135 deg F setting.

C. Duct smoke detector: Photoelectric type.
   1. Sampling tube: Design and dimensions as recommended by the manufacturer for teh specific duct size, air velocity, and installation conditions where applied.
   2. Relay fan shutdown: Contacts rated to interrupt fan motor circuit. Control circuit shall always be energized. If needed, provide an applicable relay.

2.08 OTHER DETECTORS

A. Heat detector, fixed-temperature type:
   1. Actuated by temperature that exceeds a fixted temperature of the following:

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a. Elevator shaft and elevator machine room: 135 degrees F.

2. Mounting:
   a. Adapter plate for outlet box mounting.
   b. Plug-in or twist-lock base, interchangeable with smoke detector bases.
3. Integral addressable module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

B. Carbon monoxide detector:
1. General: Carbon monoxide detector listed for connection to fire-alarm system.
   a. Mounting: Adapter plate for outlet mounting.
   b. Field testable by introducing test carbon monoxide into the sensing cell.
   c. Integral addressable module: Arranged to communicate detector status (normal, alarm, or trouble) to the fire alarm system.
   d. Intelligent sounder base capable of generating an audible Temp 4 pattern for CO alarm indication.
   e. Detector shall have separate addressable relay module or relay base for connection to building automatiion system (BAS) to report alarm and trouble conditions.
   f. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
   g. Comply with UL 2075.
   h. Locate, mount, and wire according to manufacturer's written instructions.
   i. Test button simulates an alarm condition.

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2.09 CONCEALED DETECTOR INDICATING AND TEST STATION

A. Description: Flush-mounted, single-gang station for each duct smoke detector an other detector that is not readily visible, with indicating light and test switch.

B. Indicating light: Flashes when the associated device is in an alarm or trouble mode.

C. Test switch: Forces detector into alarm, allowing test of outputs programmed to occur following alarm initiation at devices.

D. Device plate: Reading SMOKE DETECTOR ABOVE CEILING, or other test as appropriate. Confirm exact wording with Owner.

2.10 NOTIFICATION APPLIANCES

A. Description: Equipped for mounting as indicated and have screw terminals for system connections.
1. Combination devices: Factory-integrated audible and visible devices ina single-mounting assembly.
2. Confirm finish color of devices with Architect and Owner; red finish with white letters or white finish with red letters.

B. Visible alarm devices: Synchronized xenon strobe lights listed under UL 1971 with clear or nominal white polycarbonate lens. Mount lens on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch high letters on a removable sleeve on the lens.
1. Rated light output: multi-candela rating, minimum 15cd to 110cd.
2. Strobe leads: Factory connected to screw terminals.

C. Speakers:
1. UL 1480 listed.

2. Sound output: Minimum of 84 dBA at 10 feet when tapped at 0.5 watt, and maximum of 87 dBA at 10 feet. Taps shall be available at 0.25, 0.5, 1, and 2 watts.
3. 25 or 70.7 V rms.
4. Mounting: Flush or surface mountable; bi-directional as indicated, with sealed back.
5. Operation: From standard signaling circuits or addressable single or mult-zone I/O modules.

D. Combination speaker/strobe units: Speaker and visible alarm device as specified above, mounted in a fire retardant, high-impact, white polycarbonate housing suitable for flush or surface mounting.
1. Speaker: Tapped at 0.5 watts; 25 V rms.

2.11 FIRE ALARM NOTIFICATION BOOSTER

A. Power supply booster designed to extend power available to

B. Enclosure: Steel, with lockable front panel allowing access to all interior components, surface mounted.

C. Functions: Contains circuits to monitor and charge batteries, control and supervise 4 Class B appliance circuits, and monitor two controlling inputs from external sources.
1. Configurable to operate at any one of three signaling rates, or to follow the main panel's notification appliance circuit.
2. Trouble contact with 16-second delay.

D. Batteries: Two, sized for a minimum of 4 hours of standby followed by 15 minutes of alarm.

E. Indicators: LEDs, one for each circuit, one for battery supervision, one for ground fault, and one for power.

2.12 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching door plate.
1. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.
2. Wall mounted units: Flush mounted, unless otherwise indicated.
3. Rating: 12/24 V DC.

B. Material and finish: Match door hardware.

2.13 ADDRESSABLE INTERFACE DEVICE

A. Monitor module: Microelectronic monitor module listed for use in providing a system address for external alarm-initiating devices with normal open contacts.
1. Dual circuit, intelligent, signaling circuit interface module.

B. Control module: Microelectronic control relay module listed for use in providing control to external appliances or equipment shutdown and to circuit breaker shunt trip for power shutdown.
1. One Form C (SPDT) dry relay contact rated at 2 amps and 24V DC.

C. Isolator module: Microelectronic fault isolator module listed for isolating and removing a fault from a data circuit while allowing the remaining data loop to continue operating.
1. Protect loop system against wire-to-wire short circuits by isolating section of loop and permitting other loop sections to continue to operate.

D. Non-addressable control relay: Isolation relay for control of HVAC unit contactors and magnetic door holders, UL 864 listed.

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1. Construction: Sealed, non-removable, with terminations to pressure-type screw terminals.
2. Rating: Use with circuits up to 240 V AC at 7 amps inductive.

2.14 WIRE AND WIRING SYSTEM

A. Non-power-limited circuits: Solid copper conductors with 600V rated 75 degree C, color coded insulation.
   1. Low-voltage circuits: No. 16 AWG, minimum.
   2. Line-voltage circuits: No. 12 AWG, minimum.

B. Power-limited circuits: NFPA 70, Types FPL, FPLR, or FPLP, as recommended by manufacturer.

C. Wiring System: Class B in accordance with NFPA 72.

D. Survivability: Circuits necessary for the operation of notification applicances shall be protected by a 2-hour fire-rated cable system or a 2-hour fire-rated enclosure.

E. Type MC fire alarm cable: Equal to AFC Cable Systems FPLP metal-clad, multi-conductor, fire alarm and control cable.
   1. Ratings:
      a. Plenum rated.
      b. Approved for use as fixed wiring concealed in building.
      c. Maximum operating temperaturess:
         1) 105 degrees C dry for FPLP applications at nominal voltage ratings 300V and less.
         2) 90 degrees C dry for MC cable installations at nominal voltage ratings of 600V and less.
      d. UL listed for penetrations of wall and floor assemblies of gypsum wallboard, concrete, and concrete masonry wth 1-, 2-, and 3-hour fire ratings.
   2. Shield over conductor assemply: Laminated aluminum and mylar tape and tinned copper drain wire.
      a. Drain wire: Minimum No. 18 AWG, in contact with aluminum shield.
   3. Listed in accordance with UL 1596:
      a. Insulated or bare grounding conductor in accordance with Table 6.3, cabled with the circuit conductors and identified in compliance with Section 35.
      b. Galvanized steel armor, red, applied over inner cable assembly with positive interlock conforming to the requirements of Section 12.
      c. Tested in accordance with applicable requirements.

2.15 PERIPHERAL EQUIPMENT

A. Alarm reporting device: A digital communicator shall report an alarm or trouble condition. It shall notify Owner's fire alarm monitoring service and one or more facilities personnel. Provide unit compatible with the Owner's monitoring service.

B. Sprinkler flow and tamper switches: Specified in fire suppression sprinkler system specifications. Provide a monitor module for addressing each device. Unit shall mount on 4-inch square, 2.5-inch deep back box.
   a. Provide monitoring of interconnected systems. Coordinate notification appliance alternate markings as indicated on drawings.

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PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Factory-authorized service representative, as required in "Quality Assurance" in Part 1 above, shall supervise installation, software documentation, adjustment, preliinary testing, final testing, and certification of the system, and provide the operating instructions.

B. Provide wiring, conduit, and outlet boxes required for the complete system, in accordance with system manufacturer's instructions and with the requirements specified in Division 26 for wiring, conduit, and boxes. Provide 12 inches of slack at each outlet.

1. Install wiring in conduit, except where noted on drawings to provide Type MC fire alarm cable.
2. Install Type MC fire alarm cable within concealed ceiling spaces and within drywall partitions, in accordance with Article 330 of the National Electric Code (NFPA 70).
3. Identification: Paint fire alarm junction box covers red.

C. Wires, cables, conduits, and wiring connections are specified in Division 26, Electrical. Include in the work of this section, wiring, conduits, and equipment connections complying with the requirements of Division 26, so that the fire alarm system will function as specified and indicated on the drawings.

D. Wiring: Free from grounds or crosses between conductors.

1. Identification: Color code wiring, not duplicating building wiring colors. Tag each wire at each junction point.

E. Final connections between equipment and the wiring system shall be made under the direction and supervision of the qualified supplier.

F. Provide 20 percent spare capacity for each notification appliance circuit.

G. Locate 135 degrees F rated heat detectors in elevator shafts and elevator machine rooms within 18 inches of sprinklers.

3.02 INSTALLATION, FIRE ALARM NOTIFICATION BOOSTER

A. Provide number of notification power supply boosters required for a complete fire alarm system.

B. Utilize a single pole, 20 amp circuit breaker in a 120V electrical panelboard to make electrical connection to each power supply booster.

1. Circuit breakers shall match and shall be compatible with the other breakers in the panelboard.

C. Branch circuits from panelboards to each notification power supply booster: Two No. 12 wires and one No. 12 ground in conduit, no less than 0.75 inch trade size, unless otherwise indicated.

D. Install conduits and wiring as specified in Sections 260519 and 260533.

E. Provide smoke detector above each power supply booster.

3.03 INTERFACE WITH OTHER WORK

A. Furnish duct smoke detectors to be installed as part of ductwork specified in Division 2

B. Coordinate with installation of flow and tamper switches in fire suppression sprinkler system.

C. Coordinate with sprinkler contractor for number and locations of sprinklers in elevator shafts and elevator machine rooms.

D. Coordinate locations of control modules for connections to sound systems override.

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3.04 CARBON MONOXIDE DETECTORS

A. Provide carbon monoxide detectors where fuel fired equipment are present. Provide addressable relay for connection to BAS (building automation system).

3.05 LOCATIONS OF FIRE ALARM EQUIPMENT

A. Locate the annunciator and other associated equipment as shown on the drawings.

B. Visual indicating appliances: Install where shown on the drawings. If field conditions require variation from drawings, do not violate ADA requirements, including, but not limited to, the following:

1. Any room or space required to have a visual appliance, including corridors or hallways: No place shall be more than 50 feet from the indicating appliance in the horizontal plane.
2. Rooms and spaces exceeding 100 feet in one dimension, without obstructions 6 feet above the finished floor: Indicating appliances may be placed around the perimeter, spaced approximately 100 feet apart.

C. Mount indicating and test station for concealed smoke detectors near ceiling under detector. Text engraved on plate shall be descriptive of the device identified.

D. Provide a smoke detector at each fire alarm panel location, including but not limited to main control, auxiliary control, and power panels.

3.06 INSPECTION, TEST, ADJUSTMENT AND REPORT

A. Furnish equipment and appliances for testing the complete system during progress of the work and after completion of the installation, including a megger test of wiring. The tests generally shall demonstrate the following:

1. Circuits are continuous and free from
2. Circuits are free from unspecified grounds.
3. Resistance to ground of non-grounded circuits is not less than one megohm.
4. Circuits are properly connected in accordance with the applicable wiring diagrams.
5. Each detector operates correctly.
6. Detectors are correctly located and sufficient in number.

B. Defects or omissions observed during general and system tests shall be repaired as quickly as possible and the tests reconducted.

C. Submit report as required in Part 1 above.

3.07 OPERATING INSTRUCTIONS

A. Furnish the necessary technicians, skilled workers, and helpers to operate the electrical systems and equipment of the entire project for one 8-hour day.

B. Where specified in technical sections, provide longer periods required for specialized equipment.

C. Instruct the Owner or designated personnel in operation, maintenance, lubrication, and adjustment of systems and equipment.

D. The Operating and Maintenance Manual shall be available at the time of the instructions for use by instructors and Owner personnel.

E. Schedule the general and specialized instruction periods for a time agreed upon by the Owner and Engineer of record.

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F. Provide at least 8 hours of additional instruction time for the systems and equipment specified in this section, consisting of 2 periods of 4 consecutive hours, during a period of not more than 60 days.

3.08 INSTALLATION

A. Install field-devices, components, FACU and related equipment, and accessories in accordance with the following:

3.09 INSPECTION AND TESTING FOR COMPLETION

3.10 CLOSEOUT ACTIVITIES

A. See Section **<< 017800 - Closeout Submittals>>** for additional submittals.

B. See Section **<< 017900 - Demonstration and Training>>** for additional requirements.

C. Closeout Demonstration: Demonstrate operation of all functions to **<<Owner>>**.
   1. Be prepared to conduct any of required tests.
   2. Have minimum **<< one; or _____>>** copy of operation and maintenance data,**<< preliminary; _____; or None - N/A>>** copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
   3. Have authorized technical representative of FACU manufacturer present during demonstration.
   4. Demonstration may be combined with inspection and testing required by AHJ; notify AHJ with enough time to schedule demonstration.
   5. Repeat demonstration until successful.

D. Submit electronic copies of tests on a USB thumb drive to Owner.

E. Provide an electronic copy of the fire alarm control panel programming upon the completion on a USB thumb drive to Owner.

F. Substantial Completion of project cannot be achieved until inspection and testing is successful and the following:
   1. Approved operating and maintenance data has been delivered.
   2. All aspects of operation have been demonstrated to **<<Owner>>**.
   3. Final acceptance of fire alarm system has been given by AHJ.

G. Project record documents:
   1. Maintain onsite one set of record documents; record actual revision to the work of this division. The record set of documents shall be in electronic form, and stored on a USB flash drive for uploading to a server. All electronic files shall be book marked and searchable. ***** MCPS Standard ***** The record set of drawings shall contain, at a minimum, the following:
      a. Contract Drawings.
         1) As-built drawings shall be digital drawings, not scans. ***** MCPS Standard *****
      b. Specifications.
         1) The specifications shall be sectioned out to reduce file sizes. Confirm requirements with Paul Geisler. ***** MCPS Standard *****
      c. Addenda.
      d. Change Orders and other Modifications to the Contract.
      e. Reviewed shop drawings, product data, and samples.
   2. Maintain

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3.11 MAINTENANCE

A. Provide to **<<Owner>>**, at no extra cost, written maintenance contract for **<< entire manufacturer's warranty period; 2 years; or ____>>**, to include work described below.

B. Perform routine inspection, testing, and preventive maintenance required by **<<NFPA 72>>**, including:
   1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
   2. Repairs required, unless due to improper use, accidents, or negligence beyond control of maintenance contractor.
   3. Record keeping required by **<<NFPA 72>>** and AHJ.

C. Provide trouble call-back service upon notification by **<<Owner>>**:
   1. Provide on-site response within **<< two hours; or _____>>** of notification.
   2. Include allowance for call-back service during normal working hours at no extra cost to **<<Owner>>**.
   3. **<<Owner>>** will pay for call-back service outside of normal working hours on hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

D. Provide complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with detailed schedule.

E. Provide all necessary materials, laptop, programs and service tools for fire alarm system with training(s). The Owner must have access to TechSupport for the life of the materials.

F. Maintain on-site log listing date and time of each inspection and call-back visit, condition of system, nature of trouble, correction performed, and parts replaced. Submit duplicate of each log entry to **<<Owner>>**'s representative upon completion of site visit.

G. Comply with **<<Owner>>**'s requirements for access to facility and security.

END OF SECTION 284600

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SECTION 311000
SITE CLEARING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Clearing and grubbing.

B. Selective removal and trimming.

C. Earth stripping and stockpiling.

D. Repair and restoration.

E. Debris removal.

1.02 RELATED REQUIREMENTS

A. Section **<< 024100 - Demolition>>**: Removal of built elements and utilities.

B. Section **<< 026500 - Underground Storage Tank Removal>>**.

C. Section **<< 312323 - Fill>>**: Material for filling holes, pits, and excavations generated as result of removal operations.

D. Section **<< 329300 - Plants>>**: Relocation of existing trees, shrubs, and other plants; pruning.

1.03 REFERENCE STANDARDS

A. Maryland Department of the Envinronment Standards and Specifications for Soil Erosion and Sediment Control, current edition.

B. Terms and conditions of the Final Forest Conservation Plan, Tree Save Plan or other Landscape Credit Plans as approved by the Authority having Jurisdiction.

C. ANSI A300 Part 1 - American National Standard for Tree Care Operations - Tree, Shrub, and Other Woody Plant Management - Standard Practices (Pruning).

D. ANSI A300 Part 5 - American National Standard for Tree Care Operations – Tree, Shrub and Other Woody Plant Maintenance Standard Practices (Management of Trees and Shrubs During Site Planning, Site Development, and Construction).

E. ANSI Z133 - American National Standard for Arboricultural Operations - Safety Requirements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-Construction Meeting: Convene prework meeting**<< one week; at least one week; _____; or None - N/A>>** prior to start of work of this section; require attendance by affected personnel, Arborist, Authority having jurisdiction Inspector, and Architect.

B. Sequencing: Ensure utility disconnections are in orderly and expeditious manner.

1.05 SUBMITTALS

A. See Section **<< 013000 - Administrative Requirements>>** for submittal procedures.

B. Site Plan:

1. Indicate vegetation removal limits.
2. Indicate areas for temporary construction and field offices.

C. Clearing Firm Qualification Statement: Documentation of specialized experience.

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D. Existing Conditions Report: Written documentation of vegetation to remain, see Section **<< 013000 - Administrative Requirements>>**.

E. Photographs: Photographic documentation of existing vegetation.

F. Documention of legal off-site disposal areas. Obtain required federal, state, county, or local approvals for off-site borrow areas or waste sites if located on private property and/or Maryland Department of the Environment approval if on State or Federal property. Furnish documentation of such local approvals in advance of any off-site borrow operations to the Owner.

1. Final Payment will be retained until all off-site permits are submitted to the Owner.

1.06 QUALITY ASSURANCE

A. Clearing Firm Qualifications: Company specializing in performing work of type specified and with at least **<< five; or _____>>** years of**<< documented; _____; or None - N/A>>** experience.

B. Trimming or Pruning Qualifications: Tree Care Industry Association (TCIA) **<< accredited company; utility contractor accredited company; Certified Treecare Safety Professional; or _____>>**.

1.07 FIELD CONDITIONS

A. Ambient Conditions: Terminate work during hazardous environmental conditions according to **<<29 CFR 1910.266>>**.

B. Existing Utilities: Locations of existing utilities are approximate. Locations have been determined from field survey, public utility records and Owner records.

1. Contractor shall be responsible for contacting "Miss Utility" and Owner or controlling agencies of existing utilities within construction area for verification of locations, prior to beginning of work.
   a. On-Site Utilities shall be marked by Contractor according to ASCE Quality Level 'B'.
   b. Contractor shall test pit all proposed utility crossings prior to the start of any utility installation. Provide results as a shop drawing to the Architect.
2. Contractor shall be responsible for coordination of utility relocation or removal by others with phases of construction activities.

C. Traffic: Conduct site-clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction.

D. Temporary Erosion and Sediment Control: Comply with other requirements specified in Section **<< 015713 - Temporary Erosion and Sediment Control>>**.

E. Protect improvements on adjoining properties and on Owner's property.

F. Restore damaged improvements to original condition, as acceptable to property Owners.

G. Protection of Existing Trees and Vegetation: Employ and provide services of an appropriately Licensed Maryland Arborist at no additional cost to Owner, when necessary, that appropriate measures are implemented to ensure continued health of and protect existing trees and vegetation indicated to remain in place. Protect existing trees and vegetation indicated to remain in place protected against unnecessary cutting, breaking or skinning of roots, skinning or bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing. Clearing operations are to be conducted in strict accordance with requirements of approved Final Forest

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Conservation Plan, Tree Save Plan or other landscape credit plan for project. As directed by the Arborist these measures may include the following at no additional cost to the Owner:

1. Water trees and other vegetation indicated to remain during clearing and subsequent construction operations within limits of Contract work as required maintaining health during construction operations.
2. Provide protection for roots over 1-1/2 inch in diameter that are cut during construction operations. Coat cut faces with emulsified asphalt or other acceptable coating formulated to use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.
3. Repair or replace trees and vegetation to remain that are damaged during construction operations in a manner acceptable to Architect. Employ a licensed Arborist to repair damage to trees and shrubs.
4. Replace trees that cannot be repaired and restored to full-growth status, as determined by arborist.

H. Salvageable Improvements: Carefully remove items indicated to be salvaged and, unless directed otherwise, store on Owner's premises where indicated or directed.

PART 2 PRODUCTS

2.01 MATERIALS

A. Tree Wound Compound: Application capable of sealing vegetation wounds and grafts.

B. Temporary Tree Protection Fencing: Provide "Temporary Tree Protection" for trees indicated to remain, and as required for existing trees beyond indicated "Clearing and Grading Limits". Install as indicated as noted on the approved plans, or as directed by the Inspector.

C. Fence Posts: Install posts, spaced no more than 10 feet on center, by driving plumb to one-third post height above grade. Stretch fence fabric between posts and fasten securely to steel posts with tie wire.

1. Steel "T" or "U" channel, with punched or riveted lugs for fence attachment.
2. Weight: 1.33 pounds per linear foot
3. Length: 66 inches
4. Bottom End Shape: Pointed
5. Finish: Rust inhibitive primer paint

D. Fence Fabric: 14 Gauge 2 inch X 4 inch Welded Wire Fence.

1. Fabric Height: Three (3) Feet

E. Tree Proectection Signage: Provide in accordance with the approved Forest Conservation or Tree Save Plans.

PART 3 EXECUTION

3.01 EXAMINATION

A. Comply with additional requirements specified in Section **<< 017000 - Execution and Closeout Requirements>>**.

B. Identify potential runoff areas.

C. Construction Fencing: See Section **<< 015000 - Temporary Facilities and Controls>>**.

D. Boundary Demarcations: See Section **<< 017123 - Field Engineering>>**.

E. Identify potential dust sources.

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F. Identify preexisting debris, junk, and trash on-site.

3.02 PREPARATION

A. Coordinate work with utility companies; notify before starting work and comply with local requirements; obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Protect existing structures and other elements that are to remain.

E. Protect existing vegetation to remain from damage and monitor according to **<<ANSI A300 Part 5>>**.

1. Photograph vegetation with documentation indicating data, time, weather, and brief description of health condition.

F. Install sedimentation barriers according to Section **<< 015713 - Temporary Erosion and Sediment Control>>**.

G. Develop dust remediation controls and methods in accordance with local ordinances.

H. Remove preexisting debris, junk, and trash on-site.

3.03 CLEARING AND GRUBBING

A. Clearing: Cut trees, stumps, shrubs, downed timber, and other vegetation for removal within identified area**<< as indicated on drawings; _____; or None - N/A>>** according to **<<29 CFR 1910.266>>**. Follow recommendations of **<<ANSI Z133>>** and best local practices for species involved.

B. Do not remove or damage vegetation beyond limits indicated on drawings.

C. In areas where vegetation must be removed but no construction will occur remove vegetation with minimum subsoil disturbance.

D. Grubbing: Remove stumps, roots, buried timber, and other vegetation minimum depth **<< 12 inches (30 cm); or _____ inches (_____ cm)>>** from ground. Remove rocks 2 1/2" diameter minimum depth **<< 6 inches (15 cm); or 12 inches (30 cm)>>** from ground.

3.04 SELECTIVE REMOVAL AND TRIMMING

A. Selective Removal: Individual tree and shrub identified for removal**<< as indicated on drawings; _____; or None - N/A>>** according to **<<29 CFR 1910.266>>**.

1. Includes trees, stumps, shrubs, downed timber, and other vegetation identified for removal as indicated on drawings.
2. Fell trees away from vegetation identified to remain.
3. **<< Grind; Pull; or _____>>** stumps, remove roots, buried timber, and other vegetation identified for removal **<< 12 inches (30 cm); or _____ inches (_____ cm)>>**, minimum depth, from ground. Remove rocks 2 1/2" diameter **<< 6 inches (15 cm); or 12 inches (30 cm)>>**, minimum depth, from ground.
4. Fill holes left by removal of stumps and roots, using suitable fill material, with top surface neat in appearance and matching existing grade.

B. Selective Trimming: Individual limbs and branches cut back according to **<<ANSI A300 Part 1>>** identified for removal**<< as indicated on drawings; _____; or None - N/A>>**. Follow recommendations of **<<ANSI Z133>>** and best local practices for species involved.

1. Prune dead branches and balance overall appearance; see Section **<< 329300>>**.

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3.05 EARTH STRIPPING AND STOCKPILING

A. Stripping:
   1. Remove topsoil within identified area:
      a. According to soil report.

B. Stockpiling:
   1. Place topsoil in identified areas**<< as indicated on drawings; _____; or None - N/A>>**:
      a. Protect piles from erosion.
      b. Vegetatively stabilize any stockpiles to remain exposed over seven (7) calendar days.
      c. Stockpile areas shall be encompassed with silt fence.
   2. Cut sod into portable sections for undamaged removal.
   3. Record topsoil depth at rate of **<< five; or _____>>** measurements per **<< acre>>** or within each identified area**<< as indicated on drawings; _____; or None - N/A>>**.

3.06 REPAIR AND RESTORATION

A. Remaining Existing Facilities, Utilities, and Site Features: If damaged due to this work, repair or replace to original condition.
   1. Outside removal limits.
      a. **<< 4 inches (10 cm); 6 inches (15 cm); or _____ inches (_____ cm)>>** deep.

B. Vegetation: Replace damaged or destroyed vegetation identified to remain**<< as indicated on drawings; _____; or None - N/A>>** at no cost to **<<Owner>>**:

C. Apply tree wound compound according to manufacturer's recommendations.
   a. According to depth measurements.
   2. Remove topsoil within identified area as indicated on drawings.

3.07 DEBRIS REMOVAL

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and windblown debris from public and private lands.

D. Burning is not permitted on Owner’s property.

3.08 CLEANING

A. See Section **<< 017000 - Execution and Closeout Requirements>>** for additional requirements.

B. Remove unused stockpiled subsoil. Grade stockpile area to prevent standing water.

C. Leave site clean and ready to receive work.

END OF SECTION 311000

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SECTION 311005
SITE DEMOLITION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements, are a part of this section.

1.02 RELATED SECTIONS

A. Section 017419 “Construction Waste Management and Disposal”

B. Section 024100 “Demolition”

C. Section 311000 “Site Clearing”

D. Section 312000 "Earthmoving"

E. Division 26 "Electrical".

1.03 DESCRIPTION OF WORK

A. This section specifies demolition of existing site elements improvements and underground utilities. Removal and disposal, off site, of all portions of existing site items indicated (drives, parking surfaces, etc.)

1.04 CODES AND REGULATORY REQUIREMENTS

A. For existing flammable liquid storage tanks refer to National Fire Protection Association (NFPA).

B. Code of Maryland Regulations, Section 26.10.01; State of Maryland, Department of the Environment, Title 26, Subtitle 10, "Oil Pollution and Tank Management".

C. Comply with all applicable federal, state and local disposal requirements and regulations for material removed from site.

D. Recycle, compost and/or salvage plants and demolition waste in accordance with Section 017419 “Construction Waste Management and Disposal” requirements.

E. Comply with permits, approved plans and conditions thereof.

F. Comply with terms and conditions of approved Final Forest Conservation Plan, Tree Save Plan or other Landscape Credit Plans.

G. Comply with governing EPA notification regulations before starting demolition.

H. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.05 PROJECT CONDITIONS

A. Owner Responsibility: Owner assumes no responsibility for actual conditions of areas to be demolished. Conditions existing at time of bid will be maintained by Owner as far as is practical.

B. Storage or sale of removed items or materials will not be permitted.

C. Existing Utilities: Locations of existing utilities are approximate. Locations have been determined from field survey, public utility records and Owner records.

1. Contractor shall be responsible for contacting "Miss Utility", Owner or controlling agencies of existing utilities within construction area for verification of locations and marking of utilities, prior to beginning of work.

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a. On-Site Utilities shall be marked by Contractor according to ASCE Quality Level 'B'.

2. Contractor shall be responsible for coordination of utility relocation or removal by others with phases of construction activities.

D. Existing Subsurface Conditions: Verify existing pavement materials and respective thicknesses during prebid inspection. Obtain written authorization from Owner before conducting test hole explorations of existing pavements within project site. All test holes shall be patched to match existing conditions to the satisfaction of the Owner.

E. Traffic: Obtain written authorization from local jurisdiction, adjacent property Owners and Owner prior to obstructing vehicular traffic and parking areas. Obtain written authorization from local jurisdiction prior to obstructing public rights-of-way and easements.

F. No tree removal or site clearing other than specifically noted on the Contract drawings shall be performed without written consent of local Forest Conservation Inspector and Owner.

G. Blasting will not be permitted.

1.06 SUBMITTALS

A. General: Submit each item according to Conditions of Contract and Division 1 Specification Sections, for information only, unless otherwise indicated.

B. Qualifications for proposed demolition firm.

C. Proposed dust-control measures in accordance with local codes.

D. Proposed noise-control measures in accordance with local codes.

E. Schedule of selective demolition activities indicating the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
2. Interruption of utility services.
3. Coordination for shutoff, capping, and continuation of utility services.

F. Photographs or videos, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by selective demolition operations.

G. Record drawings at Project closeout according to Section 017000 "Execution and Closeout Requirements."

1. Identify and accurately locate capped utilities and other subsurface structural, electrical, or mechanical conditions.

H. Landfill records showing receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.07 QUALITY ASSURANCE

A. Demolition firm qualifications: Engage an experienced demolition firm that has successfully completed at least five years of local demolition work similar to that indicated for this project.

B. Regulatory Requirements: Comply with applicable codes and regulatory requirements. Refer to Paragraph 1.4 of this section.

C. Submit written advanced notification to public utility companies as required by respective utility purveyor, but no less than one week prior to planned work, for disconnection of active utilities.

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1.08 DEFINITIONS

A. Demolition: Complete removal and legal off-site disposal of existing facilities specified or indicated.

B. Salvage: Complete removal, by methods, which prevent damage or destruction of any items indicated to be relocated (or salvaged) and subsequent relocation and reinstallation in an area designated by Owner.

C. Remove and Salvage: Items indicated to be removed and salvaged remain Owner's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to Owner's designated storage area.

D. Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare for reuse; store and protect against damage. Reinstall items in locations indicated.

E. Existing to Remain: Protect construction indicated to remain against damage and soiling during demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and then cleaned and reinstalled in original locations.

1.09 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from site with further disposition at Contractor's option.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROTECTION AND RESTORATION

A. Refer to Section 311000 "Site Clearing" and Section 312000 "Earthmoving".

B. Existing Facilities: Protect existing facilities and structures designated to remain, temporarily or permanently, from damage during demolition or construction activities. Repair items damaged during demolition or construction activities to their original condition or replace with new. Do not overload structural elements or pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition and/or removal work. Repairs, reinforcement or structural replacement shall be approved by Architect or Owner's Representative.

C. Existing Utility Services: The locations of underground utility services are approximate and are taken from Owner's record information and record information provided by utility companies. Protect existing utility services designated to remain temporarily or permanently, or to be relocated or removed by others. Contractor shall sequence demolition and construction activities to minimize utility service interruptions to existing facilities to remain. Where removal of existing utility services is required for other site construction, provide temporary covering of exposed areas, and temporary service or connections for utilities until permanent utility service replacements are completed.

1. Contractor shall coordinate with affected utility companies to determine extent of relocation work to be done by others.
2. Contractor shall coordinate utility relocation or removal by others with phases of construction activity.

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3.02 EXISTING SITE IMPROVEMENTS DEMOLITION

A. Existing Pavements: Demolish existing pavements including stone sub-base, regardless of pavement thickness, to limits indicated at no increase to Contract Sum. Neatly saw cut existing bituminous concrete pavement to straight, smooth and sharp edges perpendicular to pavement surface.

B. Existing Sidewalks and Curbing: Demolish existing sidewalks and curbing to limits indicated, unless nearest expansion joint is less than six (6) feet from indicated limits of removal. In that case, remove existing concrete to nearest expansion joint beyond indicated demolition limits at no increase to the Contract Sum. Neatly saw cut existing cement concrete curbing, to limits indicated, to smooth, clean and sharp edges perpendicular to top and face of curbing.

1. Contractor's Option: Remove existing concrete curbing and sidewalk to nearest expansion joint beyond demolition limits indicated at no increase to Contract Sum.

C. Existing Entrances and Aprons: Demolish existing entrances and aprons indicated.

D. Miscellaneous: Demolish existing fencing indicated, including posts, footings and related appurtenances. Demolish additional miscellaneous existing site improvements indicated, specified and required to construct project.

3.03 EXISTING OVERHEAD UTILITY DEMOLITION

A. Existing overhead electrical service facilities will be removed by the responsible Power Company. Contractor shall contact appropriate power company to schedule and arrange for payment for removals.

B. Existing overhead telecommunication facilities will be removed by responsible Telecommunication Company. Contractor shall contact Telecommunication Company to schedule and arrange for payment for removals.

C. Existing overhead cable service facilities will be removed by responsible Cable. Contractor shall contact Cable Company to schedule and arrange for payment for removals.

3.04 EXISTING UNDERGROUND UTILITY DEMOLITION

A. Excavate and expose existing underground utilities and related structures designated for, or as required to implement, removal. For excavation operations refer to Section 331000 "Utility Standards". Remove existing utility structure castings. Backfill excavations, upon completion of utility demolition operations. For backfill operations refer to Section 331000 "Utility Standards".

B. Place detectable markers to indicate location of disconnected services. Identify service lines and capping locations on project record documents.

C. EXISTING UNDERGROUND STORAGE TANKS:

D. Demolish existing tanks in accordance with NFPA Standard No. 30, Appendix C, Code of Maryland Regulations, Section 26.10.10, all local jurisdictional requirements, and as noted on the drawings. Pump out and remove liquid from each tank. Flush tanks with clean water to remove residue. Purge tanks of all vapors. Excavate and expose tank pipe connections. Disconnect and remove pipe connections and related equipment pipe connections and related equipment (e.g. pipe vaults, etc.). Remove empty tanks and test excavation for contaminated soils. Immediately inform Soils Engineer, Owner's Representative, and Architect if contaminated soils are discovered. Do not begin contaminated soil removal operations until written authorization is obtained from the Soils Engineer, Owner's Representative, or Architect and measurements are obtained. Any contaminated soils discovered shall be removed and disposed of off-site in accordance with all applicable Federal, State and local requirements. Backfill excavations as specified in Section 331000 "Utility Standards". Payment for contaminated soil removal, disposal and backfill to be by Change Order.

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E. If contaminated soils are found, the Contractor shall provide soil testing for contaminants. These tests shall be conducted prior to any excavation, periodically at differing soil elevations during excavation, and as a final check after excavations are completed. Forward all test results to the Owner's Representative and Architect. The Contractor shall prepare and file all materials required by Federal, State and local jurisdictions, including, but not limited to, the Initial Notification Form, the Initial Abatement Measure Report, and the Site Characterization Report. The Contractor shall protect the excavated area from flooding. The Contractor shall stockpile contaminated soils to prevent contamination of surrounding soils. Once excavation is complete, stockpiled soils shall be measured by the Soils Engineer or Owner's Representative prior to removal.

F. Before final disposition of excavated tanks, retest for vapors and, if necessary, purge again. Contractor shall make holes or openings in tanks to render unfit for further use.

3.05 MAINTENANCE

A. Refer to Section 312000 "Earthmoving".

3.06 SALVAGE MATERIALS

A. Carefully remove items designated for Salvage, or "Remove and Relocate", to avoid damage. Store site items indicated for salvage, or "Remove and Relocate", to prevent damage during construction. Relocate items as indicated on site plan or as directed in field by Owner's Representative. Contractor shall replace salvage items damaged during removal, storage or relocation operations at no increase to Contract Sum.

3.07 WASTE MANAGEMENT

A. Transport demolition waste materials from project site to legal offsite waste disposal areas. Document legal offsite waste disposal areas.

B. Recyclable/salvageable/compostable site-clearing materials to be recycled, salvaged, or chipped/composted in accordance with Section 017419 “Construction Waste Management and Disposal” requirements.

END OF SECTION 311005

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SECTION 312000
EARTH MOVING

PART 1 GENERAL

1.01 RELATED DRAWINGS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 1, Specification Sections, apply to Work in this section.

1.02 DESCRIPTION OF WORK

A. Section specifies materials, equipment and Work required to perform earthwork and grading operations for site development including:
   1. Rough grading.
   2. Sediment control measures.
   3. Excavation of materials and disposal of unsuitable materials.
   4. Footing and foundation trenches and pits.
   5. Stability of excavations.
   6. Removal of water.
   7. Filling, backfilling and compacting.
   8. Finish grading.
   9. Trenching and backfilling for piped utilities.
   10. Porous fill under concrete slabs.
   11. Testing and inspections.

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1.03 RELATED SECTIONS

A. Section 311000 "Site Clearing"

B. Section 311005 "Site Demolition"

C. Section 312500 “Erosion and Sedimentation Control”

D. Section 315000 “Excavation Support and Protection”

E. Section 329305 “Lawns and Grasses”

F. Section 329500 “Trees, Shrubs and Groundcovers”.

1.04 CODES AND REGULATORY REQUIREMENTS

A. Contractor shall comply with applicable requirements of governing agencies and/or authorities having jurisdiction.

B. Latest edition of Maryland Department of Transportation, State Highway Administration, Standard Specifications for Construction and Materials and approved addenda, except Method of Measurement and Basis of Payment, are controlling specifications for Work within State rights-of-way.

C. Latest Montgomery County Department of Transportation standards and specifications for Work in County rights-of-way and on County property.

D. Latest City of Rockville Standard Specifications for Work in City right-of-way.

E. Latest City of Gaithersburg Standard Specifications for Work in City right-of-way.

1.05 EXAMINATION OF SITE DOCUMENTS

A. Plans, surveys, measurements, and dimensions under which Work will be performed are believed to be correct. Examine both site and documents and report inconsistencies to Architect prior to beginning Work.

1.06 SPECIAL REQUIREMENTS

A. Topsoil Removal: No topsoil shall be removed from site without Owner's permission and fill material shall be subject to approval of Geotechnical/Soils Engineer and as further approved by both Architect and Owner.

B. Soil Erosion and Sediment Control: Implement and maintain soil erosion and sediment control measures and conduct activities in accordance with approved permit drawings. Arrange for and secure required inspections and approvals and provide documentation of same.

C. Layout and Grades: Layout lines and grade Work in accordance with Contract Documents. Establish permanent benchmarks determined by a Maryland Registered Land Surveyor or Professional Engineer. Maintain established bounds and benchmarks and replace, as directed, any which are destroyed or disturbed.

D. Maintenance of Traffic: Do not close or obstruct any street, sidewalk, alley or passageway unless specifically designated to be closed or obstructed on Contract drawings.

E. Cleaning of Paved Surfaces: Clean and maintain paved roadways, sidewalks, and public thoroughfares on or adjacent to Job Site of dirt, earth and debris spillage from equipment involved in connection with Work at all times.

F. Existing Utilities:
   1. Locate existing underground utilities in areas of Work per ASCE Quality Level 'B'. All proposed utility crossings are to be located by test pit. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations. Notify Miss Utility 48 hours prior to excavation.
   2. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult utility Owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility Owner.
   3. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, during occupied hours, except when permitted in writing by Owner and then only after acceptable temporary utility services have been provided/if required.
   4. Provide minimum of 48-hour notice to Owner and receive written notice to proceed before interrupting any utility.
   5. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut off of services if lines are active.
   6. Underground pipes greater than 4-inches in diameter that are indicated to be abandoned in place shall be filled with flow-able fill and permanently sealed at both ends. Pipe fill operation to be witnessed by the geotechnical engineer before concealment. The abandoned pipe must be shown on the approved as-builts prior to final payment.

G. Seismic Survey Agency: The contractor shall employ an independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys procedures to perform the following services:
   1. Report operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
   2. Seismographic monitoring during rock removal operations.

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1.07 DEFINITIONS

A. Excavation: Removal of earth materials to sub-grade elevations indicated or specified.

B. Over-Excavation: Removal of earth materials, beyond sub-grade elevations indicated or specified, without written authorization from Architect.

C. Unsuitable Earth/Material: Defined as topsoil, organic soils, stone greater than 2” (in any direction), rock fragments, ice, snow, construction debris, shrink-swell soils, existing fill, and other material judged unsuitable by geotechnical engineer and material so classified in geotechnical report and soft or unstable earth materials (e.g. muck, soft clays, organic soils, peat, etc.), not meeting requirements of Section 2.1.B.

D. Unclassified Excavation: Defined as complete removal of materials encountered during excavation including rocks, organic materials, slabs, debris, concrete, paving, slabs etc. All excavation is unclassified to design subgrade.

E. Fill: Placement of earth materials over existing ground surfaces to sub-grade elevations indicated or specified.

F. Backfill: Placement of earth materials in excavations to sub-grade elevations indicated or specified.

G. Soils Engineer: Shall be a Professional Engineer, currently registered in State of Maryland, or shall be an authorized representative of such an engineer.

H. Trench: Defined as an excavation having vertical sides of any length in which width is not more than 10-feet and whose depth exceeds its width.

I. Unauthorized Excavation: Defined as removal of materials beyond indicated sub-grade elevations or dimensions saving and, excepting required undercutting, without specific direction of Owner or Architect. Unauthorized excavation, as well as remedial Work directed by Construction Manager or General Contractor, shall be at Contractor’s expense.

J. Finished Grade: Defined as required final grade elevations indicated. Spot elevations shall be given uniformed slopes between points for which finished grades are indicated or between such points and existing established grades.

K. Subgrade: Defined as required surface of subsoil, borrow fill or compacted fill. Surface is immediately beneath site improvements, including but not limited to: utilities, specially dimensioned fill, paving, loam or other surfacing material. See Section 329305, “Lawns and Grasses” for preparation of landscape areas.

L. Structure: Defined, within this scope of the Work, to include buildings, foundations, concrete slabs, curbs and gutters, site improvements, and other man-made stationary features occurring above or below ground surface.

1.08 REFERENCE STANDARDS

A. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).

B. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).

C. ASTM D1883 - Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils.

D. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

E. ASTM D5268 - Standard Specification for Topsoil Used for Landscaping and Construction Purposes.

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1.09 SUBMITTALS

A. Density Test Results: Contractor shall submit copies of results of specified density testing to Owner's Representative for review and approval.

B. Submit location of product manufacture and of harvest, extraction/recovery of primary raw materials.

C. Submit recycled-content data, designating percentages of post-consumer and post-industrial recycled material.

D. Product Samples: Submit samples of borrowed material and structural fill material to Soils Engineer. Sample size to be fifty pounds. Number of samples to be determined by Soils Engineer. Contractor shall deliver samples to Soils Engineer’s testing laboratory.

E. Test Reports-Excavating: Testing and inspection service will submit following reports directly to Architect from testing services, with copy to Contractor and Owner’s representative.
   1. Test reports on borrow material.
   2. Verification of each footing sub-grade.
   3. Field density test reports.
   4. One optimum moisture-maximum density curve for each type of soil encountered, but not less than one curve for each 1,000 cubic yards of any particular soil encountered.
   5. Report of actual unconfined compressive strength and/or results of bearing.

F. Documentation of Acceptance of Limits of Disturbance from the Sediment Control Inspector and Forest Conservation Inspector.

G. Documentation from Forest Conservation Inspector that site has been prepared and tree protection measures have been installed in accordance with approved Final Forest Conservation or Tree Save Plan.
   1. Copies of inspection reports and violation notices. Payment of monthly requisitions will be held without copies of inspections reports and any violation notices.

H. Inspection Certification that on-site topsoil has been screened on-site and meets the requirements of this specification.

I. Playfield Topsoil Submittals:
   1. Manufacturer's and/or source data for all materials including soils.
   2. Certified chemical and mechanical analysis of samples of topsoil, existing soil, soil mixes, soil amendments and organic compost materials used in making of soil mixes.
   3. Submit a list of equipment anticipated for each type of soil work: decompaction, blending, unloading materials, handling and installation.
   4. Samples provided by the Contractor shall be typical of material to be delivered to the site and shall provide an accurate indication of color, texture, and the organic make-up of the material. Submit three (3) pound samples of the following:
      a. Organic Matter: one (1) sample of each type of organic matter to be used.
      b. Imported Off-Site Soil Prior to Amendment: one (1) sample.
      c. Amended Off-Site Soil: one (1) sample.
   5. Submit for approval the name of the company that will be testing the soil for approval.
   6. Submit all soil tests for all soil to be obtained from both on-site, off-site, and prepared soil.
   7. Submit fertilizer and soil amendment plan for approval. This plan shall be based on the results of the soil testing and meeting the required soil parameters.

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1.10 PROJECT CONDITIONS

A. Existing Subsurface Conditions: Refer to Section 023000 “Subsurface Explorations”. All excavation materials shall be “unclassified”.

B. Existing Utilities: Locations of existing utilities are approximate. Locations have been determined from field survey, public utility records and Owner records.
   1. Contractor shall be responsible for contacting "Miss Utility", Owner or controlling agencies of existing utilities within construction area for verification of locations, prior to beginning of Work.
   2. Contractor shall be responsible for coordination of utility relocation or removal by others with phases of construction activities.

1.11 TESTING AND INSPECTIONS

A. The Owner shall be responsible for providing a Maryland Registered Professional Soils Engineer for required testing and inspections.

B. Services of the Soils Engineer will not necessarily be on a full-time basis, but will include the number of visits and tests required to observe the performance of all earthwork under this Section. If in the opinion of the Soils Engineer, any work performed under this Section does not meet the technical or design requirements stipulated for the work, the Contractor shall make all necessary readjustments to his/her approval.

C. All earthwork procedures shall be performed in the presence of the Soils Engineer. Give adequate (24 hours) notice when Soils Engineer’s services are required.

D. Earthwork procedures shall be performed in presence of Soils Engineer. Make all submittals in accordance with Submittals article above.

1.12 CONSTRUCTION SURVEYS

A. Provide survey equipment and a duly licensed Maryland Professional Land Surveyor for construction surveys. Provide stakes required to perform earthwork operations to sub-grade elevations indicated or specified.

B. All construction stakeout shall be per Section 107 of the most current Maryland Department of Transportation, State Highway Administration, Standard Specifications for Construction and Materials.

1.13 EARTHWORK BALANCE

A. Perform earthwork operations regardless of actual quantities encountered.
   1. Excess materials shall be legally disposed of off project property.
   2. Off-site borrow, including topsoil, shall be provided at no increase to Contract Sum.

PART 2 PRODUCTS

2.01 MATERIALS

A. Provide products manufactured of primary raw materials harvested, extracted/recovered within a 500-mile radius of project site.

B. Some on-site soils may be suitable for use as structural fill or general fill. Contractor shall provide adequate test data indicating such soils meet requirements of section prior to placement.

C. Fill material shall be free of deleterious matter such as ice, snow, organics, building rubble, construction debris, shrink-swell soils and rock greater than 2-inches in diameter.

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D. Definitions:
   1. Satisfactory/suitable soils are defined as those complying with **<<ASTM D2487>>** soil classification groups ML, SM, SC, GC, GP, or GM except where modified by geotechnical report.
      a. Soils shall have a liquid limit less than 40 and a plasticity index less than 20.
      b. Soils shall have a minimum CBR value of 3.0 and swell shall be less than 1 percent in accordance with **<<ASTM D1883>>** when compacted to 98% compaction per **<<ASTM D1557>>**.
   2. Unsatisfactory soil materials are defined as those not meeting requirements above. Unacceptable fill materials include topsoil, organics (OH, OL), high plasticity silts and clays (MH, CH), and those specified in geotechnical report.

E. Structural Fill: Provide satisfactory/suitable soils, compacted – in-place, to support site improvements and pavement sections.

F. Dense-graded aggregate base for asphalt pavement support shall meet requirements of GA Base per latest edition of Maryland Department of Transportation, Standard Specifications for Construction and Materials and subsequently approved addenda thereto. Dense-graded aggregate base shall be compacted to at least 95 percent of maximum dry density per **<<ASTM D698>>** (AASHTO T-99).

G. Crushed Stone/Washed Gravel Floor Slab Moisture Barrier / Drainage Fill: MDOT-SHA Size No. 57 aggregate.

H. General Fill: Satisfactory/suitable on-site or borrow material compacted in place for general site grading.

I. Sub-base Fill Material: Natural or artificially graded mixture of natural or crushed gravel, crushed stone, natural or crushed sand and as noted on drawings.

J. Drainage Fill: Washed (to be inspected and certified by the geotechnical engineer), evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing a 1-1/2 inch sieve and not more than 5 percent passing a No. 4 sieve.

K. Fill Materials: Soils used as fill materials shall have Unified Soils Classification (ASTM D 2487) of ML or more granular but shall exclude highly plastic clays or silts (MH-CH), and well-graded gravel (GW). Soil material for fill shall be free of organic matter or debris, waste materials, frozen materials, vegetable matter and rock or stones exceeding 2-1/2 inches in dimension. No more than 15 percent of rocks or lumps shall be larger than 2-1/2 inches in dimension. Materials shall be non-frost susceptible soils and shall have a liquid limit of less than 40 and a plasticity index of less than 20. Altering moisture contents to obtain adequate degrees of compaction shall be performed at no additional cost to Owner.
   1. Fill material used within the top 12 inches of fill shall be free of rocks or stones exceeding two inches in any dimension.
      a. For all playfields, the top 12 inches shall be SM or more granular screened soil, but not GW.
   2. Recycled concrete RC-6 may, at Contractor's discretion for temporary on-site road, but must be completely removed from the site at the end of construction.

L. Backfill Material: As indicated for fill material.

M. Borrow Material: Off-site borrow, if required, shall be as specified for Fill Materials. Obtain and transport borrowed material at no increase to Contract Sum.

N. Product Handling:
   1. Take means necessary to protect materials of this Section before, during, and after installation and to protect installed Work of other trades. In event of damage to these

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items, immediately make repairs or replacements necessary to approval of Architect and at no additional cost to Owner.

2. Take means necessary to control dust on and near Work if caused by Contractor's operation during performance of Work of this Section and if resulting from condition in which Contractor leaves site. Dust controls shall be performed in accordance with authority having jurisdiction requirements.
3. Locate all active utilities traversing site or areas of off-site Work and protect from damage.

O. Excavation Materials:
1. Classification of Material: All Materials to be excavated on this project are unclassified excavations to subgrade.
2. Differing Conditions below Subgrade: Should, during progress of Work, rock or physical conditions substantially differing from those described in project Geotechnical Report and generally recognized as being inherent in Work of such character be encountered, immediately notify Architect of conditions before they are disturbed.
3. Excess Excavation Materials: Excess materials resulting from excavating operations and not used backfilling shall become property of Contractor and shall be legally disposed of off-site using approved methods to legal disposal sites. No on-site burying will be permitted.

P. Sand: Sand shall be clean and free from silt, clay, sticks and other foreign material complying with gradation requirements in ASTM C 33 for fine aggregate.
1. Sand for stormwater management facilities must be washed natural sand.

Q. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by an independent geotechnical testing agency, according to ASTM D 1586. For field determinations, rock is defined as material that cannot be removed by certain sized piece of equipment as follows:
1. Rock excavating equipment for open cut excavation shall be the equivalent to Caterpillar Model No. D-8N, heavy duty track-type tractor, rated at not less than 285 hp flywheel power and equipped with a single-shank hydraulic ripper, capable of exerting not less than 45,000 lbs. breakout force.
2. Rock excavating equipment for footings, trenches, and pits shall be equivalent to Caterpillar Model No. 21D-LC track-type hydraulic excavator, equipped with a 42” wide short-tip radius rock bucket, rated at not less than 120 hp flywheel power with bucket curling force of not less than 25,000 lbs. and stick-crowd force of not less than 18,000 lbs.

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2.02 TOPSOIL FOR PLANTING AND LAWNS

A. Topsoil stockpiled for re-use (if any) shall be approved prior to incorporation in Work. If quantity of stockpiled topsoil is insufficient, provide additional topsoil as required.

B. No topsoil is to be removed from site without Owner’s permission.

C. Prior to re-use on-site, stockpiled topsoil shall be screened and inspected by geotechnical engineer for compliance with specifications. Make amendments to existing topsoil as required to comply with this section. Geotechnical engineer shall inspect and certify topsoil prior to its re-use on-site.

D. Existing or imported topsoil shall be a fertile, friable, sandy loam containing organic matter of 2 percent or greater and shall be capable of sustaining vigorous plant growth. Topsoil shall consist of 60-75 percent sand, 15-30 percent silt, and a maximum of 5 percent clay. It shall be free of add-mixture of subsoil, and contain no stones, lumps, clods of hard earth, slag, cinders, sticks, plants or their roots, trash or other extraneous materials greater than 1” in dimension.

Topsoil must also be free of plant parts of Mugwort, Bermuda grass, Quack grass, Johnson grass, nut sedge, poison ivy, Canada thistle, or others as specified. Topsoil shall not be used for planting operations while in a frozen or muddy condition. Topsoil sources shall be tested by a recognized laboratory at expense of Contractor for pH, soil texture and soluble salts. Test results must be presented to Landscape Architect prior to placement of topsoil on site. Topsoil shall contain between 3 percent and 7 percent decomposed organic determined by loss on ignition on moisture-free samples dried in accordance with current methods of Association of Official Agricultural Chemists.

E. Acceptable soil test results:
   1. pH Range: 5.8 - 7.0.
   2. Organic Matter: 3% - 7%.
   3. Magnesium (Mg): 100+ units.
   4. Phosphorus (P205): 150+ units.
   5. Potassium (K20): 120+ units.
   6. Soluble Salts/Conductivity: Not to exceed 450 ppm/0.9 mmhos/cm (in soil); not to exceed 300 ppm/2.5 mmhos/cm (in high organic mix).
   7. Boron: Not to exceed 3 lbs./acre.
   8. Manganese: Not to exceed 50 lbs./acre.

2.03 TOPSOIL FOR PLAYFIELDS

A. Soil amendments may be used to amend the soil to meet specified requirements. Soil amendments and rates of application are to be determined based on soil test results. Specific recommendations for the type of amendments can be found in the Landscape Specification Guidelines by the Landscape Contractors Association of MD, DC, and VA (most recent edition).
   1. Sulfur: Sulfur for adjustment of soil pH shall be an unadulterated flower of sulfur.
   2. Lime: Ground or pulverized limestone, which contains a maximum of 50 percent total oxides. In addition, Solu-Cal can also be used to correct pH.
   3. Organic Matter: To increase organic matter based on soil test results, the following materials can be used:
      a. Compost shall be made from yard trimmings, such as leaves, grass clippings and pruning that have been properly composted, are mature and have been sieved through a 3/4-inch screen.
      b. Compost shall be free of trash and contain no toxic substances harmful to plant growth.
      c. Compost testing shall include a Solvita Compost Maturity Test on a fresh compost samples per testing instructions and have an CMI >6.0. The soluble salt contents shall be between 1-4 dS/m.
      d. Compost should have between 35% and 50% organic matter, pH between 6.2 and 7.2, total organic carbon above 20%, carbon to nitrogen ratio between 12:1 and 20:1 and heavy metals within acceptable range.
   4. Fertilizer: Fertilizer analysis and rate of application shall be determined based on soil test results. Fertilizer shall be uniform in composition, free flowing and suitable for application with approved equipment. The fertilizer requirements shall be reviewed by a certified Maryland Fertilizer Applicator. All fertilization shall meet Maryland’s Lawn Fertilizer Law.
   5. Sand: The sand shall meet the specification per ASTM F2396 for sand type, particle size distribution and shape. The contractor shall supply independent testing to verify compliance with ASTM F2396.

B. Delivery, Storage, and Handling:

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1. Package materials will be delivered in manufacturers' unopened containers or bundles; they will be identified with name, brand, type, weight, and analysis. Packaged materials will be stored in a manner that will prevent damage or intrusion of foreign matter. Any material that becomes contaminated will be removed from the job site.
2. Organic amendments will not be delivered or installed excessively wet or frozen.
3. Delivery location, stockpile locations and schedule will be coordinated with the Owner prior to delivery. Soils will be protected from eroding while stockpiled on site.
4. Bulk materials will be stabilized after delivery according to the Sediment Control Plan.

PART 3 EXECUTION

3.01 GENERAL

A. Familiarization and General Information:
   1. Prior to beginning Work, become thoroughly familiar with site, site conditions and portions of Work specified in this section.
   2. Contractor shall conduct operations and execute Work in such fashion as not to preclude or obstruct required on-going operations of Owner and site occupant. Contractor shall immediately repair damages to buildings, streets, site improvements and utilities at no expense to Owner.
   3. Data on indicated subsurface conditions as specified in geotechnical report, provided by Owner, are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn by Contractor. Data are made available for convenience of Contractor. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.
   4. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility Owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility Owner.

B. Blasting: Not permitted.

C. Backfilling prior to approvals:
   1. Do not allow or cause any Work to be performed, installed, covered up or enclosed by Work of this section prior to required inspections, tests, and approvals. Contractor is solely responsible for arranging and securing required inspections, tests and approvals.
   2. Should Work be enclosed or covered up before it has been approved, Contractor shall uncover such Work at no additional cost to Owner.
   3. After Work has been completely inspected, tested, and approved, make repairs and replacements necessary to restore Work to condition in which it was found at time of uncovering, at no additional cost to Owner.

3.02 CLEARING & SITE PREPARATION

A. Before start of construction, all topsoil, organic soils, soils mixed with excessive amounts of roots or other organic materials, and all soft, loose, excessively wet or frozen soils shall be removed from building and pavement areas and including at least 5-ft. offsets outside building and pavement lines.

B. Stockpile suitable materials, topsoil etc. on-site for reuse.

C. Prepare site for construction by removing topsoil, and existing loose, soft, wet, organic, or otherwise unsuitable materials encountered within building construction limits which shall

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extend approximately ten feet beyond actual building and paving lines. Tree stumps shall be removed in their entirety. Stockpile topsoil in well-drained piles in locations as approved by Architect for later use. The entire stripped area shall be proof rolled utilizing a heavily loaded dump truck or other pneumatic-tired vehicle of similar size and weight in presence of Soils Engineer. Proof rolling shall not be performed during or following wet weather conditions. Any unsuitable materials shall be removed and replaced as directed by Soils Engineer.

D. Remove and dispose of materials resulting from site stripping, and on-site materials not acceptable for use as structural fill in an approved and lawful manner.

3.03 GRADING AND TOPSOIL INSTALLATION

A. Topsoil is to be screened on-site and certified for conformance to specifications by geotechnical/soils engineer prior to placement or spreading of topsoil on site.

B. Uniformly grade areas covered by project, including transition areas. Finished surface to be smooth, compacted and free from irregular surface changes. Ditches and swales to readily drain as shown on plans and be free of humps or hollows.

C. Grading tolerances (note that positive drainage must be maintained):
   1. Rough Grade:
      a. Building, Paved, and Sidewalk Areas: Plus or minus 0.1 foot.
      b. Landscaped Areas: Plus or minus 0.3 foot.
      c. Athletic Fields: Plus or minus 0.2 foot.
   2. Finish Grade:
      a. Builiding, Paved, and Sidewalk Areas: Plus or minus 0.05 foot*.
      b. Landscaped Areas: Plus or minus 0.1 foot.
      c. Athletic Fields: Plus or minus 0.4 foot*.

      *Tolerance shall not relieve Contractor from complying with ADA maximum slope requirements.

D. Topsoil Installation for Lawns and Landscape Areas:
   1. Topsoil mixture shall not to be spread until underground pipe work and fine sub-grading is completed to satisfaction of Owner in accordance with drawings.
   2. Immediately prior to dumping and spreading topsoil mixture, subsurface shall be loosened by disking or by scarifying to depth of at least 5 inches to permit thorough bonding. Fine grade all areas to be topsoiled to new contour grades, less topsoil mixture depth.
   3. Add together a mixture of two-thirds sandy loam topsoil and one-third organic matter by volume to a depth of 4 inches and rototill into subsoil. During spreading operation, this mixture shall be raked and stones in excess of one inch in diameter and rubbish shall be removed.
   4. The topsoil mixture shall have a minimum thickness of six inches after natural settlement and light rolling and shall conform to grades and elevations as shown on plans. Do not place topsoil mixture when muddy or frozen conditions exist.
   5. Topsoil mixture shall be spread on areas to be sodded or seeded.

E. Topsoil Installation for Playfields:
   1. Commencement of work will not begin until all submittals have been approved. This includes but not limited to soil testing results and recommendations.
   2. All areas to receive topsoil shall be free of construction debris, refuse, compressible or decayable materials, stones greater than two inches and standing water to a depth of 12 inches for landscape areas and 6 inches for lawn areas.

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3. Do not place fill when fill materials are wet, frozen or not at the optimum moisture content for proper compaction. Adjust subgrade levels as required to ensure that planting and lawn areas have adequate drainage. Installation of all utilities and irrigation mainlines shall be completed prior to beginning topsoil work.
4. After the rough grade of the existing soil is accepted by the Owner, the Contractor shall perform soil tests as specified and submit test results and soil amendment recommendations.
5. The Contractor shall install soil amendments over the existing soil as approved. Soil amendments shall be tilled into the soil to loosen existing soil to a depth of 12 inches; excavation is not required. Rake the area smooth and compact the subsoil not to exceed 85 percent compaction per ASTM D698. Level and regrade planting bed prior to installation of topsoil.
6. Topsoil shall be amended to meet the criteria of this section. Soil may be blended on or off-site. Soil to be blended on-site, the amendments shall be blended into soil by layering the soil and soil amendments in alternating thin layers (not to exceed six inches) and mixing them uniformly as each layer is added.
7. Blending should be performed using a commercial soil blending equipment designed for this purpose.
8. Fill excavated areas with topsoil amended to meet the criteria of this section. Soil shall be placed in successive lifts no thicker than six inches and compacted with hand- operated equipment to a maximum dry density of 85 percent per ASTM D698. Over compaction of fills, which would be detrimental to planting objectives, shall be corrected by loosening fills through tilling or other means and recompacting to specified limits at no additional cost
9. The soil shall not be tilled or amended when the soil's moisture level is above field capacity or when soil is frozen.
10. If at any stage the soil is left exposed to weather conditions, the Owner may require decompaction so to meet the requirements of this specification at no expense.
11. For soil preparation in critical root zone areas of existing trees, all work must be done by hand with shovels and rakes, unless otherwise approved in writing by the Forest Conservation Inspector.

3.04 FILL MATERIAL

A. Fill material, imported or on-site, shall be free of organic inclusions, such as tree roots, frozen materials debris, cinders, or other deleterious materials. Fill material shall be approved by Soils Engineer and shall be ML or SM per **<<ASTM D2487>>**. Fill material shall not contain rocks and lumps greater than 6 inches in dimension and not more than 15% of rocks and lumps shall be greater than 2-1/2 inches in dimension. Altering moisture contents to obtain adequate degrees of compaction shall be performed at no additional cost to Owner.

B. Fill material shall be subject to approval of Soils Engineer and as further approved by Owner and Architect.

3.05 PROOF-ROLLING

A. After site clearing and cutting of excavation areas, cleared and cut sub-grades shall be proof-rolled with a fully loaded 10-ton dump-truck in presence of Contractor's testing agency and Owner's Representative. Proof-roll two complete coverages of building and pavement areas. Soft, loose, or unsuitable areas shall be removed and replaced with suitable compacted material.

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3.06 PROTECTION AND RESTORATION

A. General: Provide protection to prevent settlement, movement, undermining of or erosion to existing site improvements, existing utilities, existing buildings, new site improvements, new buildings and new utilities.

B. Do not permit heavy equipment to pass over any utility until a minimum cover as required by code and manufacturers' recommendations, whichever is more stringent, is placed over the top of utility.

C. Restore damage resulting from lack of protection or improper installation of protective measures or careless execution of construction activities at no increase to Contract Sum. Restoration Work to be approved by Soils Engineer and Owner's Representative.

D. Protect structures, utilities, curbs, paving and trees indicated to remain, and other facilities in areas of Work. Barricade open excavations and provide warning lights from dusk to dawn each day in accordance with OSHA requirements. Use barrier gates and orange cones with yellow traffic tape to block off area of construction.

E. Freezing Temperature: Make no excavations to full depth indicated when freezing temperature may be expected, unless footings or slabs can be placed immediately after excavation has been completed. Protect bottom from frost if placing of concrete is delayed. Should protection fail, remove frozen materials and replace with concrete or gravel fill, as directed. Protect newly placed footings from frost penetration below bottom of footing.

F. Barricade Open Excavations occurring as part of Work; post with warning lights. Operate warning lights as recommended by authorities having jurisdiction and OSHA requirements.

G. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

H. Perform Excavation, within critical root zone of large trees to remain, by hand and protect root system from damage or dry out to greatest extent possible. Maintain moist condition for root system and cover exposed roots with burlap. Paint root cuts of 1-inch diameter and larger with emulsified asphalt tree paint.

3.07 MEASUREMENT AND PAYMENT

A. Unanticipated Soil Conditions: If unsuitable bearing materials are encountered at subgrade, extend excavation deeper and replace excavated material as directed by the Geotechnical Engineer.

B. If part of excavation is extended, through error, beyond depth and dimensions indicated or specified, Contractor shall provide suitable compacted fill or concrete where directed by Geotechnical Engineer up to required level at Contractor's expense.

C. Excavation and removal of unsuitable materials below sub-grades or as required by Contract Documents will be paid for as an extra in accordance with the unit prices provided in the contract documents, only after removal of materials has been authorized by Owner. Quantities of excavation and removal involving an extra or other adjustment of Contract Sum are subject to measurement, verification, and approval by the Owner's Representative and the Geotechnical Engineer, prior to removal of materials. Volume shall be established from dimensions of cut. Such dimensions shall be submitted to Owner's representative by Contractor for record.

3.08 EXISTING UTILITIES

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A. Notify public utility companies, 48 hours prior to start of earthwork operations. Verify and mark horizontal utility locations prior to start of earthwork operation. Manually excavate and expose utilities as earthwork operations approach marked locations.

B. Immediately notify Owner's Representative or Architect in event horizontal or vertical utility locations differ from locations indicated. Provide horizontal and vertical details of utility locations as directed by Owner's Representative or Architect. Conflicts with construction are to be determined by Owner's Representative or Architect. Payment for correction of unforeseen conflicts with construction shall be by change order.

C. Coordinate public utility relocation Work required for public utilities conflicting with construction. Owner's Representative or Architect will provide directions and details required to relocate utilities conflicting with construction.

D. Do not disconnect or interrupt existing utilities serving existing facilities to remain without notification and authorization of Architect or Owner's representatives.

3.09 DEWATERING

A. Perform in accordance with Section 312319 "Dewatering".

3.10 EXCAVATION

A. Excavation Classifications:
   1. Excavate materials encountered to sub-grade elevations indicated or specified. Excavation is unclassified to subgrade. Excavate materials regardless of character of the materials encountered, at no increase to Contract Sum. Remove substrate materials required to achieve proper sub-base, including, but not limited to: soils, organics, abandoned structures, rock, etc.

B. General:
   1. Excavate to lines, elevations, and limits indicated on plans and in specifications plus sufficient distance and space to permit erection of forms, shoring and inspections. Placing of concrete footings or foundations on existing fill is not permitted. Remove all existing fill below foundations. Fill any excess cuts under footings and foundation with structural fill. Excavate as required, regardless of type, condition, or moisture content of material encountered. If suitable bearings for foundations are not encountered at depths indicated, immediately notify Architect, protect excavation, and do not proceed further until instructions are given. Exposure of footing sub-grade shall be kept to a minimum. Footing concrete shall be placed on same day of excavation. If excavation must remain open overnight or if rainfall or other precipitation is eminent, protect sub-grade with a 2- to 4-inch-thick mud mat and other protection devices to ensure that excavation remains dry.
      a. Remove existing man-placed fill in areas of addition and replace with satisfactory/suitable compacted fill.
      b. Remove existing foundations and structures in areas of excavation and replace with satisfactory/suitable compacted fill.
      c. The Contractor's testing agency shall evaluate suitability of sub-grades including those for building and wall footings, building slabs, below-grade structures and pavement areas and certify suitability prior to further construction.

C. Excavation for Footings, Foundations, Slabs and Pavements:
   1. Grade site so as to prevent water from entering footing excavations and/or ponding on floor sub-grades. Protect excavations from exposure to direct rainfall.
   2. Contractor shall undercut, repair and restore damaged/unprotected sub-grades at no additional cost to Owner.

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3. Extend all sub-grade undercuts at least five (5') feet outside building foundation, footing, slab and pavement lines.

D. Excavation for Utility Trenches:
   1. Dig trenches to the uniform width required for particular item to be installed, sufficiently wide to provide ample Working room. Provide 6 to 9 inches of clearance on both sides of pipe or conduit, or as required by the utility purveyor.
   2. Excavate trenches to depth indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations. Beyond building perimeter, keep bottoms of trenches sufficiently below finish grade to avoid freeze-ups.
   3. Where rock is encountered at subgrade, carry excavation 6 inches below required elevation and suitable backfill as approved by the geotechnical engineer prior to installation of pipe.
   4. Grade bottoms of trenches as indicated, notching under pipe bells to provide solid bearing for entire body of pipe.

E. Backfill of Trenches:
   1. Provide suitable compacted material, backfill and/or approved on-site soil material backfill in accordance with detail(s) shown on drawings.
   2. Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and which are carried below bottom of such footings, or which pass under wall footings. Place concrete to level of bottom of adjacent footing.
   3. Do not backfill trenches until tests and inspections have been made and backfilling authorized by Architect/Engineer. Use care in backfilling to avoid damage or displacement of pipe systems.

F. Stability of Excavations:
   1. Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.

3.11 EXCESS WATER CONTROL

A. Unfavorable Weather:
   1. Do not place, spread, or roll fill material during unfavorable weather conditions.
   2. Do not resume operations until moisture content and fill density are acceptable to Contractor's testing agency.
   3. Protect all open excavations as well as slab on grade, sub-grade from damage due to rain or runoff.

B. Flooding:
   1. Provide berms or channels to prevent flooding of sub-grade. Promptly remove water collecting in depressions

C. Softened Sub-grade:
   1. Where soil has been softened or eroded by flooding or placement during unfavorable weather, remove damaged areas and recompact or replace with suitable material as required to ensure properly stabilized sub-grade. Replaced or recompacted sub-grades shall be certified as being satisfactory by Contractors Testing agency.

D. Dewatering:
   1. Provide and maintain during construction, ample means and devices to promptly remove and dispose of water from every source entering excavations or other parts of Work.

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3.12 SUB-GRADE PREPARATION

A. Sub-grade Preparation: Upon completion of excavation activities, exposed sub-grade should be proof-rolled utilizing a heavily loaded dump truck or other pneumatic-tired vehicle of similar size and weight, in presence of Soils Engineer. Proof-rolling shall not be performed during or following wet weather conditions. Unsuitable materials discovered during proof-rolling operations shall be removed and replaced as specified below. Upon completion of proof-rolling activities and approval of sub-grade by Soils Engineer, exposed sub-grade shall be further prepared as follows:
   1. Unpaved Areas: Scarify sub-grade to six-inch depth prior to topsoil placement.
   2. Paved Areas: Scarify sub-grade to twelve-inch depth and compact to 95 percent maximum dry density. Density test methods: ASTM D 698. Remove unsuitable earth, exhibiting excessive weaving during compaction operations, as specified.

3.13 FILL AND COMPACTION

A. Fill and Excavation Requirements:
   1. Fill or excavate as required under items of constructions as follows:
      a. In planting areas, sub-grade shall be 12 inches below finish grades with 12 inches of topsoil applied over sub-grade. In lawn areas, sub-grade shall be 6 inches below finished grades with 6 inches of topsoil applied over sub-grade.
         1) In athletic and playfields (baseball, softball, soccer, etc.) subgrade shall be 12 inches below finished grade with 6 inches of screened soil containing no material greater than 1/2-inch and 6 inches of topsoil over the 6 inches of screened material.
         2) Skinned Infields: subgrade shall be 12 inches below finished grade with 7 inches of screened soil containing no material greater than 1/2-inch and 5 inches of infield mix over the 7 inches of screened material.
      b. Under concrete sidewalks, sub-grade shall be to bottom of granular fills under sidewalks.
      c. Under floor slabs on grade, sub-grade shall be at underside of stone or washed gravel moisture barrier below bottom of slab.
      d. Under building foundations, sub-grade shall be to bottom of footing. Place compacted structural fill to bottom of footing where required, due to undercutting.
      e. Under pavement sections, sub-grade shall be to bottom of base course or graded aggregate base.
      f. In areas with existing fill materials, sub-grade shall be to bottom of fill. Compacted structural fills shall be used to bring such areas back to required elevations
   2. Construct fills at location and to lines and grades required. Use sheepsfoot rollers, rubber-tired rollers, or other equipment capable of obtaining required density in placing fills. Use power tampers or hand tampers to compact material in areas where rollers are impractical to use.

B. Backfilling and Compaction:
   1. Fill placing operation shall be such that materials when compacted will be blended sufficiently to meet compaction requirements. Suitability of materials is subject to Architect's approval. Dump successive loads of materials, then spread and mix to give horizontal layer of not more than eight inches in loose thickness.
   2. Do not roll or compact fill material until layer of material has uniform moisture content within two percentage points of optimum moisture content and which will keep under action of rollers, and material in each layer of fill, while being compacted by rolling or

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tamping equipment, maintained as nearly as practical at that degree of moisture content which is optimum for obtaining required compaction.

3. Material having moisture content too high for proper compaction, should be modified by aeration until moisture content is lowered to point where satisfactory compaction may be obtained.
4. If moisture of fill material is too low, add water to material and thoroughly mix by blading and disking to produce uniform and satisfactory moisture content. In applying water, do not use jets having sufficient force to wash out fine material. Water or aerate fill material, as necessary, and thoroughly mix to obtain a moisture content which will permit proper compaction but remain within +/- 2 percent of optimum moisture content as determined by ASTM D698.
5. After sub-grade has been approved by Soils Engineer, spread specified fill material in horizontal layers not to exceed 8 inches in loose thickness.
6. During placement and compaction of fill, scarify and bench existing sub-grades so that a seak plane can not be formed between new fill and existing sub-grade soils. Existing soils shall be scarified to depths of at least 6 inches, and benching generally shall be provided for every 5 ft. height of new fill placed.
7. Do not begin backfilling until construction below finish grade has been approved, forms removed, and excavations cleaned of trash and debris. Bring backfill to required grades. Do not place backfill in wet or frozen areas. Do not operate compaction equipment exceeding 3,000 pounds in dead weight for spreading and compacting closer to foundations, curbs, or walls than a distance equal to height of backfill above top of structural members or height of wall; compact area remaining by power-driven hand tampers suitable for material being compacted. Do not place backfills against walls prior to 7 days after completion of walls.
8. After material has been brought to uniform and satisfactory moisture content, compact fill material to maximum dry density requirements specified below.

Zone	Maximum Dry Density Required (%)	Specification
Top 18” of fill placed below foundation and slabs.	100	**<<ASTM D698>>**
Fill areas within building, 10’ from building perimeter, and paved areas	95	**<<ASTM D698>>**
Back fill at retaining walls	90	ASTM D698
Other site grading	90	**<<ASTM D698>>**

1. Special care should be taken in compacting structural fill at interface with natural soils to ensure uniformity of settlement at transition between fill and natural ground.

C. Compaction Testing and Monitoring:

1. Fill placed in building, pavement, and utility excavations shall be tested in accordance with ASTM D 1556 (Sand Cone Method), or ASTM D 2922, or ASTM D 3017 (Nuclear Method) to verify density and moisture content. A minimum of one test per 2,000 square feet of material placed in building areas should be performed on each lift. A minimum of one test per 5,000 square feet of material placed in parking areas should be performed on each

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lift. A minimum of one test per 100 linear feet of material placed in footings and utility trenches should be performed on each lift. However, no fewer than three tests per day should be performed on each lift.

3.14 OVER-EXCAVATION

A. Correct over-excavated areas as directed by Soils Engineer. Remove unsuitable earth encountered as a direct result of over-excavation. Excavate and dispose of all unsuitable earth. Correct excavated area as directed.

3.15 UNSUITABLE EARTH

A. Immediately notify Owner's Representative or Architect and Soils Engineer in event unsuitable earth below subgrade is encountered during earthwork or subsequent construction operations beyond limit of excavation and grading specified in this section. Stop Work within immediate area of unsuitable earth. Do not remove unsuitable earth until written authorization is obtained from Owner's Representative and proper measurements are obtained. Excavate and dispose of unsuitable earth upon receipt of written authorization from Owner's Representative. Backfill excavated area as specified. Payment for unsuitable earth removal and associated backfill operations below design grade to be by change order.

3.16 EXCAVATED MATERIAL STORAGE AND DISPOSAL

A. General:
   1. Excavation is unclassified to subgrade. Remove substrate materials required to achieve proper sub-base, including, but not limited to: soils, organics, abandoned structures, rock, etc.
   2. Excavate to lines, elevations, and limits indicated on drawings and specifications plus sufficient distance and space to permit erection of forms, shoring and inspections. Placing of concrete footings or foundations on existing fill is not permitted. Remove all existing fill below foundations. Fill any excess cuts under footings and foundation with structural fill. Excavate as required, regardless of type, condition, or moisture content of material encountered. If suitable bearings for foundations are not encountered at depths indicated, immediately notify Architect, protect excavation, and do not proceed further until instructions are given. Exposure of footing sub-grade shall be kept to a minimum. Footing concrete shall be placed on same day of excavation. If excavation must remain open overnight or if rainfall or other precipitation is eminent, protect sub-grade with a 2- to 4-inch-thick mud mat and other protection devices to ensure that excavation remains dry.
      a. Remove existing man-placed fill in areas of addition and replace with satisfactory/suitable compacted fill.
      b. Remove existing foundations and structures in areas of excavation and replace with satisfactory/suitable compacted fill.
      c. Contractor's testing agency shall evaluate suitability of sub-grades including those for building and wall footings, building slabs, below-grade structures and pavement areas and certify suitability prior to further construction.

B. Stockpile select excavated materials required for fill and/or backfill operations. Stockpile locations to be approved by Owner's Representative or Architect. Shape and grade stockpiles to prevent ponding of surface water. Temporarily stabilize stockpiles as specified on Drawings. Dispose of excess excavation materials as specified.

C. Excess excavated material shall be legally disposed of by removal from project site.

D. Site Clearing Debris, Rubble, and Unsuitable Soils: Remove and legally dispose of excavated materials not suitable for re-use on-site as fill or backfill, site clearing debris and rubble resulting from clearing grading and removal operations to an approved off-site disposal area.

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E. Suitable Soils/Materials: Soils and materials suitable for re-use on-site shall remain on job site.

F. Stockpiling of Excavated Materials suitable for re-use on-site will be permitted where convenient on-site and does not interfere with Work. Stockpiling shall be performed in accordance with approved sediment control plans. In event that stockpiled materials are rendered unsuitable for re-use on-site, Contractor shall remove all unsuitable materials from site and replace same with suitable soils at no additional cost to Owner.

3.17 EARTH FILL

A. Existing Ground Surface Preparation: Remove vegetation and topsoil as specified in Section 311000 "Site Clearing". Proofroll exposed sub-grade utilizing a heavily loaded dump truck or other pneumatic-tired vehicle of similar size and weight, in the presence of Soils Engineer. Proofrolling shall not be performed during or following wet weather conditions.

B. Existing Sub-grade Preparation: Remove unsuitable earth, upon completion of clearing and proofrolling operations, as specified. Continuously bench existing slopes exceeding four feet horizontal to one foot vertical. Bench sufficiently to accommodate earthmoving and compaction equipment and meet requirements of Maryland Department of the Environment Standards and Specifications for Soil and Erosion Control. Select material, removed as a result of benching operations, may be used for fill and/or backfill as specified.
   1. Unpaved Areas: Scarify existing sub-grade to six-inch depth and compact to 92 percent maximum dry density. Density test method: ASTM D698.
   2. Paved Areas: Scarify existing sub-grade to twelve-inch depth and compact to 98 percent maximum dry density. Density test method: ASTM D698. Remove unsuitable earth, exhibiting excessive weaving during compaction operations, as specified.

C. Fill Placement: Do not place fill material on frozen or muddy sub-grades.
   1. Unpaved Areas: Place fill material in loose lifts not exceeding eight-inches.
   2. Paved Areas: Place fill material in loose lifts not exceeding eight-inches.

D. Fill Compaction and Moisture Control: Obtain compaction with approved compaction equipment. Provide compaction equipment of proper size and in proper mechanical operating condition. Fill material shall be moisture conditioned to within two percent of optimum moisture content.
   1. Unpaved Areas: Compact each lift to 92 percent maximum dry density. Density test method: ASTM D698.
   2. Paved Areas: Compact each lift to 98 percent maximum dry density. Density test method: ASTM D698.
      a. Control moisture during placement and compaction operations. Remove and replace or scarify and aerate excessively moist material until required moisture content is obtained. Moisten excessively dry material by applying measured amounts of water uniformly to fill material until required moisture content is obtained.

3.18 EARTH BACKFILL

A. General: Backfill excavations as promptly as Work permits, but not until completion of inspection, testing and approval by Soils Engineer.

B. Placement and Compaction: Do not place backfill on frozen or muddy sub-grades.
   1. Unpaved Areas: Place backfill material in loose lifts not exceeding twelve inches. Compact each lift to 92 percent maximum dry density. Density test method: ASTM D698.
   2. Paved Areas: Place backfill material in loose lifts not exceeding eight inches. Compact each lift to 98 percent maximum dry density. Density test method: ASTM D698.

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3. All material to be moisture conditioned to within two percent of optimum moisture content.

3.19 GRADING

A. General: Grade unpaved and paved areas to smooth and uniform surfaces and to prevent ponding of surface water.
   1. Unpaved Areas: Grade slopes exceeding four feet horizontal to one foot vertical, to smooth and uniformly rounded surfaces.
   2. Paved Areas: Grade paved area sub-grades to lines, elevations and sections indicated or specified.

3.20 MAINTENANCE, PROTECTION, AND REMEDIAL WORK:

A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

B. Protection of Existing Conditions: Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, under-mining, washout, and other hazards created by earthwork operation. Protect all trees shown or scheduled to remain. Comply with tree protection requirements specified in Section 311000 – Site Clearing.

C. Maintenance of Erosion and Sediment Control Measures: Protect and maintain erosion and sediment controls throughout duration of Project until removal is authorized by Sediment Control Inspector. Comply with any directives for maintenance of, or modifications to, these measures issued by Inspector.

D. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction at no additional cost to Owner.

E. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent Work, and eliminate of restoration to greatest extent possible.

F. Clean-Up: Thoroughly clean entire Job Site of trash and other debris. Haul materials away and dispose of off-site in an approved manner.

G. Maintain all paved access roads in a clean and dust free condition during earthwork or subsequent construction operations. Clean trucks and equipment, removing mud and debris, prior to entering project site access roads and public right-of-way.

H. Maintain completed areas of project site free of trash and debris. Scarify, regrade and recompact sub-grades damaged or disturbed by adverse weather, soil erosion, settlement and subsequent construction operations.

3.21 TESTING

A. Conduct following tests:
   1. Laboratory Density Tests:
      a. Test Method: As specified.
      b. Test Interval: One test per each 15,000 square feet, or fraction thereof, of each lift of fill or backfill compacted by other than hand-operated machines, and 1 per each 5,000 square feet, etc., for areas done by hand-operated machines.
   2. In-Place Field Density Tests:
      a. Test Method: ASTM D1556 or ASTM D2167.

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b. Density Required: As specified.

c. Test Interval: One test per 2,000 square feet, or fraction thereof, of compacted subgrade, or of each lift of fill or backfill compacted by other than hand-operated machines, and 1 per 1000 square feet, etc., for each lift of fill or backfill compacted by hand-operated machines

B. Correct Work not conforming to specified densities as directed by Soils Engineer, at no increase to Contract Sum.

C. Testing for Topsoil on Playfields:

1. Each soil test shall determine soil texture (mechanical analysis), pH, magnesium, phosphorus, potassium, soluble salts, total calcium, nitrogen, and percent organic matter. If the soil is sandy, it shall also be tested for boron. Soil test results shall include laboratory recommendations for soil amendments to correct deficiencies and accomplish planting objectives. Follow recommendation of ASTM D5268, Landscape Specification Guidelines, latest edition, Landscape Contractors Association of Maryland, Virginia, and The District of Columbia, and provide course of action based on their recommendation. The Contractor shall submit plans with the soil test results showing the locations of all soil tests. Incomplete test results and plans will be rejected and shall be redone at the Contractor's expense.
2. Soils provided from off-site sources: Obtain one soil test for each soil source per 500 cubic yards of soil and submit soil test results and soil amendment recommendations for review and acceptance prior to distributing and amending soil.
3. Existing stockpiled topsoil to be redistributed on site: Obtain one soil test per 500 cubic yards of soil prior to application. Submit soil test results and soil amendment recommendations for review and acceptance prior to redistributing and amending soil.
4. Pavement or stone removal areas: Obtain one composite soil test per 10,000 square feet of subsoil material, or at least one composite test for each separate excavated area.
5. Where existing soil to remain in place: Obtain one composite soil test for each isolated bed area. Submit one composite soil test per 20,000 square feet.
6. After final soil preparation: Obtain ten (10) additional soil samples shall be taken at random from planting and lawn areas throughout the site. The Owner shall determine locations of tests. These samples shall not be composite samples of different areas and are to ensure that soils have been amended properly prior to planting or installation of lawn. Submit soil test results for review. If it is apparent that soils have not been amended as specified or protected from contamination, areas not in compliance with specified requirements shall be reworked and retested as required until soils meet specified requirements. All rework and retesting shall be at the Contractor's expense.

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3.22 WASTE MANAGEMENT

A. Recycle or salvage waste earthwork materials in accordance with Division 1 "Construction Waste Management" requirements.

B. Completely remove from Site and dispose of in a legal manner debris and excess material resulting from Work of this Section. No topsoil shall be removed from the site unless approved by the Owner.

END OF SECTION 312000

SECTION 312005
BUILDING EARTHWORK

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1, specification sections, apply to work of this section.

1.02 DESCRIPTION OF WORK

A. Section specifies materials, equipment and work required to perform building earthwork operations.

1.03 TESTING AND INSPECTIONS

A. Refer to Section 312000 "Earthmoving".

B. Earthwork procedures shall be performed in presence of Soils Engineer. Give adequate (24 hours) notice when Soils Engineer’s services are required. Soils Engineer's duties will include, but not be limited to the following:

1. Observation, testing, and approval of sub-grade for footings before placement of concrete.
2. Observation and approval of floor sub-grade and fill placement before placement of underfloor granular base.
3. Testing of proposed import fill material and verification of correlation of import material to laboratory test samples. Test results shall be forwarded to the seeding and sodding Contractor.
4. Verification of removal of sediment from sediment control basins and testing of sub-grade in basins prior to fill placement.

1.04 RELATED SECTIONS

A. Refer to Section 311000 "Site Clearing", Section 31 20 00 "Earthmoving".

1.05 CODES:

A. Refer to Section 312000 "Earthmoving ".

1.06 STANDARDS:

A. Refer to Section 312000 "Earthmoving ".

1.07 SUBMITTALS

A. Refer to Section 312000 "Earthmoving " and as noted.

B. Product Samples: Submit samples of borrowed material and structural fill material to Soils Engineer. Sample size to be fifty pounds. Number of samples to be determined by Soils Engineer. Contractor shall deliver samples to Soils Engineer’s testing laboratory.

1.08 DEFINITIONS

A. Refer to Section 312000 "Earthmoving".

1.09 REFERENCE STANDARDS

A. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).

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B. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

1.10 PROJECT CONDITIONS

A. Refer to Section 312000 "Earthmoving".

1.11 CONSTRUCTION SURVEYS

A. Refer to Section 312000 "Earthmoving".

PART 2 PRODUCTS

2.01 MATERIALS

A. Fill Material: **<<ASTM D2487>>**, Unified Soils Classification SM or better. Liquid limit not to exceed forty (40). Plasticity Index not to exceed twenty (20). Maximum particle size to be 2-1/2 inches. Free of debris, organic materials, waste materials and frozen materials. Obtain and transport fill materials from project site or borrow areas at no increase to Contract Sum.

B. Samples: Submit fill material samples for testing and approval to Soils Engineer. Do not place fill until written approval is obtained. Sample approval will not relieve Contractor of responsibility to have material placed conform to approved samples.

C. Porous Fill: ASTM C 33 Coarse Aggregate, size number 467 **<< 1-1/2 inch>>** to No. 4), blast furnace slag prohibited.

1. Size to be AASHTO M 43, size 57.

D. Backfill Material: Refer to Section 312000 "Earthmoving".

PART 3 EXECUTION

3.01 PROTECTION AND RESTORATION

A. Refer to Section 312000 "Earthmoving" and as noted. Provide support systems (e.g. sheeting, shoring, sheet piling, cribbing, etc.) at no increase to Contract Sum. Protect footing, foundation and slab sub-grades, with insulating materials, to prevent frost penetration. Restore sub-grades damaged from the lack of protection. Restoration work as directed by the Soils Engineer.

3.02 DEWATERING

A. Refer to Section 312000 "Earthmoving" and as noted. Perform building earthwork operations to prevent water accumulations detrimental to stability of footing and foundation sub-grades.

3.03 EXCAVATION

A. Refer to Section 312000 "Earthmoving" and as noted.

B. Foundation Excavation: Excavate to footing and foundation elevations indicated or specified. Extend excavations horizontally beyond footings and foundations to permit formwork placement and removal, support system placement and removal, foundation drainage system installation, building utility installations, waterproofing and inspection. Do not place concrete until completion of inspections, testing and approval by Soils Engineer. Trim and shape excavations by manual methods, prior to concrete placement.

C. Slab Excavation: Excavate to slab sub-grade elevations indicated or specified. Excavate slab sub-grades to smooth and even surfaces, free of voids and depressions. Prepare exposed sub-grades as specified for paved areas, Section 312000 "Earthmoving". Do not place concrete or porous fill until completion of inspection, testing and approval by Soils Engineer. Inspection,

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testing and approval of sub-grade shall be performed immediately prior to placement of porous fill and concrete.

D. Below Slab Utility Excavation: Refer to Section 331000 "Utility Standards" and as noted.
   1. Trench width below and 12 inches above top of utility not to exceed 12-inch clearance on each side of utility, unless otherwise specified by the utility purveyor.

3.04 OVER-EXCAVATION

A. Refer to Section 312000 "Earthmoving " except as noted. Correct over-excavated areas as directed by the Soils Engineer or Owner's Representative.

3.05 UNSUITABLE EARTH BELOW SUB-GRADE

A. Refer to Section 312000 "Earthmoving" except as noted. Soils Engineer shall determine the least costly restoration method.

B. Payment for unsuitable earth removal below sub-grade and associated restoration operations will be by Change Order.

3.06 EXCAVATED MATERIAL STORAGE

A. Refer to Section 312000 "Earthmoving".

3.07 FILL

A. Refer to Section 312000 "Earthmoving", except as noted.

B. Earth Fill: Prepare exposed sub-grades as specified for paved areas, Section 312000 "Earthmoving". Place fill material in loose lifts not exceeding eight inches and at moisture content within plus or minus two percentage points of optimum moisture content, and compact to 95 percent maximum dry density. Top 18 inches below foundations and slabs shall be compacted to 98 percent maximum dry density. Density test method: **<<ASTM D698>>**.
   1. Compacted fill material shall extend at least ten feet beyond building lines for lateral support.
   2. Do not place concrete or porous fill until completion of inspection, testing and approval by the Soils Engineer. Inspection, testing and approval of sub-grade shall be performed immediately prior to placement of porous fill and concrete.

C. Porous Fill: Upon approval of prepared sub-grade, place porous fill in uniform lifts and compact to 70 percent relative density.

3.08 BACKFILL

A. Refer to Section 312000 "Earthmoving". Place and compact backfill as specified for fill, except as noted.

B. Backfill excavations as promptly as work permits, but not until completion of formwork removal, foundation drainage system installation, building utility installations, waterproofing, termite treatment, trash and debris removal, support system removal, temporary and/or permanent wall bracing installation, and inspection and approval by Soils Engineer.

C. Exercise care in placement of backfill material adjacent to structure. Place backfill evenly and in a manner to prevent wedging action against structure. Place backfill uniformly around structure in lifts of equal elevation. Correct damage from improper backfilling operations, as directed by Soils Engineer or Owner's Representative, at no increase to Contract Sum.

D. Backfill placement operations to be tested and approved by Soils Engineer.

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3.09 TESTING

A. Refer to Section 312000 "Earthmoving" and as noted.

B. Foundation Sub-grade Testing: For each stratum of soil, on which foundations will be placed, conduct one test to verify required design bearing capacities. Conduct a minimum of one test beneath each wall. Subsequent verification and approval of each foundation sub-grade may be based on a visual comparison of each sub-grade with related tested strata. Additional testing shall be conducted as required by Soils Engineer.

3.10 MAINTENANCE

A. Refer to Section 312000 "Earthmoving" and as noted.

B. Tests, inspections, and approvals specified will be conducted in accordance with applicable Division One Sections regarding "Testing Services".

END OF SECTION 312005

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SECTION 312319
DEWATERING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Conditions and Division 1 through Division 33, apply to work of this Section.

1.02 SUMMARY

A. Section includes construction dewatering.

1.03 RELATED WORK

A. Section 311000 Site Clearing

B. Section 312000 Earthmoving

1.04 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of groundwater and permit excavation and construction to proceed on dry, stable subgrades.

1.05 SUBMITTALS

A. Shop Drawings: For dewatering system. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, discharge lines, piezometers, and flow-measuring devices; and means of discharge, control of sediment, and disposal of water.

B. Delegated-Design Submittal: For dewatering system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.06 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with Montgomery County Standards and governing EPA notification regulations before beginning dewatering. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Preinstallation Conference: Conduct conference at Project site.

1.07 PROJECT CONDITIONS

A. Survey Work: Engage a Maryland Registered land surveyor to survey adjacent existing buildings, structures, and site improvements, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

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PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 INSTALLATION

A. Provide temporary grading to facilitate dewatering and control of surface water.

B. Monitor dewatering systems continuously.

C. Protect and maintain temporary erosion and sedimentation controls, during dewatering operations.

D. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.

1. Space well points or wells at intervals required to provide sufficient dewatering.
2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.

E. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

F. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.

1. Do not permit open-sump pumping, which leads to loss of fines, soil piping, subgrade softening, and slope instability.

G. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.

1. Maintain piezometric water level a minimum of 24 inches below surface of excavation.

H. Provide standby equipment on site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner.

1. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

END OF SECTION 312319

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SECTION 312500
EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1, Specification Sections apply to work in this section.

1.02 DESCRIPTION OF WORK

A. This section specifies materials and work required to construct soil erosion and sediment control measures.

1.03 RELATED WORK

A. Section 311000 "Site Clearing"

B. Section 312000 "Earthmoving"

C. Section 329500 "Lawns and Grasses"

D. Section 331000 "Utility Standards"

E. Section 331005 "Water Distribution System"

F. Section 334100 "Storm Drainage"

1.04 CODES

A. Comply with State of Maryland Code, COMAR 26.17.01.

B. Comply with Montgomery Code, Chapter 19, Article I, “Erosion and Sediment Control”.

C. Comply with City of Rockville Code, Chapter 19, Article V, “Sediment Control Code”.

D. Comply with City of Gaithersburg Code, Chapter 8, Articles I, II and IV, “Erosion and Sediment Control and Stormwater Management and Illicit Discharge Detection, Connection and Elimination Code”.

1.05 STANDARDS

A. Maryland Standards and Specifications for Soil Erosion and Sediment Control, current edition.

B. Maryland Department of Transportation, State Highway Administration, Standard Specifications for Construction and Materials, Section 308.

C. Montgomery County Department of Permitting Services Standards for Erosion and Sediment Control.

D. City of Rockville Construction Standards and Details.

E. City of Gaithersburg Construction Standards and Details.

1.06 PROJECT CONDITIONS:

A. Refer to Section 310000 "Earthwork" and as noted.

B. Controls: Provide controls required to prevent soil, silt, sediment, or debris from flowing onto adjacent or downstream properties, prior to or in conjunction with demolition, earthwork, and utility excavation operations.

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C. Temporary Soil Stabilization: Temporarily stabilize all areas, not permanently constructed upon within 7 calendar days, after completion of clearing and earthwork operations. Temporarily stabilize topsoil and earth stockpiles and control diversions within 7 calendar days after completion of initial earthwork operations.

D. Limitations: Temporarily stabilize soil with mulch, as specified, when no seeding date is applicable.

E. Permanent Vegetation: Immediately stabilize backfilled utility trenches located beyond "Clearing and Grading Limits" indicated and completed unpaved areas as specified in Section 329305 "Lawns and Grasses".

PART 2 PRODUCTS

2.01 GENERAL

A. Products shall be in accordance with standards specified, and as noted on the drawings.

2.02 SUBMITTALS

A. Provide submittals for all materials used for sediment control as shown on the plans.

PART 3 EXECUTION

3.01 FIELD PROCEDURES, INSTALLATION, AND REMOVAL

A. Upon approval of the construction contract and issuance of the Notice to Proceed, the Owner will approve the Contractor to stake out the Limits of Disturbance (LOD) and then arrange a pre-construction meeting between Sediment Control Inspection Staff, the Contractor, Owner, and any other required county, state, or jurisdictional personnel.

B. The Contractor will be provided with copies of the Sediment Control Permit and all other required permits at this time and must keep a copy of each permit on site at all times. Any printing of drawings for the inspectors is the responsibility of the Contractor.

C. The Contractor shall not start any construction prior to this meeting.

D. Contractor shall review and understand Sequence of Construction and present any concerns to Owner and Architect prior to start of work.

E. Installation of sediment controls shall begin only after the Sediment Control Inspector has granted approval and shall include any modifications to the approved Sediment Control Plan that the Sediment Control Inspector has required. Contractor is responsible for proper installation of all controls and coordinate field adjustments to ensure functioning throughout construction.

F. All subsequent notifications for inspection and coordination with the Sediment Inspector are the responsibility of the Contractor. Events requiring Sediment Control inspection and approval include, but may not be limited to start of grading, compliance with warning notices, lifting of stop work orders for violations, start of temporary or permanent stabilization, removal of Sediment Control facilities, and any other pertinent events noted in the plans or specifications.

G. Grading shall be accomplished throughout the entire project such that: existing surface drainage pathways and existing pipe/culvert conveyance systems outside of the LOD are not impacted; hazardous conditions are not created; erosive conditions are not created outside of the LOD as a result of site work; and uncontrolled sediment will not pass or collect into existing drainage systems and their downstream tributaries.

H. The Contractor shall be aware of current onsite graded conditions and ensure that sequence of site work and drainage area delineations comply with the approved sediment control plans. The

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Contractor shall ensure all disturbed and unstabilized drainage areas are properly conveyed to the sediment control device specified on the approved sediment control plans. The Contractor shall identify offsite drainage patterns and ensure LOD crossings of drainage paths are appropriately stabilized and/or clean water conveyances around work areas are established during construction.

I. Maintenance and repair of all sediment control facilities shall be the responsibility of the Contractor. The Contractor shall inspect and properly maintain all sediment control facilities at the end of each working day to ensure that the sediment control device will not be overburdened by sediment-laden runoff during storm events. Sediment Control Inspector will also conduct regular inspections of the facilities and inform the contractor of any required maintenance and/or repairs.

J. Infiltration or porous structures such as porous asphalt, porous concrete, concrete pavers, and stone trenches shall be protected and kept clean at all times from dirt and debris after installation and until final approval by the Sediment Control Inspector and Owner. The contractor shall, at a minimum, sweep, vacuum, and use hand blowers at regular intervals to comply with this requirement.

K. The Contractor is required to perform weekly inspections of all sediment controls on the entire site as well as after every rain or snow event, as part of the MDE/WMA NPDES NOI general permit requirements. All findings shall be documented on the MDE inspection forms provided at the pre-construction meeting. The completed inspection forms shall remain on-site at all times and be accessible to all who ask to review these documents.

L. The Sediment Control Inspector may require the Contractor to install additional sediment controls to improve sediment removal without impacting the functioning of the approved Sediment Control Plan. Examples of additional controls including installing a second row of silt/super silt fence and installing erosion control matting to disturbed areas.

M. Dust and Airborne Contaminates Control: The Contractor shall provide water as necessary to reduce airborne dust when directed by the Sediment Control Inspector and Owner, at no additional cost.

N. The Contractor shall ensure that all public and private roads used by construction equipment are maintained in safe conditions and kept clean of sediment and debris. Sediment shall be removed from truck tires via stabilized construction entrances, tire wash racks, or by other acceptable methods before leaving the construction site. Routine maintenance shall be performed on the roadways as necessary, including sweeping, vacuuming, or other acceptable methods and as directed by the Owner.

O. When washing construction equipment, rinsate shall be directed towards approved-sediment control devices. Rinsate from equipment that is used to handle and transport concrete shall be directed towards watertight concrete washout structures per design criteria and details in Section H-6 of the MDE Sediment and Erosion Control manual, current edition.

P. Removal of sediment control facilities:
   1. Once the project has been completed, and all disturbed areas have been stabilized as called for in the plans, the Contractor shall contact the Sediment Control Inspector for approval to remove the sediment control features. Note that seeded areas must have a visible stand of vegetation prior to this inspection.
   2. When permitted, the Contractor shall remove all sediment control features and regrade such areas to proposed designed grades and seed and/or sod them as required.

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Q. CLEANING: Clean improvements and facilities, damaged by hydraulic seed application overspray, as directed by the Architect and Owner.

END OF SECTION 312500

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SECTION 313116
TERMITE CONTROL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract including the General and Supplementary Conditions and Division 1, specification sections, apply to work of this section.

1.02 RELATED WORK

A. Refer to Section 312000 "Earthmoving".

1.03 DESCRIPTION OF WORK

A. This section specifies application of Termite Control soil treatment prior to placement of concrete floor slabs, foundation walls or grade beams.

1.04 QUALITY ASSURANCE

A. Applicator's Qualifications: Applicators shall be registered or licensed where required by State or County jurisdictions.

1.05 WARRANTY

A. On final acceptance, furnish the Owner's Representative with a written guarantee, executed by the Applicator and the Contractor, stating application was made in accordance with this specification, and certifying that the applied soil termiticide treatment will prevent infestation of subterranean termites.

B. Guarantee effectiveness of treatment for not less than five years.

C. Guarantee to correct damage caused by termite infestations in treated areas, within the five-year guarantee period. If subterranean termite activity is discovered during the guarantee period, the Contractor will re-treat the soil and repair or replace damage caused by the termite infestation.

1.06 STANDARDS

A. United States Department of Agriculture Federal Insecticide, Fungicide and Rodenticide Act.

B. The formulation of all soil poisons, insecticides, fungicides, etc. shall be registered under the Act and shall be registered with the appropriate agency of the State of Maryland.

1.07 SUBMITTALS

A. Submit manufacturer's written mixing and application instructions.

B. Submit typewritten detailed description of termite treatment program to, and obtain approval from, the local jurisdiction prior to implementation.

C. Submit evidence of compliance with Federal and State regulations.

1.08 PROJECT CONDITIONS

A. Protect occupied portions of existing structures to remain from fumes and vapors from application of the termite treatment.

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PART 2 PRODUCTS

2.01 SOIL TREATMENT SOLUTIONS:

A. General: Use an emulsible, concentrated termiticide that dilutes with water, specially formulated to prevent termite infestation. Fuel oil will not be permitted as a dilutent. Use only soil treatment solutions that are not harmful to plants.

B. Provide a solution consisting one of the following chemical elements:
   1. Premise, Bayer.
   2. Permathrin:
      a. Dragnet.
   3. Cypermethrine:
      a. Prevail FT, FMC Corp.
      b. Dermon, ICI Americas, Inc.
   4. Fenvalerate:
      a. Gold Coast Tribute, Du Pont
   5. Isofenphose:
      a. Pryfon, Mobay Corp.
   6. Or approved equal

C. Mixes: Dilute with water to concentration level recommended by the manufacturer. Follow manufacturer's written mixing instructions.

PART 3 EXECUTION

3.01 INSPECTION

A. Verify that soil is in friable condition with moisture content low enough to permit absorption of toxicant solution. Remove any foreign matter which could decrease effectiveness of treatment.

B. Do not apply soil treatment until excavating, filling and grading operations are complete, except as otherwise required.

C. Do not apply soil treatment to frozen or excessively wet soils or during inclement weather.

3.02 APPLICATION

A. Apply soil treatment to areas beneath concrete floor slabs on grade or fill, suspended slab structures, at hollow masonry foundations and grade beams and along interior and exterior sides of foundation walls and grade beams.

B. Apply soil treatment at expansion joints, control joints and all areas where slabs will be penetrated.

C. Do not apply soil treatment solution until excavating

3.03 RATE OF APPLICATION

A. Surface Preparation: Remove foreign matter which could decrease effectiveness of treatment on areas to be treated. Loosen, rake and level soil to be treated, except previously compacted areas under slabs and foundations. Toxicants may be applied before placement of compacted fill under slabs, if recommended by toxicant manufacturer.

B. Application Rates: Apply soil treatment solution as follows:

C. Under slab-on-grade structures, treat soil before concrete slabs are placed, using the following rates of application:

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1. Apply 4 gallons of chemical solution per 10 linear feet to soil in critical area under slab, including entire inside perimeter inside of foundation walls, along both sides of interior partition walls, around plumbing pipes and electric conduit penetrating slab, and around interior column footers.
2. Apply one gallon of chemical solution per **<< 10 sq feet>>** as an overall treatment under slab and attached slab areas where fill is soil or unwashed gravel. Apply one and one half gallons of chemical solution per 10 square feet to areas where fill is washed gravel or other coarse absorbent material.
3. Apply 4 gallons of chemical solution per 10 linear feet of trench, for each foot of depth from grade to footing, along outside edge of building. Dig a trench six inches to eight inches along outside of foundation to a depth of not less than 12 inches. Punch holes to top of footing at not more than 12 inches on center and apply chemical solution. Mix chemical solution with the soil as it is being replaced in trench.

D. Under crawl-space and basement structures, treat soil along exterior and interior walls of foundations with shallow footings as specified above for exterior of slab-on-grade structures.

E. At hollow masonry foundations or grade beams, treat voids at rate of 2 gallons per 10 linear feet, poured directly into the hollow spaces.

F. At expansion joints, control joints, and areas where slabs will be penetrated, apply at a rate of 4 gallons per 10 linear feet of penetration.

G. Post signs in areas of application to warn workers that soil termiticide treatment has been applied. Remove signs when areas are covered by other construction.

H. Re-apply soil treatment solution to areas disturbed by subsequent excavation, landscape grading, or other construction activities following application.

END OF SECTION 313116

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SECTION 315000
EXCAVATION SUPPORT AND PROTECTION

PART 1 GENERAL

1.01 SUMMARY

A. Work of this section includes sheeting and shoring and bracing.

1.02 RELATED SECTIONS

A. Section 311000: Site Clearing

B. Section 312000: Earthmoving

1.03 SYSTEM DESCRIPTION DESIGN REQUIREMENTS

A. Shoring systems shall be designed to safely and adequately prevent collapse of adjacent materials and permit construction of Work to arrangement shown on Contract Documents.

B. B Secure approvals, including those of local governmental agencies having jurisdiction.

C. Analyze site conditions. Make supplemental investigations as needed for proper design of shoring.

1.04 QUALITY ASSURANCE SUBMITTALS FOR DESIGN DATA

A. Prepare and submit design drawings and calculations showing analysis of work to be performed, including horizontal support for shoring.

B. Drawings shall include methods, equipment and work procedures.

1. Include plans, elevations, sections, and details.
2. Show arrangement, locations, and details of soldier piles, piling, lagging, tiebacks, bracing, and other components of excavation support and protection system according to engineering design.
3. Indicate type and location of waterproofing.
4. Include a written plan for excavation support and protection, including sequence of construction of support and protection coordinated with progress of excavation.

C. Contractor is responsible for obtaining all permits or approvals from authorities having jurisdiction for the installation of the shoring. Documentation of these permits/approvals shall be provided to the owner prior to starting work.

1.05 QUALITY ASSURANCE

A. Qualifications

1. Bracing and shoring drawings shall be prepared by a registered professional engineer, licensed to practice in the State of Maryland. Drawings and calculations shall bear seal of Professional Engineer registered in the State of Maryland.
2. Personnel performing installation shall be trained or qualified in techniques and procedures of shoring installation with a minimum of three (3) years' successful experience in such installation.
3. Installation shall be performed under supervision of a Professional Engineer registered in the State of Maryland, experienced in this type of work.

B. Regulatory Requirements: Conform to requirements of Occupational Safety and Health Administration (OSHA) as well as measures accepted as standards of industry.

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C. Certifications: Upon completion of shoring, submit a letter signed and sealed by design engineer stating that, to best of his or her knowledge, systems were constructed in compliance with design drawings and calculations.

1.06 SUBMITTALS

A. For products having recycled content, documentation indicating percentages by weight of pre-consumer and post-consumer recycled content. Include statement indicating cost of each product with recycled content.

B. For products having regional material content, documentation indicating location of manufacture and location of extraction, recovery or harvest of primary raw materials. Include statement indicating cost of each product with regional material content.

C. Chain-of-custody certificates certifying that products specified to be made from certified wood comply with forest certification requirements. Include vendor invoice indicating Chain of Custody number and wood products listed per requirements Section 016000 Product Requirements.

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials shall be selected and furnished to perform in compliance with design criteria.

B. Structural Steel Shapes and Plates: ASTM A36 or ASTM A572. Steel shall be of American manufacturer, new and free from defects in strength, durability, appearance and function.

1. Recycled Content: Provide steel with minimum 90 percent total recycled content, including at least 60 percent post-consumer recycled content.
2. Regional Materials: Provide steel manufactured and of primary raw materials extracted or recovered within 500-mile radius of Project Site.

C. Forest Certification: Provide wood products made from forests certified by an FSC-accredited certification body. All non-FSC wood in assemblies with FSC-certified wood shall meet the FSC Controlled Wood (CW) criteria.

PART 3 EXECUTION

3.01 EXAMINATION

A. Site Verification of Conditions: Prior to commencing work of this Section, check and verify governing dimensions and elevations, including field measurements of existing or adjoining work on which this work is dependent to assure proper fit and clearances between new and existing structures.

3.02 PREPARATION

A. Protection

1. Protect and support water, sewer, gas, and other pipes and electrical conduits encountered and immediately notify persons, companies or governmental agencies, granting them ample opportunity to take such additional precautions as they may deem necessary.
2. Cut and cap street connections encountered in excavating along curb lines in compliance with local jurisdiction requirements. Mark locations of capped utilities so they may be subsequently located and reconnected as needed.

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3. Damage to adjacent properties, streets, sidewalks and utilities caused by work under this Section shall be repaired, restored to original condition, or replaced at no additional expense to Owner.

B. Coordination
1. Prepare a photographic or video survey of existing crack conditions in adjacent facilities and other conditions of structures prior to commencing work.
2. Maintain free flow of pedestrian and vehicular traffic to and from adjacent properties at levels existing prior to start of work and as described in Section 311000 “Site Clearing”.
3. Interior bracing shall be arranged to offer no interference with formwork for new construction.
4. Provide sufficient quantity of materials on hand at all times for protection of Work and for use in event of emergency.
5. Setting of formwork, reinforcing and placement of concrete shall be in compliance with requirements described in other related Sections of this Project Manual.
6. Provide pumps and other equipment as necessary to dewater excavations for shoring operations.

C. Sheeting
1. Provide sheeting of proper lengths and section needed, and anchor or brace to resist earth and hydrostatic pressures and superimposed loads from adjacent structures and/or construction equipment.
2. Install sheeting plumb and true, to lines and locations as indicated on design submittal drawings. Sheeting shall be used to form concrete walls and shall be located and driven to ensure that no part of sheeting is within outline of permanent construction.
3. Sheeting retaining earth on which support and stability of existing structures is dependent shall be left in place at completion of Work.

D. Shoring
1. Locate shoring at distances away from new construction sufficient to allow working room and observation of construction.
2. Shoring shall be set clear of permanent footings, walls and other structural features.
3. Shoring shall be installed to retain earth under surcharges, including such loads as weight of construction materials and equipment, vibration, snow, rainwater, water absorption by soils, and temporary construction.
4. Extend shoring as high as necessary to allow for construction of foundation walls and for berming to divert water run-off. Depth of shoring shall be as deep as necessary to brace excavation to ultimate depth.
5. Shoring supporting formwork may not be left in place upon written approval by the Owner’s Representative.

3.03 RESTORATION

A. Remove temporary protective installations upon completion of shoring operations.
1. Contractors option: Remove excavation support and protection systems to a minimum depth of 36 inches below overlying construction and abandon remainder. This will need approval from the permit authority. Denial from the permit authority will require the complete removal at no additional cost to the contract.
2. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earthmoving."
3. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.

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B. Repair damage to structures caused by shoring operations and restore surfaces to original or better condition.

3.04 CLEANING

A. Remove debris and excess earth resulting from shoring operations as it accumulates. Do not store debris on site or permit debris to be scattered over site.

3.05 FIELD QUALITY CONTROL

A. Owner will engage an independent inspection agency to perform field quality control inspections.

END OF SECTION 315000

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SECTION 321216
HOT-MIXED ASPHALT PAVEMENT

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).

C. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1, Specification Sections, apply to work in this section.

1.03 DESCRIPTION OF WORK

A. Section specifies materials and work required to construct new asphalt pavement over prepared sub-base, asphalt curbing, asphalt walks and overlay existing asphalt pavement.

1.04 RELATED SECTIONS

A. Refer to Section 311000 "Site Clearing"

B. Section 311005 "Site Demolition"

C. Section 312000 "Earthmoving"

D. Section 321610 "Concrete Curbing"

1.05 CODES AND STANDARDS

A. Comply with latest edition of Maryland Department of Transportation, State Highway Administration, Standard Specifications for Construction and Materials, and approved addenda, except Method of Measurement and Basis of Payment.

B. Work in County rights-of-way shall comply with latest Montgomery County, Maryland Department of Transportation standards and specifications.

C. Work in City of Rockville rights-of-way shall comply with latest City of Rockville Standard Specifications for work in City right-of-way.

D. Work in City of Gaithersburg rights-of-way shall comply with latest City of Gaithersburg Standard Specifications for work in City right-of-way.

1.06 SUBMITTALS

A. Products:

1. Submit asphalt plant mix formula, for each course specified. Mix formula to include percentage of aggregate passing each sieve size, percentage of bituminous material added to aggregate and mix temperature.
2. Submit certificates, signed by producer or manufacturer and Contractor, stating that base course material and asphalt comply and meet or exceed standards of this specification.

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3. Submit results of testing specified for review by Architect, Owner's Representative and required jurisdictional inspectors.
4. Submit location of product manufacture and of extraction/recovery of primary raw materials.
5. Submit recycled-content data, designating percentages of pre- and post-consumer and post-industrial recycled materials.

1.07 PRODUCT DELIVERY AND STORAGE

A. Asphalt mixtures: Delivery temperature not to exceed 25 degrees F below plant mix temperature.

1.08 PROJECT CONDITIONS

A. Existing Asphalt Pavements: Verify existing pavement conditions (e.g. deteriorated surface, joints, etc.) during pre-bid inspection.

B. Traffic: Maintain vehicular traffic during pavement construction operations.

C. Limitations: Do not proceed with pavement construction until underground utility construction is complete. Do not proceed with asphalt placement operations until adjacent or adjoining Portland cement concrete curb construction is complete. Do not place bituminous materials when ambient air temperature is below 40 degrees F or air temperature has been below 35 degrees F for 12 or more consecutive hours. Do not place materials from 15 November to 01 March without written authorization from Architect.

D. Construction Surveys: Establish and maintain required lines and elevations. Retain services of a Maryland Registered Land Surveyor to provide combined horizontal and vertical alignment stakes for road base construction.
   1. Paved area base alignment stake horizontal interval: 50-foot maximum stations at centerline and both edges to finished base elevations.

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PART 2 PRODUCTS

2.01 MATERIALS

A. General: Provide products manufactured and of raw materials extracted/recovered within a 500-mile radius of Project Site.

B. Sub-base Course: SHA Graded Aggregate Base: Section 901.01 – Table 901A.

C. Asphalt Base (Binder) Course: SHA Hot Mix Asphalt Superpave: Section 901.01, and 904.02. Gradation shall be as shown on approved drawings.

D. Tack Coat: SHA cut-back asphalt: Section 504.03.04, M 81 or M 82.

E. Overlay Binder Coat: Asphalt cement: AASHTO MP-1, penetration grade 80-100.

F. Overlay Protective Membrane: "Petromat MPG" protective membrane manufactured by Somax; or approved equal.

G. Overlay Protective Membrane Strips: "Rapid Repair System" fiber reinforced mastic strips, manufactured by Tensar or approved equal.

H. Asphalt Surface Course: SHA Hot Mix Asphalt Superpave: Section 901.01, and 904.01. Gradation shall be as shown on approved drawings.

I. Asphalt Surface Course for Athletic Courts and Paved Play Areas: SHA Hot Mix Asphalt Superpave: Sections 901.01, 904.01 and 904. Gradation shall be at 4.75mm

J. Joint Sealant: SHA Section 911.01.

PART 3 EXECUTION

3.01 PROTECTION AND RESTORATION

A. Asphalt Pavement: Protect improvements and facilities during tack coat and overlay binder coat applications to prevent overspray damage. Protect completed surface from damage. Do not permit heavy equipment or rollers on completed surface. Do not permit vehicular traffic on surface for 24 hours after completion. Restore damaged pavement as directed by Owner's Representative or Architect, at no increase to Contract Sum.

3.02 SUB-GRADE PREPARATION

A. Paved Areas: Refer to Section 312000 "Earthmoving" and as noted.

B. Proof-roll prepared sub-grade to check for unstable areas and areas requiring additional compaction. Do not begin work until deficient sub-grade areas have been corrected and are ready to receive paving.

C. Verify sub-grade compaction and elevations and correct discrepancies before proceeding with base construction. Verify utility casting elevations and reset or adjust to meet flush with finished pavement surface. Do not place base material/sub-base material on frozen or muddy sub-grade.

D. Place aggregate base on prepared sub-grade as soon as possible after grading operations are completed.

E. Aggregate Base Material: Place Aggregate base material in loose layers not exceeding 6 inches nor less than 3 inches to a finished thickness 6 inch compacted depth. Spread, shape and compact all aggregate base materials deposited on sub-grade during same day. Fill areas to contours and elevations using unfrozen materials.

1. Compact aggregate base material to not less than 95 percent of maximum density at optimum moisture content plus or minus 3 percent in accordance with **<<AASHTO T 180>>**.

3.03 PLACING HOT-MIX ASPHALT PAVEMENT

A. General: Place Hot-Mixed asphalt mixture on prepared surface, spread and strike off. Spread mixture at minimum temperature of 225 degrees F. Place areas inaccessible to equipment by hand. Place each course to require grade, cross-section, and compacted thickness.

B. Exercise care in applying bituminous materials to avoid smearing of adjoining concrete surfaces. Remove and clean or replace damaged surfaces at no additional cost to Owner.

C. Paver Placing: Place in strips not less than 10 feet wide, unless otherwise acceptable to Architect and/or Owner. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete base course for a section before placing surface course.

1. Immediately correct surface irregularities in finish course behind paver. Remove excess material forming high spots with shovel or lute.

D. Base Course: Provide 4 inch minimum compacted thickness, except as otherwise indicated on the drawings, conforming to grade, cross-section, finish thickness and density as indicated.

E. Surface Course: Provide 2 inch minimum compacted thickness, except as otherwise indicated on the drawings, compacted with a roller weighing not less than 6-tons.

F. Joints: Make joints between old and new pavements, or between successive days' Work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density, and smoothness as other sections of hot-mixed asphalt course. Clean contact surfaces and apply tack coat.

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1. Both longitudinal and transverse joints in successive courses shall be staggered so that one is not above the other. Stagger transverse joints by the length of the paver. Stagger longitudinal joints at least 6 inches.

3.04 ROLLING

A. General: Begin rolling when mixture will bear roller weight without excessive displacement.

B. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.

C. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling and repair displaced areas by loosening and filling, if required, with hot material.

D. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been evenly compacted.

E. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated, and course has attained 95 percent laboratory density.

F. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut out such areas and fill with fresh, hot hot-mixed asphalt. Compact by rolling to specified surface density and smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.05 TRAFFIC LANE AND GAME LINE MARKINGS

A. Cleaning: Sweep and clean surface to eliminate loose material and dust.

B. Do not apply marking paint until layout and placement have been verified with Architect.

C. Apply paint with mechanical equipment to produce uniform straight edges. Apply at manufacturer's recommended rates to provide minimum 15 mils dry thickness.

D. Except where noted otherwise, parking lines shall be white in color (understriping for after-hours parking shall be blue).

3.06 SUBBASE COURSE

A. Place sub-base course material on prepared sub-grade in one uniform layer to depth required to produce compacted thickness indicated. Shape material, to sections and elevations indicated with blade grader and compact with pneumatic tired rollers in accordance with Section 312000 "Earthmoving". Control moisture content of base course material to within 2 percent of optimum during compaction operations. Compaction Standard: **<<ASTM D698>>**. Proof roll sub-base course with 8-ton tandem steel wheel roller and correct irregularities.

3.07 ASPHALT BASE COURSE

A. Sub-base Course Surface Preparation: Apply tack coat material to previously placed asphalt base course, existing pavement, curbing, utility castings and any structure abutting or projecting into paved area.

B. Base Course Placement: Place asphalt in layers not exceeding four inches in compacted depth to total depth required to produce compacted thickness indicated. Place material with mechanical self-powered pavers capable of maintaining required line and grade. Place

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material by approved manual methods in areas inaccessible to self-powered pavers. Temperature of material shall be not less than 225 degrees F at the time of placement.

C. Base Course Compaction: Compaction operations shall begin immediately following placement of base course material, and shall consist of breakdown, intermediate and finish rolling. Material shall be compacted in accordance with Section 312000 “Earthmoving”. In-place compaction shall be completed before material cools below 185 degrees F. Use self-powered tandem steel wheel rollers. Use power driven trench rollers in areas inaccessible to self-powered equipment. Begin rolling longitudinally at low side or edge and proceed toward high side or crown. Overlap successive roller trips one half-roller width. Do not terminate alternate roller trips at same location. Continue finish rolling until 98 percent to 102 percent theoretical maximum density is obtained and all roller marks are eliminated. Density test method: AASHTO T-230.

3.08 ASPHALT SURFACE COURSE AND OVERLAY

A. General: Provide overlay protective membrane treatment where indicated, or as directed by the Owner’s Representative. Provide overlay protective membrane strips over long, running cracks or pavement joints except in areas where overlay protective membrane is indicated on the drawings or as field directed by the Owner or Architect.

B. Asphalt Base Course Surface Preparation: Remove loose material from surface before applying tack coat. Apply tack coat material uniformly to surface at a rate of 0.10 gallon per square yard. Allow tack coat to cure as long as required to properly set but not less than 12 hours.

C. Existing Asphalt Pavement Preparation: Clean and dry pavement, with compressed air, removing debris, dust, foreign materials and moisture.

1. Obtain pavement preparation approval, from Architect prior to overlay binder coat application. Apply overlay binder coat material uniformly to prepared asphalt surface. Apply at a rate of 0.25 gallon per square yard. For long running cracks or joints in existing pavement surface where overlay protective membrane strips will be used, apply overlay binder coat material to a width of approximately two feet so as to span existing cracks or joints. Adjust application rate, based on existing pavement relative porosity, at no increase to Contract Sum. Apply overlay binder coat material at 300 degrees F minimum to 350 degrees F maximum.
2. Lay down overlay protective membrane, on cured overlay binder coat, in accordance with manufacturer's installation instructions and as noted. Transverse joint overlap to be 12 inches, "shingled" in direction of paving to prevent edge pick-up by the pavers. Longitudinal joint overlap to be six inches. Cut and piece membrane to fit irregular shaped areas (e.g. access road intersections, curb returns, etc.). Obtain pavement preparation approval from Owner or Architect prior to tack coat application.
3. Lay down overlay protective membrane strips on cured overlay binder coat, in accordance with manufacturer's installation instructions and as noted. Unroll overlay protective membrane strips, aligned with pavement joints, and seat in tacky overlay binder coat material by brooming, so as to span existing pavement joints. Blot excess overlay binder coat materials on edges of membrane strips with sand blanket. Cut and piece membrane to fit irregular shaped areas (e.g. access road intersections, curb returns, etc.). Obtain pavement preparation approval from Owner or Architect prior to tack coat application.
4. Apply tack coat material uniformly to prepared asphalt surface. Apply at rate of minimum of 0.05 gallon per square yard and a maximum of 0.15 gallon per square yard. Tack coat to cure as long as required to properly set, but not less than 12 hours.
5. Prepare existing asphalt pavement, as indicated and specified, at no increase to Contract Sum.

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D. Surface Course and Overlay Placement: Place asphalt, in one uniform layer, to depth required to produce compacted thickness indicated. Place with mechanical self-powered pavers capable of maintaining required line and grade. Place and spread asphalt by approved manual methods in areas inaccessible to self-powered pavers. Temperature of the material shall be not less than 225 degrees F at time of placement. Contractor shall provide certification for temperature of the placed material for record. Should the certification not be provided the asphalt may need to be removed and replaced at no additional cost to the Owner.

E. Surface Course and Overlay Compaction: Compaction operations shall begin immediately following placement of surface course material, and shall consist of joint, breakdown, intermediate and finish rolling. In-place compaction shall be completed before material cools below 185 degrees F. Use power driven trench rollers in areas inaccessible to self-powered rollers. Begin rolling longitudinally at low side or edge and proceed toward high side or crown. Overlap successive roller trips, one-half roller width. Do not terminate alternate trips at same point. Continue finish rolling until 98 percent to 102 percent theoretical maximum density is obtained and all roller marks are eliminated. Density test method: AASHTO T 230.

3.09 JOINT SEALING

A. Completely seal and fill joints along existing and new pavement and curbing interface with joint sealant.

3.10 TESTING

A. General: Correct work not conforming to specified tolerances as directed by Owner's Representative or Architect, at no increase to Contract Sum.

B. Thickness Tests: Conduct sub-base, base and surface course thickness tests and provide test area restoration upon completion. Tolerance not less than 1/2-inch from compacted thickness indicated. Test locations are random and to be determined by Owner's Representative or Architect. Regardless of paved area size, at least one test shall be performed for each newly paved area. Thickness testing shall be performed by Ground Penetrating Radar (GPR) only, pavement cores will not be allowed.

C. Smoothness Tests: Conduct surface course smoothness tests. Tolerance not to exceed 1/8-inch between any two surface contacts on 10-foot straightedge. Test locations are random and to be determined by Owner or Civil Engineer. Regardless of paved area size, at least one test shall be performed for each newly paved area.

D. Laboratory Density Tests: Conduct sub-grade, sub-base and base course laboratory density tests. Density testing shall be performed by individuals certified to perform asphalt testing. Test method: **<<ASTM D1557>>**. Test interval to be determined by Owner's Representative or Architect, but no less than one test for each newly paved area and/or one test per 1000 feet of roadway shall be performed.

1. Provide test area restoration.

E. Field Density Tests: Conduct sub-grade, sub-base and base course in-place field density tests. Density testing shall be performed by individuals certified to perform asphalt testing. Test method: ASTM D1556 or ASTM D2167. Test locations are random and to be determined by Owner's Representative or Architect, but no less than one test for each newly paved area and/or one test per 1000 feet of roadway shall be performed.

1. Provide test area restoration.

3.11 CLEANING

A. Clean improvements and facilities damaged by tack coat overspray as directed by Owner or Architect.

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3.12 WASTE MANAGEMENT

A. Recycle waste materials in accordance with Section 017419 “Construction Waste Management and Disposal” requirements.

END OF SECTION 321216

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SECTION 321220
ROAD AND PARKING ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1, Specification Sections, apply to work in this section.

1.02 DESCRIPTION OF WORK

A. Section specifies materials and work required to apply, install, and construct miscellaneous road and parking accessories.

1.03 RELATED SECTIONS

A. Refer to Section 31 20 00 "Earthmoving", and Section 32 16 10 "Concrete Curbing".

1.04 STANDARDS

A. Maryland Department of Transportation State Highway Administration's current "Standard Specifications for Construction Materials", latest edition.

B. "Manual on uniform Traffic Control Devices for Streets and Highways", US Department of Transportation, latest edition.

C. "Maryland Manual on uniform Traffic Control Devices ", Maryland Department of Transportation State Highway Administration, latest edition.

1.05 SUBMITTALS

A. Products:

1. Submit manufacturer's specifications and application instructions for pavement marking paint.
2. Submit manufacturer's descriptive literature for road and parking area signs.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver paint to project site in original unopened containers bearing manufacturer's label.

B. Store paint in tightly covered containers.

1.07 PROJECT CONDITIONS

A. Maintain vehicular and pedestrian traffic during pavement marking operations. Do not apply paint when ambient air temperature is below 50 deg. F, relative humidity exceeds 85%, wind exceeds 20 miles per hour, or pavement surface temperature is below 50 deg. F.

B. Contractor shall notify Fire Marshal within 48 hours of completion of fire lane signage installation to schedule site inspection for approval.

C. Line stripes at handicapped parking spaces shall be painted yellow.

D. All other on-site striping shall be white.

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PART 2 PRODUCTS

2.01 MATERIALS

A. Pavement Marking: AASHTO M 248, type I, non-reflective paint, colors as noted. Materials used in the Public Right-of-Way shall be Type B, Class I, Thermoplastic alkyd. Materials used in Public Right-of-Way shall be approved by Montgomery County Department of Transportation, Traffic Engineering prior to installation. Colors shall be:
   1. Standard Parking Spaces: White
   2. Bus Stacking Spaces: White
   3. Handicapped Parking Spaces: Yellow
   4. Traffic Lanes: Yellow
   5. Afterhours Parking Spaces: Blue

B. Road and Parking Area Signs:
   1. Handicapped Parking Area and Fire Lane Signs: In accordance with Montgomery County Department of Transportation standards, and the MUTCD.
   2. Stop Signs shall be 30 inch by 30 inch signs.

C. Traffic Control Signs:
   1. Traffic control signs in accordance with Montgomery County Department of Transportations standards, the MUTCD, and as indicated.

D. Sign Posts: Square Galvanized ‘break-away’ steel post with 5/16 by two inch steel nuts and bolts and galvanized steel washers.

E. Wheel Stops: Wheel stops shall be precast concrete “Elevation Type I” in accordance with Maryland Department of Transportation - State Highway Administration standards.
   1. Only concrete wheel stops will be accepted.

PART 3 EXECUTION

3.01 PAVEMENT MARKING

A. Surface Preparation: Clean pavement surfaces, removing grease, oil, mud, and foreign materials.

B. Preparation for New Pavement Markings: Lay out markings to dimensions and line widths indicated and specified. Bituminous concrete pavement to cool and set five calendar days prior to paint application. Do not apply marking materials to wet or damp pavement surfaces. Do not apply marking materials until pavement marking removal paint has set and hardened. Surfaces to set an additional eight hours after appearing dry.

C. Application: Apply paint to width and length of pavement marking lines indicated, and as noted. Apply paint with spray equipment and/or conventional traffic line striping equipment, and in accordance with paint manufacturer's recommendations, to produce markings parallel and with sharp line edges, uniform in cross section and with line widths as indicated or specified. Minimum application rate to be 100 feet per gallon.
   1. Lay out and apply paint for universal handicapped space symbols in accordance with standard practice and as directed by Architect or Owner.

D. Protection and Restoration: Protect completed paint marking from damage. Do not permit vehicular or pedestrian traffic on completed marking until paint has set and hardened. Restore damaged paint marking as directed by Architect.

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3.02 ROAD AND PARKING AREA SIGNS

A. Sign Locations: Locations of various sign types shall be as indicated on Construction Drawings and as directed by Owner and Architect. Contractor shall provide and install indicated and selected signs at no increase to Contract Sum.

B. Post Installation: Excavate post footing to 12 inch diameter and 30 inch depth. Place and consolidate concrete in footing excavation. Install post and assembled sign in concrete plumb to 1/4-inch in 10 feet and 24 inch depth. Provide bracing to prevent movement. Slope concrete surface one inch with outside edges flush with finished grade and trowel to smooth finish. Contractor shall allow concrete footings to cure a minimum of 14 calendar days before removing bracing.

3.03 WHEEL STOPS

A. Wheel-Stops: Install per MDOT-SHA requirement. Wheel stop shall be centered in space and be placed no closer than three feet to end of space.

END OF SECTION 321220

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SECTION 321600
CONCRETE WALKS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM C642 - Standard Test Method for Density, Absorption, and Voids in Hardened Concrete.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1, Specification Sections apply to work in this section.

1.03 DESCRIPTION OF WORK

A. Section specifies materials and work required to construct Portland cement concrete walks.

1.04 RELATED SECTIONS

A. Section 312000 "Earthmoving"

B. Section 321610 "Concrete Curbing"

1.05 STANDARDS

A. Maryland Department of Transportation State Highway Administration's current "Standard Specifications for Construction and Materials".

B. Montgomery County, Department of Transportation's current "Design Standards".

1.06 SUBMITTALS

A. Contractor shall construct eight linear feet of typical concrete walk in the presence of the Owner’s Representative, with a control joint. No additional concrete walk may be constructed until sample is inspected and approved by the Owner.

B. Submit location of product manufacture and of extraction/recovery of primary raw materials.

C. Submit recycled-content data, designating percentages of post-consumer and post-industrial recycled material.

D. Submit certification of FSC-certified sustainably harvested wood formwork materials, if applicable.

1.07 PROJECT CONDITIONS

A. Traffic: Maintain pedestrian traffic during walk construction operations.

B. Limitations:

1. Underground Utilities: Do not proceed with concrete construction until underground utility construction is complete.
2. Curbing: Do not proceed with concrete walk construction until adjacent or adjoining curb construction is complete.
3. Environmental: Refer to Section 331000 "Utility Standards".

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PART 2 PRODUCTS

2.01 MATERIALS

A. General: Provide products manufactured and of raw materials extracted/recovered within a 500-mile radius of the Project Site.

B. Gravel Base: MDOT-SHA 'GA Base'.

C. Concrete:
   1. Per MDOT-SHA Mix number 06.
   2. Maximum 50 percent GGBF slag replacement for Portland cement, per MDOT-SHA Specification 902.06.05

D. Joint Materials: Expansion and Isolation Joints: ASTM D 994, bituminous preformed joint filler, 3/8-inch thick.

E. Forms: Steel or wood for straight or tangent walks. Non-rented wood materials shall be FSC-certified sustainably harvested.

F. Curing Materials: Liquid Membrane in accordance with MDOT-SHA Standards and Specifications for Construction and Materials section 902.07.03.

G. Form Release Compound: Non-staining, zero-VOC, 100 percent biodegradable made from plant-based oils and approved by Architect.

H. Joint Caps: All Construction, Expansion and Isolation Joints shall be topped with Vinylex Removable Cap Strip (Vinylex Corporation, www.vinylexwaterstop.com), or approved equal, and sealed with a polyurethane sealant.
   1. Joints between curbing and concrete walks shall require sealant.
   2. Remove joint cap prior to caulking joint.

I. Concrete sealer: Provide on all exterior concrete sidewalks and pavement. Provide a clear, exterior, water-based, 40% alkylalkoxysilane penetrating sealer providing protection against moisture intrusion, freeze/thaw cycles, and chloride intrusion. Sealer shall meet NCHRP 244 (Series II and IV), **<<ASTM C642>>** (48-hours: 0.42%; 50-Days: 1.2%), ASTM C672 (100 cycles and 0 scaling), and AASHTO T295 & T260. Application and Installation shall be per manufacturers recommendations.
   1. The application must be performed by a contractor with minimum 5-years' experience in application of specified product on projects of similar size and scope and acceptable to the product manufacturer.

J. Concrete Finishing Broom: Utilize brooms specifically used for concrete. 2.9" bristles.

PART 3 EXECUTION

3.01 PROTECTION AND RESTORATION

A. Concrete: Protect completed concrete from damage. Restore damaged concrete as directed by Owner's Representative or Architect.

3.02 SUBGRADE PREPARATION

A. Paved Areas: Section 312000 "Earthmoving" and as noted. Verify sub-grade elevations and compaction and correct discrepancies before proceeding with construction. Verify utility casting elevations and reset or adjust to meet flush with finished concrete surface. Remove loose material from sub-grade prior to gravel base placement.

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3.03 GRAVEL BASE PLACEMENT

A. Place and compact gravel base on prepared sub-grade to depth indicated. Remove debris from surface of gravel base prior to placement of concrete. Do not place gravel base material on frozen or muddy sub-grade.

3.04 FORMS

A. Clean and coat forms with form release compound, prior to use. Install forms to lines, grades and elevations indicated or as specified. Brace forms to prevent movement during concrete placement.

3.05 EXPANSION JOINTS

A. Install expansion joints at maximum 25-foot intervals or as indicated. Install expansion joints, adjacent to curbing, opposite curbing joints and as indicated. Place expansion joints perpendicular to concrete surface and with top edge 1/4-inch **<< 1/4 inch>>** below concrete surface.

3.06 ISOLATION JOINTS

A. Install isolation joints where concrete abuts buildings, existing walk sections, utility structures, and concrete curb. Place isolation joints with top edge 1/4-inch below concrete surface.

3.07 CONTRACTION JOINTS (SCORE LINES)

A. Sidewalks: Provide Contraction joints at five-foot intervals or as indicated on the drawings. Form Contraction joints with 3/4-inch jointing tool, tooled to 1/3 depth.

B. Concrete Paving: Joints shall be saw-cut.

3.08 CONCRETE PLACEMENT

A. Sample Approval: No concrete walks may be constructed until sample section has been inspected and approved by Owner's Representative.

B. General: Place concrete in forms in one uniform layer. Consolidate concrete by tamping, spading, or vibrating to prevent honeycombing. Place and consolidate concrete carefully to prevent dislocation of joint materials.

C. Placement of concrete for walking surfaces shall be in strict accordance with American's with Disabilities Act requirements, current edition. Sidewalks that are installed that do not comply with these requirements shall be removed and replaced at no additional cost to the Owner. The Contractor shall immediately bring any identified design deviations from the ADA standards to the attention of the Owner and Architect prior to installation.

1. Maximum cross slope of 2%
2. Maximum running slope of 5%
3. Maximum running slope for ramps 8.33% (maximum rise of 30", between landings)

3.09 FINISHING

A. General: Draw a fine hair concrete broom across concrete surface. Where longitudinal grade exceeds five percent, use a coarse texture finish by drawing a stiff bristle broom across concrete surface. Do not add water to finish. Do not wet broom to finish. After screeding and bull floating allow surface water to recede into concrete prior to any other work on the concrete surface.

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B. After concrete has cured, and with permission of Owner's representative, remove joint cap and provide joint filler (color to match concrete) that spans the expansion joint to prevent surface water from entering joint.

3.10 CURING

A. Apply curing compound in accordance with Manufacturer's recommendations.

3.11 CLEANING AND SEALING

A. All sidewalks shall be pressure washed prior to occupancy. Do not wash sidewalks within 28 days of installation. Pressure wash with a 15-25 degree fan nozzle, with a pressure of 2500-3000psi. Provide a mild detergent mix.

B. After sidewalks are completely dry, apply concrete sealer.

3.12 TESTING

A. General: Correct work not conforming to tolerances as directed by Owner's Representative or Architect, at no increase to Contract Sum.

B. Walk Horizontal Alignment Test: Tolerance not to exceed 1/2-inch between any two contacts on 10-foot straightedge, except along horizontal curves. Test locations random and determined by Owner's Representative or Architect. Test observation by Owner's Representative or Architect is required.

C. Walk Surface Smoothness Test: Tolerance not to exceed 3/8-inchbetween any two surface contacts on 10-foot straightedge. Test locations are random and determined by the Owner's Representative or the Architect. Test observation by the Owner's Representative or the Architect is required.

3.13 WASTE MANAGEMENT

A. Recycle waste materials in accordance with Section 017419 "Construction Waste Management and Disposal" requirements.

END OF SECTION 321600

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SECTION 321610
CONCRETE CURBING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 and Specification Sections apply to work in this section.

1.02 DESCRIPTION OF WORK

A. Section specifies materials and work required to construct Portland cement concrete curbing.

1.03 RELATED SECTIONS

A. Section 312000 "Earthmoving"

B. Section 321600 "Concrete Walks".

1.04 STANDARDS

A. Maryland Department of Transportation State Highway Administration's current "Standard Specifications for Construction and Materials".

B. Montgomery County, Department of Transportation's current "Design Standards".

1.05 SUBMITTALS

A. Submit cut sheets for construction of curb in public right-of-way to and obtain approval from governing jurisdiction and Architect prior to curb construction.

B. Contractor shall construct eight linear feet of typical concrete curb-and-gutter in the presence of the Owner's Representative, with a control joint. No additional concrete curbing may be constructed until sample is inspected and approved by the Owner's Representative.

1.06 PROJECT CONDITIONS

A. Traffic: Maintain vehicular and pedestrian traffic during curb construction operations.

B. Limitations:

1. Environmental: Refer to Section 331000 "Utility Standards".
2. Underground Utilities: Refer to Section 321600 "Concrete Walks".

1.07 CONSTRUCTION SURVEYS

A. Retain services of a Maryland Registered Land Surveyor to provide combined horizontal and vertical alignment stakes for curb construction within public right of way. Horizontal stake interval 25 feet maximum.

B. Provide combined horizontal and vertical alignment stakes for project site curb construction. Horizontal stake interval **<< 25 feet>>** maximum.

PART 2 PRODUCTS

2.01 MATERIALS

A. Concrete: MDOT-SHA Mix No. 6.

B. Joint Materials: Expansion and isolation joints: ASTM D 994, bituminous preformed joint filler, 1/2-inch thick.

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C. Forms: For straight or tangent curbing use steel or wood. For curved curbing use flexible spring steel or laminated wood.

D. Curing Material: Refer to Section 321600 "Concrete Walks".

E. Stone Base: Refer to Section 321600 "Concrete Walks".

PART 3 EXECUTION

3.01 PROTECTION AND RESTORATION

A. Refer to Section 321600 "Concrete Walks".

3.02 SUBGRADE PREPARATION

A. Refer to Section 321600 "Concrete Walks".

3.03 FORMS

A. Refer to Section 321600 "Concrete Walks", and as noted.

B. Form curbing to standards indicated and specified.

3.04 EXPANSION JOINTS

A. Refer to Section 321600 "Concrete Walks" and as noted.

B. Install expansion joints at maximum 25-foot intervals or as indicated. Place expansion joints perpendicular to surface and curbing face. Place combination curb and gutter expansion joints, with top edge 1/2-inch below gutter surface.

3.05 ISOLATION JOINTS

A. Refer to Section 321600 "Concrete Walks".

3.06 CONTRACTION JOINTS

A. Refer to Section 321600 "Concrete Walks" and as noted.

B. Provide Contraction joints, perpendicular to surface and face of curbing, at 10 foot intervals. Place Contraction joints at points where curved and tangent sections of curbing meet. Place Contraction joints with removable form spreader places. Contractor’s option: Score joints to 1-1/4 inch depth. Sawcut joints are not acceptable.

3.07 CONCRETE PLACEMENT

A. Refer to Section 321600 "Concrete Walks".

B. For Curbs that are directly adjacent to handicap accessible parking or walkways, the gutter pan shall meet slope requirements as outlined in 321600 "Concrete Walks", unless otherwise noted on the drawings.

3.08 FINISHING

A. Strike off top surfaces of curbing to top of forms and to smooth and uniform texture. Strip curb face forms when concrete takes initial set. Trowel curb face to smooth and uniform texture. Finish top surfaces and curb face to fine texture by drawing a soft bristle brush longitudinally along curb. Finish edges of curbing with edging tool having a radius as indicated. Maintain forms, except curb face forms, in place 12 hours after concrete placement. Correct defects (e.g., holes, honeycomb areas, broken edges, etc.) upon removal of remaining forms, with cement mortar. Finish contraction joints with 1/4-inch radius edging tool. Finish curbing joints to clean and true edges. Maintain curbing surfaces moist during finishing operations.

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B. Curing: Refer to Section 321600 "Concrete Walks".

C. Protection: Contractor shall protect concrete curbs from damage, effacing, etc. during construction. Contractor shall remove and replace any curb damaged, effaced and/or marred during construction at no additional cost to Owner.

END OF SECTION 321610

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SECTION 321800
ATHLETIC FIELD CONSTRUCTION

PART 1 GENERAL

1.01 DESCRIPTION

A. This technical provision is for the construction of new athletic fields: rectangular, circular and diamond.

1.02 REFERENCE STANDARDS

A. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).

B. ASTM F1632 - Standard Test Method for Particle Size Analysis and Sand Shape Grading of Golf Course Putting Green and Sports Field Rootzone Mixes.

C. ASTM F2396 - Standard Guide for Construction of High Performance Sand-Based Roozones for Athletic Fields.

D. Landscape Specification Guidelines, Landscape Contractors Association, MD, DC, and VA, Latest Version

E. Maryland's Lawn Fertilizer Law - Mda.maryland.gov/Pages/fertilizer.aspx

F. M-NCPPC Maryland-National Capital Park and Planning Commission.

G. Specification 329220 "Seeding and Sodding For Turfed Areas"

H. Specification 321800 "Athletic Field Construction"

I. Specification 312000 "Earthmoving"

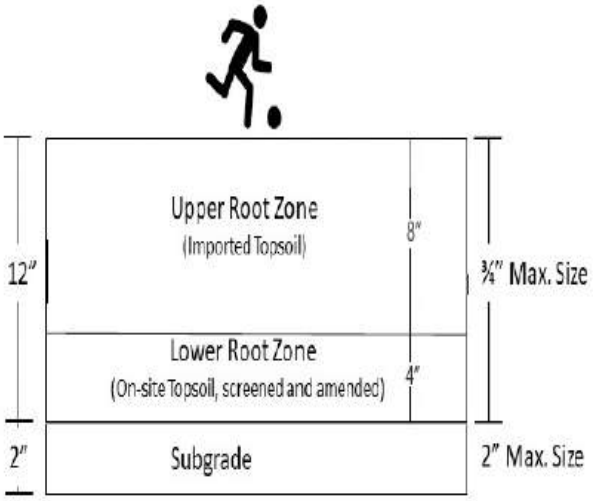
1.03 DEFINITIONS

A. Upper Root Zone is the top 8 inches of imported topsoil (3/4-inch maximum dia. debris)

B. Lower Root Zone is 4 inches of imported or mixed on site screened topsoil (3/4-inch maximum dia. debris)

C. Subgrade is the decompacted existing subsoil (2 inches maximum dia. Debris in top 2 inches; 12" decompact)

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1.04 MATERIALS

A. The sand shall meet the specifications per ASTM F2396 for sand type, particle size distribution and shape. The contractor shall supply independent testing to verify compliance with ASTM F2396. The sand shall be < 3mm particle size.

B. Soil amendments may be used to amend the soil to meet specified requirements. Soil amendments and rates of application are to be determined based on soil test results. Specific recommendations for the type of amendments can be found in the Landscape Specification Guidelines by the Landscape Contractors Association of MD, DC, and VA (most recent edition). All soil amendments must be tested whether the topsoil is made on site or imported pre-mixed.

C. Sulfur: Sulfur for adjustment of soil pH shall be an unadulterated flower of sulfur.

D. Lime: Ground or pulverized limestone, which contains a maximum of 50 percent total oxides. In addition, Solu-Cal can also be used to correct pH.

E. Compost:

1. Compost shall be made from yard trimmings, such as leaves, grass clippings and prunings that have been properly composted, and have been sieved through a 3/4-inch screen.
2. Compost shall be free of trash and contain no toxic substances harmful to plant growth.
3. Compost testing shall include a Solvita Compost Maturity Test on a fresh compost sample per testing instructions and have a CMI >6.0. The soluble salt contents shall be between 1-4 dS/m.
4. Compost should have between 35% and 50% organic matter, pH between 6.2 and 7.2, total organic carbon above 20%, carbon to nitrogen ratio between 12:1 and 20:1 and heavy metals within acceptable range. Compost testing will be performed on both compost brought to the site but also any used in pre-mixed soil.
    a. Fertilizer shall be uniform in composition, free flowing and suitable for application with approved equipment. Fertilizer analysis, recommendations and rate of application shall be determined based on soil test results by a certified Maryland Fertilizer Applicator. All fertilization shall meet Maryland's Lawn Fertilizer Law.

F. Upper Rootzone

1. The upper rootzone shall be imported topsoil that is uniform in color and texture. It must be fully mixed and prepared offsite and meet the following:

TEST PROPERTY	TEST VALUE AND AMENDMENT			
Prohibited Weeds	Free of plants or plant parts of Bermuda grass, Quack grass, Johnson grass, Nutsedge, Poison Ivy, Phragmites, Cattail, Reed Canary Grass, Canada thistle, or any noxious weeds.			
Debris	Soil shall be free of cinders, stones, slag, coarse fragments, gravel, sticks, trash, roots, and other debris over 3/4-inch.			
Grading Analysis	Sieve Size			Passing by Weight Minimum %
	3/4-inch			100
	No. 4			90
	No. 10			80
Textural Analysis	Particle		% Passing by Weight	
	Size	mm	Minimum	Maximum
	Sand	2.0 – 0.050	62	75
	Silt	0.050 – 0.002	10	25
	Clay	less than 0.002	10	18
Soil pH	Shall be based on the specific plant requirements but will be within the range of 6.0-6.5.			
Organic Matter	Shall be between 3-6%			
Nutrient Content	The acceptable amount of Magnesium shall be 17.5 ppm; Phosphorous shall be 50 ppm; and Potassium shall be 42.5 ppm.			
Soluble Salts	Soluble salts shall not exceed four (4) mmhos/cm, Calcium levels shall not exceed 2,000 parts per million.			
Harmful Materials	The soil shall contain no substances harmful to plant growth.			

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G. Lower Root Zone

1. The lower rootzone shall be uniform in color and texture and must meet the same requirements of the Upper Rootzone. It can be the same imported material as the upper root zone or be created by on site mixing of amendments into existing soil.

H. Turf seed must meet requirements of Section 329220 Seeding and Sodding for Turf Areas.

I. Packaged materials will be delivered in manufacturer's unopened container or bundles; they will be identified with name, brand, type, weight, and analysis. Packaged materials will be stored in a manner that will prevent damage or intrusion of foreign matter. Any material that becomes contaminated will be removed from the job site and replaced.

J. Organic amendments shall not be delivered or installed excessively wet or frozen.

K. Delivery location, stockpile locations and schedule will be coordinated with the Owner prior to delivery. Soils will be protected from eroding while stockpiled on site.

L. Equipment: Any specialized grading and deep ripping equipment shall be designed to minimize compaction of prepared subgrade and athletic field soil mix. Vehicle weight should not exceed 19,000 lbs. All equipment will be approved by the Owner prior to bringing to the site.
   1. The grader must be equipped with dual laser pickup, dual laser grade range mode, and the laser pickup shall operate the blade elevation controls automatically once they are locked on the laser beam. Each of the two laser pickups will operate only one end of the grader blade respectively. The laser source shall be capable of accuracy to two places of a percent (i.e., 1.23% of grade) and shall be capable of operating either the positive or negative angle of configuration without physically moving the laser source head.
   2. The deep ripping equipment shall have mounted metal tines spaced approximately one (1) foot apart and extending to a minimum depth of twelve (12) inches and shall be used to deconsolidate the soil.

M. Water: Potable water from fresh water sources, free of injurious chemicals and other toxic substances harmful to plant life.

N. Skinned Infield: Material free of any stones greater than 1/4-inch, in general conformance with ASTM F2107, and conforming to the following:
   1. Sieve Analysis:

Size	Percent Passing
#4	100.0
#10	89.5
#20	85.9
#40	79.6
#60	64.2
#100	45.2
#200	38.4

   2. It shall contain no organic matter and meet the following mechanical analysis:

Soil Type	Soil Size	Percent Passing
Sand	2.0 mm - 0.05 mm	62% - 75%
Silt	0.05 mm - 0.002 mm	10% - 25%
Clay	Less than 0.002 mm	10% - 18%

   3. Skinned infield mix shall be selected from the following manufacturers:
      a. Martin Marietta –Infield Mix
   4. New Enterprise Stone & Lime Co., Inc. – Original Diamond-Tex
      a. Turface Athletics – Turface SAF Diamond Mix
   5. Calcined Clay: Approved material from the following manufacturers:
      a. Diamond Pro – Diamond Pro® Infield Conditioner
      b. Pro's Choice – Soilmaster®
      c. Turface Athletics – Turface MVP
   6. Mound and Home Plate Clays: Approved material from the following manufacturers:
      a. Diamong Pro – Diamond Pro Home Plat Clay
      b. Stabilizer Solutions – Hilltopper Mound Clay
      c. Turface Athletics – Mound & Plate All-Purpose Packing Clay

O. Warning Track: Stone dust, washed, grading size 10 per AASHTO M 43, in general conformance with ASTM F2270.

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1.05 SUBMITTALS

A. Contractor shall supply specified information in Quality Assurance article above.

B. The Contractor must also submit the following information:
   1. Manufacturers and/or source data for all materials including soils.
   2. State of Maryland licenses for Certified Fertilizer Applicators and Certified Pesticide Applicators for personnel performing that work.
   3. Certified mechanical, and chemical analysis of samples of onsite and imported topsoil, sand, soil amendments and organic compost materials used in making the rootzone.
   4. Final Rootzone sample and soil tests.
      a. Submit nutrient management plan (fertilizer and pH adjustments) for acceptance. This plan shall be based on the results of the soil testing and meeting the required soil parameters. The soil tests and nutrient management plan must be reviewed and approved by a certified Maryland Fertilizer Applicator. This management plan shall be for both the initial soil preparation and all subsequent fertilization/pH adjustment during the maintenance period.

C. Submit schedules for watering, mowing, and Integrated Pest Management (IPM).

D. Submit a list of equipment anticipated for soil work, unloading materials, handling and installation and maintenance without over compacting the field. In addition, equipment for watering and mowing must be submitted based upon requirements for the Work and actual, in-site soils conditions observed after topsoil removal.

E. Submit soil tests for all soil to be obtained from both on-site, off-site, and soil mixes for acceptance. Obtain one soil test for each soil source per 300 cubic yards of soil. Allow a minimum of four weeks for independent testing by the Owner as required by the Owner.

F. Submit seed manufacturer's certificate of purity and guarantees of germination in accordance. Seed must be Maryland Certified Seed. Maryland Certified Seed tag must be present on the bags when brought to the site. The tags will be provided when the seed is placed.

G. Samples provided by the Contractor shall be typical of material to be delivered to the site and shall provide an accurate indication of color, texture, and the organic make-up of the material. Submit three-pound samples of the following, as relevant:
   1. Organic compost material
   2. Sand
   3. Imported Upper Rootzone Material

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1.06 QUALITY ASSURANCE

A. The Contractor or subcontractor must supply evidence of having successfully completed construction or reconstruction of a minimum of ten (10) fields in the last three (3) years are to that meet National Collegiate Athletic Association (NCAA) requirements, or alternatively shall be a Certified Sports Field Manager (CSFM) from the Sport Turf Manager's Association (STMA). All personnel performing fertilization and pesticide application work shall be Certified Fertilizer Applicators or Certified Pesticide Applicators by the State of Maryland.

B. The Contractor must also supply evidence of having maintained the degree of accuracy as indicated in this specification and in the Commission's excavation, filling and grading specifications.

C. The Contractor must supply a list of three (3) references for work done in the last three (3) years. Photographs of completed field should also be submitted.

D. If construction of a Bermuda field is required as part of the project, the Contractor must provide a reference and photographs of at least two (2) Bermuda fields completed.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONSTRUCTION

A. Commencement
   1. The Contractor shall notify the Owner at least ten (10) calendar days prior to each stage of field construction. The areas and conditions where the fields are to be installed will be examined, and the Contractor will notify of conditions detrimental to proper and timely completion of work. Work will not proceed until unsatisfactory conditions are corrected to allow proper installation of work.
   2. Determine location of all underground utilities prior to soil work. Existing utilities, paving, vegetation, and other facilities will be protected from damage caused by soil installation operations. All damaged areas, facilities and materials shall be restored, repaired or replaced as directed by the Owner at the Contractor's expense.
      a. Commencement of work will not begin until all submittals have been approved. This includes but is not limited to soil testing results and recommendations.

B. Working Conditions: All work on the athletic fields including excavation to subgrade, root zone placement, deconsolidation, and amendment operations shall be performed when soil moisture and weather conditions are suitable and shall cease when conditions are unsuitable as directed by the Owner.

C. Subgrade
   1. Perform excavation and grading to establish the subgrade elevation, which shall be twelve (12) inches lower than final grade, unless construction documents specify a different depth. All surface elevations shall be laser graded and uniform, smooth, and free from irregular surfaces.
   2. Deconsolidation of Subgrade.
      a. The compaction of the top six (6) inches of subgrade shall not exceed 90%. If the subgrade is compacted fill or the native soil exceeds 90%, deconsolidation must be performed. The minimum compaction should be 85% and may require rolling to obtain uniform compaction.
   3. Deep ripping equipment: The soil should be ripped making a minimum of three (3) passes in one direction and three (3) additional passes in an approximately perpendicular direction to ensure soil is thoroughly mixed and friable.
   4. Deep ripping of the sub-soil shall take place under suitable soil moisture conditions, and strict care must be taken to avoid re-compaction of the newly ripped soil. Appropriate soil moisture condition of the ripped soil can be identified by rolling the soil (at different depths where the ripping will occur) between hands. If a long ribbon (4 inches) forms easily, then the soil is too moist. If no ribbon can be formed, or if the soil is too hard to reform, then the soil is too dry.
   5. If the soil fails to deconsolidate in the manner desired for subsequent work, additional passes and/or other measures may be required as directed by the Owner.
   6. Debris Removal: After deconsolidation, the contractor shall remove stones and debris larger than 2 inches from the top two inches of subgrade using a combination of equipment and manual means.
   7. Testing/Approval: The Contractor shall provide sufficient notice to avoid undue delay in the continuation of work. The subgrade shall be inspected and approved by the Owner for proper elevation, compaction and disking and debris removal prior to placement of topsoil.

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The contractor shall provide sufficient notice to avoid undue delay in the continuation of work.

8. Contractor's third-party surveyor shall perform independent subgrade survey and submit an electronic file in PDF and CAD versions a 3D surface and 0.5' contours to confirm compliance with contract specifications; spot elevations shall be shown and labelled.
9. Finished Subgrade: Following subgrade survey, correct any observed or suspected high and low points after checking by using a ten (10) foot straight edge. The tolerance will be 1/2-inch or less in 25 feet in any direction on a 20-foot grid. Any detectable high or low points must be remedied.
10. Compaction: The contractor shall secure the services of an independent testing agency using nuclear density testing to verify that the compaction levels are between 85 - 90%. The testing shall be performed at a minimum of ten locations, to be determined by the Owner. If the compaction levels exceed 90%, retesting must occur after deconsolidation work has been performed.
11. The subgrade must meet all requirements as stated and no further work can continue without written permission by the Owner.

D. Lower Rootzone

1. Lower Rootzone shall be placed and spread over the deconsolidated subgrade. The subgrade shall remain deconsolidated and pitched relating to the final grade throughout the placing of soil to ensure the field drainage as designed.
2. The soil will be placed in two lifts. The first lift is 2 inch depth placed on the subgrade. The top 2 inches of subgrade and 2 inches of lower rootzone soil will be mixed using a tiller to achieve a homogeneous mixture. After mixing, the next 2 inches of soil can be placed.
3. Use box blade or other appropriate mechanical attachments specifically designed to properly compact individual topsoil lifts in the manner described above. Compaction should be to a maximum dry density of 85% and a minimum of 80%.
4. The Lower Rootzone must meet all requirements as stated and no further work can continue without written permission by Owner.

3.02 UPPER ROOTZONE

A. Upper rootzone shall be placed and spread over the lower root zone to achieve a depth of eight (8) inches or as specified in the contract documents. It is important that the lower rootzone remains deconsolidated and pitched relating to the final grade throughout the placing of the soil to ensure the field drainage as designed.

   a. The soil will be placed in multiple lifts. The first lift is 2 inch depth placed on the lower root zone. The top 2 inches of upper root zone and 2 inches of lower rootzone soil will be mixed using a tiller to achieve a homogeneous texture. After mixing, the next layer of soil can be placed.

B. Use box blade or other appropriate mechanical attachments specifically designed to properly compact individual topsoil lifts in the manner described above. Compaction should be to a maximum dry density of 85% and a minimum of 80%. The contractor shall secure the services of an independent testing agency using nuclear density testing to verify that the compaction levels are between 80 - 85%. The testing shall be performed at a minimum of ten locations, to be determined by the Owner. If the compaction levels exceed 85%, retesting must occur after deconsolidation work has been performed.

C. The contractor shall employ a third-party surveyor to perform independent, final grading survey to confirm conformance to contract specifications. The contractor shall perform an as-built survey based on a 10 foot grid or in random locations as requested by the Owner, who should be notified in advance and present when the survey is performed. Any observed or suspected high and low points shall be checked using a 10 foot straight edge. If deemed necessary by the

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Owner, additional survey information may be required for final grading approval. The Contractor shall submit an electronic file in both PDF and CAD versions with a three-dimensional surface and 0.5' contours to confirm compliance with contract specifications. Spot elevations shall be shown and labelled.

D. Grading Tolerance: The playing surface shall be graded to a general tolerance of 1/4-inch. The finished elevation tolerances shall be 1/4-inch for every 10 feet of linear direction.

E. Remedy for Low Points: Contractor is responsible for providing extra root zone mix to fill in any low spots at no additional cost to the Owner.

F. Remedy for over-compaction: Care must be taken not to over-compact any of the soil layers. Should over-compacting occur, the Contractor shall be required to de-compact the soil by loosening through tilling or other means and re-compacting to specified limits, at no additional cost to the Owner.

   a. For rectangular fields, field soil density tests to prevent compaction are required, a minimum of ten (10) over the field area as designated by the Owner are required to certify that the soil is not over-compacted and meets the requirements of this specification.

   b. For diamonds, a total of nine (9) field soil density tests over grass area for a skimmed infield and a total of fourteen (14) for diamonds with grass infield. Soils shall not be tilled or amended when the soil's moisture level is above field capacity or when soil is frozen.

G. Soil Testing: A minimum of five (5) in-situ soil test sites over the athletic field soil area shall be performed and Soil amendments shall be added to ensure proper limits for Magnesium, Phosphorus, Potassium, Calcium, Nitrogen, Soluble salts, Sulfur, Lime, and soil pH. Analysis and rate of application shall be determined based on soil test results conducted by a state laboratory or recognized commercial laboratory before seeding begins. The Contractor's certified nutrient management specialist should provide nutrient recommendations that reflect the Maryland's Lawn Fertilizer Law. All recommendations shall be approved by the Owner.

H. Turf establishment shall not begin until all conditions are met for the Upper Rootzone. Written permission is required from the Owner.

I. Seeding shall conform to Section 329220 Seeding and Sodding for Turf Areas. The Contractor shall be responsible to have adequate water available at the site prior to and during installation of seed, unless otherwise stated, and shall ensure and take proper care during seed installation not to cause over-compaction of underlying soils, i.e.: only low impact equipment permitted on the field after upper rootzone mix is in place.

J. No temporary seed will be placed on the graded field unless otherwise directed by the Owner unless required to comply with MDE Erosion and Sediment Control Standards. Straw mulch shall not be used on the athletic field soil.

K. Watering: During and after seed germination, regular watering must be performed. Submit a watering schedule for approval by the Owner. See Section 329220 Seeding and Sodding for Turf Areas on watering requirements. During the first 2-3 weeks (dependent on seed germination), the seed shall be kept moist to allow for germination.

L. Any additional seeding or sodding on the field that is recommended by the Owner will be provided at no cost to the Owner. The Contractor is responsible for providing extra topsoil and sand mix to fill in any low spots and establish turf at no cost to the Owner. The Contractor is also responsible for repair of any damaged areas due to changes or adjustments to the irrigation heads.

M. Mowing: Submit a mowing schedule for approval by the Owner. Changes can be made with the approval of the Owner. Mowing height should be determined based on best practices for a

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particular species and variety. At no time, should more than 1/3 of the grass leaf be removed at one time. In general, during the growing season, cool season grass should be kept between 2.5 to 3.0 inch height and warm season grasses at 0.75 to 1.25 inch height.

N. Acceptance: The field will only be accepted once the entire surface has 95% grass coverage. The field shall be level with no high or low spots and graded as shown in the construction documents. In addition, no rocks greater than 3/4-inch diameter may be in the 12 inch root zone. The grass must be free of any weeds.

O. Maintenance and Grow-In Period: After the field grass is growing and being maintained by the Contractor to provide proper growth and vigor, the Owner will perform a final inspection and once accepted, the Contractor will be responsible for maintenance of the fields for a minimum period of 18 weeks during growing season. During this 18-week period, regular aftercare maintenance must be performed by the Contractor on the field which will include but not be limited to regular mowing, IPM program and watering. The Contractor is responsible for providing extra topsoil meeting the original root zone requirements or top-dressing sand, as approved by the Owner, to fill in any low spots and reseed these areas at no additional cost to the Owner.

P. Skinned Infield

1. Once finish grades of the field are established, determine and mark the arc of the infield. This is to be done based on the placement location of the new home plate and pitching rubber location.
2. Using lightweight equipment, excavate infield to a depth of 2 inches. Excavated materials shall be utilized elsewhere on site as approved by the testing agency or removed from the site and disposed of by the contractor at no additional cost.
3. Excavated infield is then to be loosened by means using lightweight equipment mounted with a power rake another 2 inches for a total depth of 4 inches total. Resulting rocks and debris 1/2-inch diameter and greater are to be removed and disposed of off-site.
4. The “lip” area (the edge between the dirt and the grass) shall be installed in such a manner as to create a smooth transition between the skinned infield and the outfield grass. If the “lip” is unsatisfactory, this may entail removing up to 6 feet of sod, re-grading the “lip” area and replacing the sod with MD certified tall fescue and shall be at no additional cost to the owner.
5. Install new infield mix material 2-1/2 inches thick minimum.
6. The infield shall be laser graded at slopes shown on the plans.
7. Install 3-tons of calcined clay. This is to be mixed into the top 1-1/2 inches\ **<< 1-1/2 inches>>**.
8. The infield shall then be rolled tight with a 3-ton static roller.
9. The wear areas at the pitcher’s mound and the home plate area are to be constructed with special clays. They are to be a minimum of 4-inch thick, if using loose bagged material and 2-1/2 inch thick if using formed clay bricks.
10. A 1/4-inch final light top dressing of calcined clay is to be applied to infield and then rolled tight with a 3-ton static roller.

Q. WARNING TRACK

1. On prepared subgrade, install French Drain Subsurface Drainage.
2. Install geotextile to prevent future weed migration.
3. Install drainage course in 2 inch lifts and compact to 85 percent of the maximum dry unit weight according to **<<ASTM D698>>**.

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4. Install Warning Track material in 2 inch lifts and compact each to 85 percent of the maximum dry unity weight according to **<<ASTM D698>>**.

END OF SECTION 321800

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SECTION 321813
SYNTHETIC GRASS SURFACING

PART 1 GENERAL

1.01 SUMMARY

A. This section includes the synthetic turf playing field surfacing and associated components, including, but not limited to the following
   1. Earthwork and Compaction
   2. Geotextile Fabric
   3. Drainage Piping
   4. Cleanouts
   5. Gravel Drainage Layer
   6. Infilled Synthetic Turf for Playing Fields
   7. Turf Edge Curbs and Fasteners
   8. Sports Equipment Installation

1.02 REFERENCE STANDARDS

A. ASTM D1335 - Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings.

B. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials.

C. ASTM D5034 - Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test).

D. ASTM D5823 - Standard Test Method for Tuft Height of Pile Floor Coverings.

E. ISO 9000 - Quality Management Systems -- Fundamentals and Vocabulary.

F. ISO 14001 - Environmental Management Systems — Requirements with Guidance for Use.

G. ISO/IEC 17025 - General Requirements for the Competence of Testing and Calibration Laboratories.

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1.03 SCOPE OF WORK

A. Work included in this Section shall involve the furnishing of all the necessary design plans in accordance with these specifications, local and state permits, skilled labor, materials, aggregate material testing, and all the equipment necessary for the conversion of an existing natural turf playing field to a complete, new, vertically draining, infilled synthetic turf playing field system. The Scope of Work shall include, but is not specifically limited to, the following:
   1. The Owner will be fully responsible for providing all the necessary professional land surveying boundary and topographic scope of services prior to commencement with any design scope of services. Construction stakeout is to be provided by the Contractor.
   2. The Owner shall retain a professional geotechnical engineering firm to conduct a minimum of 5 soil borings within the area of the new synthetic turf playing field.
   3. The Owner shall be responsible for all fees at the time of permitting review submission.
   4. The Contractor shall provide a full set of construction design documents prepared by a Maryland licensed professional engineer specializing in fully functional infilled synthetic turf athletic playing field conversion systems.
   5. Demolition and haul-off of the existing turf surface and subgrade preparation to meet tolerances described herein.

6. Construct the drainage profiles in accordance with the approved design required for positive drainage.
7. Modification of existing drainage structures to accommodate the new drainage discharge configuration.
8. Review and certification of previous work performed by others (if demolition and subgrade preparation is not provided by this Contractor), specifically related to the work indicated in this section.
9. Provision for compaction of subgrade.
10. Installation of the subgrade drainage collection system.
11. Installation of the granular base layer to meet tolerances described herein.
12. Installation of sports equipment as required per sport.
13. Installation of the infilled synthetic turf system.
14. Installation of all inlaid or tufted lines, logos, and borders.
15. Provision of samples per specifications.
16. Provision of extra turf materials for future repairs.
17. Provide maintenance training, equipment, and repair manuals as well as warranty package per the specifications.
18. Provide preventative maintenance grooming during two (2) scheduled on-site visits each year of the warranty period.
19. Provide annual playing surface performance testing as delineated in Section 1.8 Quality Control
20. All material testing indicated herein shall be paid for by the Contractor.

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1.04 REFERENCES

A. Comply with applicable requirements of the following Standards:
   1. American Society of Testing and Materials (ASTM):
      a. D 1577 – Linear Density of Textile Fibers
      b. D 2256 – Tensile Properties of Yarns by the Single-Strand Method
      c. D 5034 – Breaking Strength and Elongation of Textile Fabrics
      d. D 5823 – Tuft Height of Pile Floor Coverings
      e. D 5848 – Mass per Unit Area of Pile Yarn Floor Coverings
      f. D 5793 – Binding Sites per Unit Length or Width of Pile Yarn Floor Coverings
      g. D 1335 – Tuft Bind of Pile Yarn Floor Coverings
      h. D 2859-06 – Ignition Characteristics of Finished Textile Floor Covering Materials
      i. D 4632 – Grab Breaking Load and Elongation of Geotextiles
      j. D 4533 – Trapezoid Tearing Strength of Geotextiles
      k. D 4491 – Water Permeability of Geotextiles by Permittivity
      l. D 6241 – Static Puncture Strength of Geotextiles
      m. D 6928 – Resistance of Coarse Aggregates to Degradation (Micro-Deval)
      n. F 355 – Impact Attenuation of Playing Surface Systems
      o. F 1015-03 – Relative Abrasiveness of Synthetic Turf Playing Surfaces

1.05 SYSTEM DESCRIPTION

A. General: Synthetic Turf Surfacing System shall be comprised of a subsurface drainage system, aggregate drainage base layer, containment curb with perimeter nailer to secure turf, and synthetic grass with infill material.

1. Components are to include, but are not limited to:
    a. Earthwork Requirements:
        1) Excavation, trenching, grading, filling, backfilling, compaction.
        2) Graded and compacted subgrade
        3) Disposal of spoil materials.
    b. Subdrainage System:
        1) Geotextile Fabric.
        2) Gravel drainage aggregate material.
        3) Lateral drain pipe (if indicated), collector pipe, and watertight connections.
    c. Aggregate Drainage Base Layer: Aggregate drainage base installed over geotextile fabric and flat panel drains (if indicated). Thickness of base layer to be as per plan details, compacted over properly prepared subgrade.
    d. Perimeter Turf Fastener:
        1) Pressure treated wood or a composite/synthetic wood 2” x 4” nailers.
        2) Fasten as necessary to concrete curb, foundation or structural elements, per Construction Documents.
    e. Infilled Synthetic Turf

B. Performance: Synthetic turf playing field system shall comply with the following performance criteria:
    1. Initial GMax (ASTM F 355): Shall not exceed 135 G’s, nor be less than 90 G’s when tested in accordance with ASTM Test Method F-1936
        a. GMax shall not change more than 10% at any one location through the end of the warranty period.
        b. At no time in the life of the warranty period shall the GMax exceed 165 G’s.
    2. Percolation (ASTM F 2898):
        a. Gravel Drainage Aggregate Layer: 150 inches per hour minimum.
        b. Finished Topping Stone Aggregate Layer: 50 inches per hour minimum.
        c. Finished Playing Field Surface with Infill: 12 inches per hour minimum.

1.06 SUBMITTALS REQUIRED WITH BID

A. Design-Build Synthetic Turf Surfacing System Contractor Qualifications:
    1. The Contractor shall provide a written document describing its history and experience with this particular type of design-build project. Provide the number of years of experience and number of similar projects.
    2. The Contractor shall provide a list of any current or past legal actions including, but is not specifically limited to, litigation or mediation over the last 10 years for any portion of the system failures, and or workmanship.
    3. The Contractor shall provide proof of a Certified Field Builder designation from the American Sports Builders Association (ASBA) as a direct employee to be qualified for this project.
    4. The Contractor shall provide proof of a licensed Professional Engineer on staff, and confirmation the employee is licensed and in good standing in the jurisdiction of the project location, to be qualified for this project.
    5. Provide field locations, client contact (name, address, phone number), type of synthetic turf product installed, date of installation, and general contractor (if used) for a minimum of 10 competition synthetic turf football, lacrosse, or soccer installations in the last 3 years.

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6. The Contractor shall provide resumes and certifications for all staff to be assigned to the project.
7. The Contractor shall provide a list of sub-contractors to be under the direct responsibility of the Contractor in association with the construction of this project.

B. Product Samples:
1. Synthetic Turf: one (1) 12” X 12” loose sample of the turf with perforated backing intact. Include third party test reports.
2. Synthetic Turf and Infill: Provide one (1) sample of turf system material in an 11-inch x 7-inch containerized condition resembling the installed condition as closely as possible.
3. Infill Mixture: One (1) pound (bag) of each proposed infill material. Include toxic analysis from a third-party testing laboratory.

C. Project Schedule: Provide a work schedule for all work described in these documents. The schedule is to be updated and submitted as progress continues through the completion of the project.

D. Schematic Design Documents and 3D Renderings: Provide Schematic Design Documents and 3D renderings that detail the visual design intent and proposed facility improvements. 2D Renderings will not be acceptable.

E. Sample Warranty: Provide a copy of its pre-paid 3rd party insurance policy. This policy must have an annual aggregate amount of no less than $60 million, and a per incident limit of no less than $7 million per claim. The third-party insurer must have an AM Best rating of A++ or better.

1.07 SUBMITTALS REQUIRED AFTER NOTICE TO PROCEED

A. Design Documents: During the design phase, the following submittals are required to be submitted for review and approval by Owner and local permitting authorities prior to proceeding to the next phase of design.
1. 60% Construction Documents
2. 100% Construction Documents
3. Shop Drawings: Field layouts / striping plans, including all field line dimensions, markings, and colors. Logos, end zone letters, and any other graphics to be included on the field.

B. Product Data: Provide complete product data and test reports for each product option proposed. Test reports at a minimum shall include the following:
1. ASTM D-5848 – pile height, tuft spacing, face weight, and total weight
2. **<<ASTM D1335>>** – tuft Bind
3. **<<ASTM D5034>>** – grab tear breaking strength
4. **<<ASTM D2859>>** – flammability (pill test)
5. ASTM F-1551 – water permeability

C. Synthetic Turf Product Pre-Shipment Test Data: Provide to the Owner certified copies of the pre-shipment test results delineated in paragraph 1.8 Quality Control. All tests shall be certified by an independent (third-party) testing laboratory experienced with the testing of synthetic turf. The qualifications of the testing laboratory to be utilized for the submittal and pre-shipment testing shall be submitted to the Owner for approval. Rolls with samples that do not gain approval shall not be shipped.

D. Compaction Test Data: Provide to the Owner certified copies of the Compaction test results delineated in paragraph 1.8 Quality Control.

E. Drainage and Finishing Topping Gravel Aggregate Test Data: Provide to the Owner certified copies of the Drainage and Finishing Topping Gravel Aggregate test results delineated in

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paragraph 1.8 Quality Control. Gravel test results shall be approved by the Owner prior to the delivery of material to the site.

F. Grade Verification Surveys: Submit to the Owner grade verification surveys as delineated in paragraph 1.8 Quality Control. Grade verification surveys shall be approved by the Owner prior to proceeding to the next phase of construction.

G. Gravel Layer Percolation Test Data: Provide to the Owner certified copies of percolation test results delineated in paragraph 1.8 Quality Control.

H. Proof of Positive Drainage: Provide to the Owner copies of the surveys as delineated in paragraph 1.8 Quality Control.

I. Finished Playing Field Test Data: Provide to the Owner certified copies of Finished Playing Field Test results as delineated in paragraph 1.8 Quality Control.

J. Project Warranty: Provide to the Owner copies of Owner & Maintenance Manual, Warranty, and other required items as delineated in paragraph 1.9 Warranty.

1.08 QUALITY ASSURANCE

A. Synthetic Turf Surfacing System Contractor Qualifications: The Contractor chosen to perform the work described in this Specification shall comply with the following:
   1. The Contractor shall provide proof of a Certified Field Builder designation from the American Sports Builders Association (ASBA) on staff.
   2. The Contractor shall provide proof of a licensed Professional Engineer on staff, and confirmation the employee is licensed and in good standing in the jurisdiction of the project location.
   3. Provide field locations, client contact (name, address, phone number), type of synthetic turf product installed, date of installation, and general contractor (if used) for a minimum of 10 competition synthetic turf football, lacrosse, or soccer installations in the last 3 years.

B. Synthetic Turf Manufacturer - defined as:
   1. A company specializing in the design and manufacturing of infilled turf systems with not less than ten (10) years documented experience.
   2. The Synthetic Turf Manufacturer must have been in business under the same ownership for at least ten (10) years, and shall have been installing similar sports fields for that entire period.
   3. Manufacturer shall have an experienced technical services professional who is available during the course of the work to meet with the Owner and/or Design Professional.

C. Synthetic Turf Manufacturer’s Experience Requirements:
   1. The Synthetic Turf Manufacturer shall have the experience of at least one hundred (100) acceptable installations of full-size fields (minimum 65,000 sq. ft.) in the United States within the past twelve (12) months of tufted, polyethylene grass-like fabrics with infill. Submit a list of all applicable installations with the bid. The Synthetic Turf Manufacturer shall have the experience of one hundred (100) acceptable installations (minimum 65,000 sq. ft.) of fields that are at least eight (8) years old. Submit a list of all applicable installations with the bid.
   2. The Synthetic Turf Manufacturer shall have the experience of fifty (50) acceptable installations of the specific fiber system specified. Submit a list of all applicable installations with the bid.
   3. The Synthetic Turf Manufacturer must be a certified member of the Synthetic Turf Council in good standing.
   4. The Synthetic Turf Manufacturer must have and operate its own extensive research and development laboratory. This laboratory must include testing devices for the following

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tests: Yarn Tensile Strength, Yarn Elongation, Tuft Bind, Grab Tear Strength, Seam Strength, g- max, Force Reduction, Vertical Deformation, Ball Roll, Ball Rebound, Rotational Resistance, Linear Traction, Relative Abrasive Index, UV Resistance, Flammability, and Simulated Aging.

5. Manufacturer must have an ISO 17025 Accredited Laboratory in place at the time of manufacturing to verify product standards and quality. Manufactures without an ISO 17025 Accredited Laboratory will not be accepted.
6. Testing of the synthetic turf system is mandatory and must be provided from a laboratory that is accredited by the NVLAP. Testing from laboratories that are not NVLAP accredited will not be accepted. The National Institute of Standards and Technology (NIST) is part of the U.S. Department of Commerce and administers the National Voluntary Laboratory Accreditation Program (NVLAP). Accreditation requirements are established in accordance with the U.S. Code of Federal Regulations (CFR, Title 15, Part 285), National Voluntary Laboratory Accreditation Program, and encompass the requirements of **<<ISO/IEC 17025>>**.
7. The Synthetic Turf Manufacturer must have manufactured and installed fields at every level of competition, including high school, college and professional.
8. The Synthetic Turf Manufacturer must have at least five (5) NCAA Division 1 fields, (2) NFL game fields and two (2) MLB fields currently installed.
9. The Synthetic Turf Manufacturer must not have had more than (5) five fields replaced, under warranty, during the past five (5) years.
10. The Synthetic Turf Manufacturer must be vertically integrated including in-house tufting, polyethylene monofilament extrusion, in-house coating, polyurethane compounding, manufacture own primary backing, in-house yarn texturizing, ability and flexibility to tuft various gauge widths and have the ability to recycle used/old fields.
11. The Synthetic Turf Manufacturer must have a fully integrated quality system, directly based on and compliant with **<<ISO 9000>>**, **<<ISO 14001>>** and OHSAS 18001 international standards.
12. The Synthetic Turf System Vendor shall have the capability to remove, reclaim and recycle the synthetic turf system at the end of its useful life.
13. The Synthetic Turf System Vendor must provide documentation outlining their product lifetime recycle / reuse program that is currently in place. A minimum of 5 fields must have been used in this process. All material must demonstrate the capability to reuse in a product that employs a cradle-to-cradle design. Reuse or other diversion plans that do not include production of a new and useful product will not be considered.
14. The Synthetic Turf Manufacturer must have the ability, under certain color number limitations, to tuft in logos, watermarks, lines, hashmarks and other designs into the body of the field, end zones, sidelines or D zones.
15. Synthetic turf system shall comply with all EPA, CSPC, and all other relevant regulatory agency requirements.

D. The Contractor shall be responsible for the protection of the synthetic turf playing field system through Substantial Completion. Damages caused by construction activities shall be immediately corrected at no additional cost to the Owner.

E. Grade Control System: Grading of both the final subgrade and the aggregate drainage base shall be performed with equipment utilizing a Universal Total Station (UTS) 3D grade control system. GPS or 2D grade control systems will not be acceptable.

1.09 QUALITY CONTROL

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A. Subgrade Compaction Testing: Modified Proctor (ASTM D 1557). Compaction testing shall be performed to determine the compacted density of the fill materials. Testing regimen to be as recommended by Owner's geotechnical testing agent.
   1. Number of Tests: A minimum of 9 locations representative of the entire playing field area per vertical lift.
   2. Failings: If, based on the testing and observation agency reports and observations, compacted subgrade or fills are found to be below specified density, provide additional compaction and testing in accordance with specifications.

B. Synthetic Turf Pre-Shipment Requirements: Prior to shipment of the synthetic turf materials to the job site, a 7' x 11" sample from every fifth roll shall be randomly sampled and tested by an independent testing laboratory experienced with testing synthetic turf materials. The testing laboratory shall be completely independent with no ties to the turf manufacturer. The testing shall include the following:
   1. Pile composition and denier
   2. Pile weight
   3. Total Weight
   4. Pile height
   5. Primary & Secondary backing weight
   6. Permeability
   7. Tuft bind (without infill)
   8. Grab/tear strength (length/width)

C. Gravel Drainage and Finishing Topping Gravel Test Data: The gravel drainage material shall be submitted to and approved by a qualified third-party independent testing laboratory for conformance to the specifications. All costs associated with the testing of gravel materials shall be borne by the Contractor.
   1. Phase I Testing: Prior to Construction, submit a one-gallon sample of each type of gravel for testing to establish baseline specification for the remainder of the construction process. A sample is to be tested for:
      a. Gradation – ASTM C 136
      b. Resistance to Degradation – ASTM D 6928 or LA Abrasion & Sulfate Soundness
      c. Bridging Characteristics
      d. Infiltration Rate
   2. Phase II Testing: During Construction, a one-gallon sample of each type of gravel shall be submitted for testing as follows:
      a. A one-gallon sample from the first and every subsequent 500-ton lot of each type of gravel shall be submitted and tested for:
         1) Gradation – ASTM C 136
         2) Resistance to Degradation – ASTM D 6928 or LA Abrasion & Sulfate Soundness
         3) Infiltration Rate.

D. Grade Verification Surveys: Provide as-built topographic surveys with gridded spot elevations spaced at 25 feet on center at the following milestones to display compliance with the intended grades and tolerances of each layer.
   1. Final Subgrade: 1/2-inch over 25 feet in each direction.
   2. Top of Finishing Topping Stone Gravel: 1/4-inch over 25 feet in each direction.
   3. Finished Grade of Synthetic turf (Post-Infill): 1/4-inch over 25 feet in each direction.

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E. Gravel Layer Percolation Testing: Upon completion of the installation of the Base and Finishing Gravel layers, percolation testing (ASTM F2898) is to be conducted on the finished gravel layer. Testing shall occur at a minimum of 9 locations representing the entire playing field area.

F. Proof of Positive Drainage: Upon completion of the installation of subdrainage piping, provide an as-built survey with spot elevations at the inverts of all collector pipe connections to structures, bends and/or cleanouts, displaying compliance with the slopes indicated on the playing field subdrainage plans.

G. Finished Playing Surface Testing:
   1. Impact Attenuation (ASTM F 355): GMax
   2. Infill Depth: Measurements are taken at a minimum of 9 locations representative of the entire playing field.
   3. Force Reduction
   4. Percolation
   5. Infill Level
   6. Pile Height
   7. Tuft Bind
   8. Rotational Resistance
   9. Deformation

1.10 WARRANTY

A. Complete Synthetic Turf Surfacing System Warranty: Warranty shall cover, in general, the usability of the turf surface, accessories, use characteristics, drainage performance, and suitability of the installation. All items covered by the warranty are to be replaced or repaired with new materials, including installation at the sole expense of the warranting Contractor for the period of (8) years to the Owner, for the designated uses, commencing with the date of Substantial Completion.

B. Warranty of Synthetic Turf Surfacing System:
   1. The following are inclusive of the term “Synthetic Turf Surfacing System” for provisions of the warranty:
      a. Synthetic turf product as specified and represented by the Turf Manufacturer/Vendor including seams and adhesives.
      b. All materials and products specified.
      c. Materials and working functions of the drainage system.
      d. Final grade tolerances to one-quarter inch over 25 feet in any direction.
      e. Include installation and workmanship.
      f. Must not be limited to the amount of annual usage.
      g. Must include a pre-paid 3rd party insurance policy. This policy must have an annual aggregate amount of no less than $60 million, and a per incident limit of no less than $7 million per claim. The third party insurer must have an AM Best rating of A++ or better.
   2. The Synthetic Turf Manufacturer and Contractor shall warrant to the Owner that the synthetic turf materials shall not fade, fail, shrink, wrinkle, or reflect excessive wear, and shall, at their sole expense and cost, replace such areas of the synthetic turf system not performing to these standards for the life of the Warranty. In the event the Synthetic Turf System does not retain its fiber height or shock absorbency and is consequently no longer serviceable during the warranty period, then any such portion of the turf that is no longer serviceable shall be repaired or replaced.

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a. The term “Not Fade” in the context of this warranty shall mean that the synthetic turf material shall remain a uniform shade of green, or other color installed, with no significant loss of color.

3. The Contractor warrants to the Owner that the permeable Synthetic Turf System shall drain vertically a minimum of 12 inches per hour without visible surface ponding, during a normal rain event.
4. These warranties and the Contractor’s obligations hereunder are expressly conditioned upon:
   a. The Owner making all minor repairs to the synthetic turf system upon the discovery of the need for such repairs in accordance with the turf manufacturer’s repair manual.
   b. The Owner maintaining and properly caring for the synthetic turf system in accordance with the Manufacturer/Contractor maintenance manual(s) and instructions.
   c. The Owner complying with the dynamic and static load specifications established by the Manufacturer and/or Contractor.
5. Prior to acceptance and/or occupancy by the Owner, the Contractor shall provide training to the owner on the operation and maintenance of turf grooming equipment provided.

1.11 EXTRA MATERIALS

A. Furnish to the Owner extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Turf for Future Repairs: The following are minimum areas for the extra synthetic turf to be provided by the Contractor to the Owner:
      a. Each Green Colored Turf: 250 sq. ft.
      b. White Turf: 100 l.f. of 4” wide lines
      c. Additional Used Colors: 20 sq. ft. each
   2. Infill Materials: 1 Ton each

PART 2 PRODUCTS

2.01 GENERAL

A. General: the synthetic turf system shall be a synthetic turf system manufactured in the United States and shall meet or exceed all guidelines established herein, or for characteristics not specifically stated, shall meet or exceed all guidelines published by the Synthetic Turf Council. The turf system shall consist of a synthetic grass-like surface pile, which shall be tufted into a synthetic backing. All backing layers and coatings shall be firmly bonded together. Coating material must be completely cured and bonded to the other backing layers. Synthetic turf panels or rolls that do not meet the requirements of this specification will be rejected. The entire system shall be resistant to weather, insects, rot, mildew, and fungus growth, and shall be non-allergenic and non-toxic. The entire system shall be constructed to maximize dimensional stability, to resist damage and normal wear and tear from its designated use, and to minimize ultraviolet and extreme heat degradation. All adhesives used in bonding the system together shall be resistant to moisture, bacterial and fungal attacks, and resistant to ultraviolet rays at any point in the system.

2.02 AGGREGATE DRAINAGE BASE SYSTEM

A. Geotextile Subgrade Liner: Permeable nonwoven filter fabric consisting of long-chain synthetic polymers; Minimum weight of 3.5 oz / SY. Acceptable Products:
   1. TenCate Geosynthetics Mirafi 140N

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2. US Fabrics US120NW
3. Pre-Bid Approved Equivalents

B. Subdrain Laterals / Flat Panel Drains: Flat panel composite drains to be 12 inch wide by minimum 1-inch thick (nominally) strip drain consisting of a 3-dimensional high-flow, high compressive strength HDPE core wrapped or oblong corrugated pipe with internal bracing, thermally bonded with a geotextile filter fabric wrap. Acceptable Products:
1. AdvanEDGE 12 as manufactured by Advanced Drainage Systems (ADS)
2. Hydraway HY211
3. Pre-Bid Approved Equivalents

C. Drainage & Aggregate Drainage Base Material: Shall consist of a mechanically crushed limestone or granite, or other durable hard stone, angular and elongated in nature, that meets the following criteria:
1. Material shall not exceed 18 percent loss of materials as determined by the following test methods:
   a. Micro-Deval (ASTM D7428-15)
   b. Alternate Testing
      1) Sulfate Soundness: Shall not exceed 12 percent loss of materials using magnesium sulfate (ASTM C88).
      2) LA Abrasion: Shall be less than 40 (ASTM C131).
2. Unacceptable Materials : Soft limestone and shale, sea shells or shell fragments, rounded or river stone.
3. Aggregate from multiple quarry sources shall not be used in a single playing field area.
4. Infiltration Rates:
   a. Base Layer Aggregate: ≥ 150 inches per hour
   b. Finish Topping Stone Aggregate: 50 inches per hour
   c. The overall porosity of the composite aggregate drainage base layer shall be greater than 25% when compacted and saturated.
5. Bridging Characteristics:
   a. 3 < (D50 Base Stone / D50 Finish Stone) < 6
   b. (D85 Finish Stone / D15 Base Stone) ??? 2
6. The aggregate(s) shall conform within reasonable tolerances to the following gradation chart using ASTM Method C136.

Sieve Size	Base Layer Aggregate AASHTO No. 57 Percent Passing	Finish / Topping Aggregate AASHTO No. 89 Percent Passing
1.5 inch	100	
1 inch	95 - 100	
3/4-inch		
1/2 inch	25 - 80	100
3/8-inch		90 - 100
#4	0-10	20-55
#8	0-5	5-30
#16	0	0 - 10
#50	0	0 - 5

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2.03 SYNTHETIC TURF SURFACING

A. Products: Shaw Sports Turf - GAME ON, or Pre-Bid Approved Equivalent.

B. Materials:

1. Shall be tufted, polyethylene, grass-like fabric coated with a secondary backing of high-grade polyurethane. Refer to grid in table below. The two fibers specified in this grid shall be tufted through the same needle in a grass-like fabric to a finished pile-height also specified in the grid.
2. All components and their installation method shall be designed and manufactured for use on outdoor athletic fields. The materials as hereinafter specified should be able to withstand exposure in all climates, be resistant to insect infestation, rot, fungus, mildew, ultraviolet light and heat degradation, and shall have the basic characteristics of flow-through drainage, allowing free movement of surface runoff through the synthetic turf fabric where such water may flow to the existing base and into the field drainage system.
3. The finished playing surface shall appear as mowed grass and shall resist abrasion and cutting from normal use.
4. The polyethylene pile yarn shall be a proven athletic caliber yarn designed specifically for outdoor use and stabilized to resist the effect of ultraviolet degradation, heat, foot traffic, water, and airborne pollutants.
5. The system shall be tufted at the pile height and gauge listed in specification grid, refer to grid in section shown in table below.
6. The Primary Backing must be a multi-layer backing, contain UV stabilizers and must pass 3000 hours of QUV A testing, refer to grid in table below.
7. The Secondary Backing of high-grade polyurethane shall be applied to the Primary Backing. Secondary Backing adds resistance to water degradation and strengthens grip on fibers, refer to grid in table below.
8. The backing shall allow for drainage. Partially coated backings or latex coating materials shall not be acceptable.
9. Within the parameters of capability, lines, hash marks, numbers and logo details will be tufted into each panel so that inlays are not/less necessary.

	Polyethelene	
Pile Yarn	Monofilament/Slit Film	METHOD
Linear Density (Denier)	14,000	ASTM D 1577
Yarn Thickness Mono/Slit	100/110 microns	ASTM D 3218
Pile Weight****	42 oz./yd^2	ASTM D 5848
Finished Pile Height****	2.0	**<<ASTM D5823>>**
Product Weight (total)***	62 oz./yd^2	ASTM D 5848
Primary Backing Weight****	6 oz./yd^2	ASTM D 5848
Secondary Coating Weight+	14 oz./yd^2	ASTM D 5848
Fabric Width	15’ (4.57m)	ASTM D 5793
Tuft Gauge	1/2”	ASTM D 5793
Grab Tear Strength Avg.	> 200 lb.-F	**<<ASTM D5034>>**
Tuft Bind (Avg.)	> 10 lb.-F	**<<ASTM D1335>>**
Infilltrometer	> 25	ASTM D3885

Except where noted the above specifications are nominal.

* Values are +/- 8%. ***Values are +/- 10 oz. ****Values are +/- 5%. +Values are +/- 3 oz./yd2.

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10. NaturalPlay Performance Infill
    a. Infill shall adhere
        1) Shall be equivalent to NaturalPlay provided by Shaw Sports Turf, 185 S. Industrial Blvd. Calhoun, GA 30701.
        2) If the Contractor wishes to provide an equivalent, he/she shall provide information prior to the bid illustrating equivalent performance characteristics of the shock pad.
        3) The following criteria shall be met:
            (a) 100% natural combination of coconut husks and fiber with highly rounded shells from black and English walnuts.
            (b) Balanced particle sizes distribution.
            (c) Superior cooling capabilities.
            (d) Perform well in all 7 playability metrics
            (e) 12-18 Mesh.
            (f) 0.2764 gr/cc density
11. Shock pad material is a required addition with organic, alternative infill. Suggested pad materials specification in grid in section 2.02 J. Pad must provide proper g-max.
    a. Performance Shock Pad shall adhere
        1) Shall be equivalent to NXTPlay, manufactured by Shaw Sports Turf, 185 S. Industrial Blvd. Calhoun, GA 30701.
        2) Product must carry a twenty-five (25) year warranty and cover the cost to replace or repair the turf in the affected area in the event of product failure.
        3) If the Contractor wishes to provide an equivalent, he/she shall provide information prior to the bid illustrating equivalent performance characteristics of the shock pad.
        4) The following performance criteria shall be met:
            (a) Performance shock pad shall be 16 mm thick.
            (b) Product shall drain at greater than 170 inches per hour.
            (c) Warranty shall be 25 years or more and cover the cost to replace or repair the turf in the affected area in the event of product failure.
            (d) Product must contain 30-50% recycled turf material.
            (e) Product shall contain 80% recycled content.
            (f) Product shall be manufactured in the United States of America.
            (g) Product must come in rolls. Panels or pieces will not be accepted.
            (h) Shock pad shall provide an end of life cycle option for synthetic turf materials that guarantees the turf will avoid any landfills by converting to a new useful product. Reuse or other diversion plans that do not include production of a new and useful product will not be considered.

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2.04 TURF EDGE FASTENERS

A. Turf Edge Fasteners: to be comprised of pressure treated lumber or a composite/synthetic wood 2” x 4” (nominal) nailer board attached to the perimeter concrete curbing, or structure, in an approved mechanical manner. Treated lumber used as nailer board shall have “Ground Contact” designation from the manufacturer.

2.05 SPORTS EQUIPMENT INSTALLATION

A. Football Goal Post and Standards (NFHS):

1. Goalpost MODELGP835HSPL by Sportsfield Specialties, Inc. Or approved equal
2. Powder Coat Finish. Color as approved by Owner.
3. Access Frame Kit Model: by Sportsfield Specialties, Inc. Or approved equal
4. Goal Post Pad Color to be selected by Owner

B. Soccer Goals and Standards (NFHS)
1. Portable Soccer Goals: Sportsfield Specialties, Inc. Or approved equal; SG824RS Regulation Round Faced Soccer Goal with Skids. With the SG2SGP Soccer Goal Clamp, It is recommended the back bar of the soccer goal is weighted down with (6 quantity) Saddle Sandbags. Standard Color: White Net.

2.06 SYNTHETIC TURF MAINTENANCE EQUIPMENT

A. New Grooming Equipment: Provide tow-behind maintenance and/or grooming equipment per manufacturer's recommendation.

PART 3 EXECUTION

3.01 EARTHWORK EXECUTION

A. General: Remove material of every nature or description encountered in obtaining required lines and grades. Excavate and/or place and compact fill to provide for elevation(s) required by drawings.

B. Establish required lines, levels, contours, and datum.

C. Remove vegetation, debris, unsuitable soil materials, obstructions, and deleterious materials from the surface prior to placement of fill materials.

D. Prior to placing fill materials over undisturbed material, scarify to a minimum depth of six inches.

E. Place backfill and fill materials in lifts not more than six inches in loose depth. Before compaction of subgrade, moisten or aerate each layer as necessary to provide optimum moisture content to facilitate compaction to the required density. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

F. Compact each layer to 95% proctor density (ASTM D 1557).

G. Failings: If, based on the testing and observation agency reports and observations, compacted subgrade or fills are found to be below specified density, provide additional compaction and testing in accordance with specifications.

H. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately the same elevation in each lift.

I. Moisture Control: Where subgrade soil material must be moisture conditioned before compaction, uniformly apply water to the surface of the subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on the surface during or subsequent to compaction operations.
1. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

J. Subgrade Grading: Shape surface of areas under gravel drainage material to line, grade, and cross-section, with finish surface not more than 1/2-inch in 25 feet either direction above or below required subgrade elevation. At no point shall two adjacent spot elevations vary by more

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than one-half inch. All grading to be performed with equipment utilizing a Universal Total Station (UTS) 3D grade control system.

K. Contractor to provide an as-built survey of the finished subgrade with spot elevations at 25 feet on center for Owner review.

L. Contractor's Geotechnical Testing Consultant to provide compaction & density reports for Owner review upon completion of subgrade preparation.

M. The Contractor shall bear sole responsibility for the stability and performance of the subgrade throughout the warranty period. Any fluctuation in the subgrade resulting in failure of the finish grade of the playing surface to meet specified tolerances will be immediately corrected by the Contractor at no additional cost to the Owner.

N. The Contractor shall not proceed with drainage system trenching operations or installation of gravel drainage blanket until all subgrade geotechnical tests and certified surveys have been reviewed and approved by the Engineer or Owner.

3.02 FIELD DRAINAGE INSTALLATION

A. Drainage System Trenching: Dig trenches to depth and width indicated on the Construction Drawings. Abnormal conditions such as large cobbles or unstable conditions that may cause the trench to lose integrity shall be reported to the Owner immediately. Excavate trenches to a uniform width and sufficiently wide to provide ample working room.

1. Excavate trenches and conduit to the depth indicated or required to establish indicated slope and invert elevations and to support the bottom of pipe or conduit on undisturbed soil.
2. Only perform trenching, drainage pipe installation, and backfilling operations that can be completed in one day. Exposed trenches that collapse due to rain or other occurrences shall be widened and filled as specified or refilled with subgrade materials, compacted, and retrenched.
3. Compact the bottoms of all trenches to the density described in the placement and compaction of this section. The Owner has the option of observing the general trenching operation and will not observe the entire process for approval to backfill the remaining trench areas.
4. All cuttings and spoil from trenching are to be removed from the facility. Cuttings may not be left in place or spread across the subgrade.

B. Installation of Geotextile Fabric: Place geotextile fabric according to manufacturer specifications.

1. Install geotextile fabric on the bottom and sides of trenches. Extend fabric a minimum of 12 inches past each side of the top of the trench on top of the subgrade.

C. Laying Pipe Materials: Provide full bearing for each pipe section throughout its length with drainage fill material to true grades and alignment and continuous slope in direction of flow.

1. Lay perforated/slotted pipe in accordance with pipe manufacturer's recommendations. Provide collars and couplings as required.
2. Lateral pipe connections to collector piping are to be completed with the manufacturer's recommended pipe outlet and connection fittings.

D. Clean Outs: Clean-out lid shall be set flush with the top of finishing gravel, or as indicated on the drawings. Cleanouts are to be encased in a minimum four-inch (4") width concrete collar to provide for turf attachment.

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3.03 AGGREGATE DRAINAGE BASE INSTALLATION:

A. Geotextile / Flat Panel Drains / Base Aggregate Placement: Place base aggregate layer only after subgrade has been graded and compacted to proper density and has been determined to be within acceptable grading tolerances as required in Quality Control article above.
   1. Place geotextile subgrade liner on subgrade free of rocks, depressions, voids, or irregularities that may damage the liner. Overlap joints a minimum of 12 inches and overlap in direction of surface flow. Only place liner over area that can be covered sufficiently with flat panel drains and base aggregate within a short period of time to prevent liner from being lifted or damaged by wind.
   2. Install flat panel drains over the placed geotextile subgrade liner as per spacing and pattern shown on the Construction Drawings.
   3. Care shall be taken as to not disturb the geotextile fabric during base aggregate installation. A minimum of four inches (4”) of base aggregate shall be maintained between the geotextile fabric and the wheels of trucks or spreading equipment. Construction equipment such as dozer blades, shall not make direct contact with the geotextile fabric. If tears occur in the geotextile fabric during the spreading of base aggregate, remove aggregate over the damaged section and replace or repair geotextile liner prior to continuing base aggregate installation operations.
   4. All grading to be performed with equipment utilizing a Universal Total Station (UTS) 3D grade control system.
   5. When the aggregate spreading is completed, the surface shall be compacted by a 3-5 ton roller.
   6. The base aggregate surface shall be left in a firm but not over-compacted as to protect the porosity and drainage capabilities of the aggregate profile.

B. Finish / Topping Aggregate Placement: Place finish / topping aggregate material over the base aggregate in a single layer, to the elevations indicated on the drawings.
   1. After the aggregate drainage base has been uniformly spread throughout the surface, the surface shall receive a final laser-controlled finished grade. This process shall be accomplished utilizing a Universal Total Station (UTS) 3D grade control system. GPS or 2D grade control systems will not be acceptable.
   2. After placement of finish / topping aggregate, the surface is to be rolled with a steel- wheel tandem roller to achieve planarity at the elevation indicated, and meet grading tolerances as described below.

C. Drainage Layer Grading Tolerances: Shape surface of gravel drainage layer to line, grade, and cross-section, with finish surface not more than 1/4-inch in 25 feet either direction above or below required elevation. At no point shall two adjacent spot elevations vary by more than one-quarter inch.

D. Aggregate Drainage Base Survey: Contractor to provide an as-built survey of the finished aggregate drainage base surface with spot elevations at maximum 25 feet on center.

E. Aggregate Base Layer Warranty: The Contractor shall bear sole responsibility for the stability and performance of the aggregate drainage layer throughout the warranty period. Any fluctuation in the gravel drainage layer resulting in failure of the finish grade of the playing surface to meet specified tolerances will be immediately corrected by the Contractor.

3.04 SYNTHETIC TURF PRE-INSTALLATION EXAMINATION

A. Contractor to examine substrates, areas, and conditions where the playing surface is to be installed for compliance with requirements for conditions affecting the performance of the installed playing surface.

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1. Verify that substrates for placing playing surface are firm; dry; clean; free from oil, and waxy films.
2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located under the playing field surface has been completed before installing the synthetic turf system.
3. Verify that joints and cracks in substrates will not adversely affect the installed playing surface.
4. Verify ambient temperatures are in compliance with the manufacturer's recommendations for installation.

B. Acceptance of Aggregate Drainage Base Installation: The Contractor, or his installation subcontractor, shall perform an inspection of the completed aggregate drainage base and stipulate acceptance of the aggregate drainage base prior to the installation of the infilled synthetic turf system. Stipulation shall include:
1. Acceptance of the subbase construction finished surface as totally suitable for the application of work specified in this section.
2. Verification and certification of the infiltration and permeability rates of the aggregate section per the specified requirements – 50 inches per hour minimum.
3. Final grade to be within 1/4-inch, or 0.02 feet, of proposed grades, when surveyed on a 25 foot grid.

C. Do not proceed with installation until unsatisfactory conditions have been corrected.

D. Inspection of Materials: Prior to installation and immediately upon delivery of synthetic turf system materials to the project site, the Contractor shall inspect materials as follows:
1. For damaged or defective items.
2. Measure turf pile height of each roll.
3. Measure backing perforation diameter and spacing.
4. Reject damaged materials and all materials out of tolerance with the specifications.

3.05 SYNTHETIC TURF INSTALLATION

A. Immediately prior to installation of the synthetic turf, the base shall be thoroughly cleaned of all foreign material, soil, and any other substances that may be detrimental to the permeability and the installation of the turf system.

B. Over the aggregate base layer, install synthetic turf carpet in accordance with manufacturer's written instructions. Seams shall be sewn with thread especially made for the carpet materials, or glued, bonded, or welded according to the manufacturer's written instructions.

C. Synthetic turf rolls shall begin with the longest perpendicular cross-field distance and should following the following procedures:
1. No head seams shall be permitted in the inbound playing surfaces unless required for field markings or logos.
2. All visible wrinkles shall be stretched out before seaming.
3. Yard Lines and field marking should be straight and set with precision.

D. Synthetic turf edge shall be mechanically fastened to the installed turf edge fastener per manufacturer's instructions and per the drawing details.

E. Special care shall be taken not to disturb the finish grade of approved aggregate base layer during synthetic turf carpet installation.

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F. Bonding of Material Surface: The bonding or fastening of all system material components shall provide a permanent, tight, secure, and hazard-free athletic playing surface. System material components include:
   1. Bonding and/or sewing of all seams and inlaid lines and markings.
   2. Bonding and seaming must maintain their integrity for the total length of the warranty period.

G. All turf seams shall be bonded with supplemental backing material or sewn with high strength polyester fiber cord.
   1. All sewn seams shall be brushed to provide full coverage of fiber over the thread.
   2. All bonded/glued seams shall be brushed to eliminate adhesive materials from turf fibers.
   3. All seams shall be flat, tight, and permanent with no separation or fraying.
   4. Seams shall be rolled with weighted roller to ensure adhesion.
   5. Synthetic turf yarn fabric that is trapped or glued between seams shall be freed from the seams by hand or other approved method to an upright position prior to the commencement of brushing and top-dressing synthetic grass rolls by the manufacturer wherever possible.

3.06 LINES AND MARKINGS INSTALLATION:

A. Field markings shall be provided with the initial installation of the surfacing system. Provide lines and markings in conformance with these specifications. Layouts shall be accurately surveyed and marked prior to installation.

B. If overlapping backing materials are utilized for the inlaid lines and markings, the backing material shall be perforated after gluing and prior to installation of the infill material.

C. Installation of inlays: All inlaid markings shall be installed per the Turf Manufacturer's recommendations.

3.07 ADHESIVE AND INFILL MATERIAL INSTALLATION GUIDELINES

A. Environmental Conditions: Do not apply adhesive materials or infill material when:
   1. Ambient air temperature is below 40 degrees F.
   2. Material temperatures are below 40 degrees F.
   3. Rain is falling or pending
   4. Conditions exist or are pending that will be unsuitable to the installation of the system.

B. Remove debris from turf installation prior to installation of infill materials.

C. Inspect seams and inlays for secure bonding. Bonded seams and inlays shall be properly cured before infill is installed.

D. Pre-Infill Inspection: Contractor and Owner to inspect the synthetic turf playing surface for acceptance prior to the infill installation process. All seams, inlays, and edges shall be inspected to be free of trapped fibers, adhesive bonding, loose edges, and gaps in inlays. Contractor shall make all repairs necessary prior to commencement of infill installation.

E. Vibrate and brush infill materials into synthetic turf at the rate and depth recommended by the manufacturer. Infill material shall be applied in a dry condition, and only when the turf is dry. It shall be applied in uniform layers throughout the installation.

F. Post Installation Inspection: Immediately after installation, inspect project area for uniformity of color of turf, field lines and markings, insert installations, and edge details. Contractor to immediately correct all non-conforming items.

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3.08 CLEANING AND PROTECTION

A. Remove all excess materials of all types; equipment, debris, etc. from the site daily, immediately after completion of the work. Remove all stains and other blemishes from all finished surfaces. Leave work in clean, new appearing condition, ready for use by Owner.

B. All reasonable precautions shall be made by the Contractor to protect all installed material and finished work from damage during installation and until acceptance of the work by the Owner. Any material damaged prior to final acceptance by the Owner due to the Contractor's negligence shall be replaced at no cost to the Owner.

END OF SECTION 321813

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SECTION 321820
SITE ATHLETIC EQUIPMENT

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM D1335 - Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings.

B. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 1, Specification Sections, apply to work in this section.

1.03 DESCRIPTION OF WORK

A. This section specifies materials and work required to install new athletic court and track-and-field equipment and to construct new athletic court, track surfacing and artificial turf football/soccer field surfacing systems on prepared asphalt pavement bases for courts and track events, and on prepared subgrade for baseball fields and football/soccer fields.

B. Furnish all labor, materials, tools and equipment necessary to install all artificial grass field turf as indicated on the plans and as specified herein. The installation of all new materials shall be performed in strict accordance with the manufacturer's installation instructions and in accordance with all approved shop drawings.

C. Perimeter edge details required for the system shall be as detailed and recommended by the Manufacturer, and as approved by the Owner.

1.04 RELATED WORK

A. Refer to Division One for LEED coordination and documentation requirements, Section 310000 “Earthwork and Grading”, Section 321200 "Asphalt Pavement", Section 323100 "Chain Link Fencing" and Section 330500 “Utility Standards”.

B. References:

1. National Asphalt Pavement Association (NAPA)
2. USA Track & Field (USATF)
3. U.S. Tennis Court and Track Builders Association
4. National Federation of State High School Associations (NFHSA)
5. International Association of Athletics Federation (IAAF)
6. American Sports Builders Association (ASBA)
7. NCAA Football Rules and Interpretations and/National Federation Rules; FIFA Rules and Regulations, current edition.

1.05 QUALITY ASSURANCE

A. For installation of athletic court and track equipment and/or surfacing systems use only thoroughly trained and experienced personnel, completely familiar with specified products, the manufacturer's recommended methods of installation, and the requirements of this work.

B. Asphalt surface shall comply with the guidelines of the ASBA and NAPA for surface planarity and density.

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C. All liquid materials shall be from a single source and manufactured for the purpose of resilient track construction.

D. The contractor shall record the batch number of each product used on the site and maintain it throughout the warranty period.

E. The contractor shall provide the owner an estimate of the volume of each liquid product and the weight of the rubber granule to be used on site.

F. The installer shall be an Authorized Applicator of the specified surface system.

G. The manufacturer's representative shall be available to help resolve material issues.

H. All manufacturer's warranties shall pass to the Owner.

I. Artificial Turf System construction shall be provided by a Contractor with a minimum of 5 completed field installations, providing specific installations with the exact name of the product, contacts names, addresses, telephone numbers, age of the installation and type of infill material for the following types:

1. Soccer pitch and football fields of 65,000 square feet or more, of the exact specified material, including the infill material and fiber, in play for at least 5 years with the same manufacturer, fiber and company they are proposing for this field.

J. The Artificial Turf System Contractor shall provide information proving the experience level of the project supervisor, who shall be a current employee of the contractor, shall be skilled in the performance of his duties, shall have a minimum of 18 months experience in supervising similar sized projects, and shall have installed the proposed product at least twice.

1. The designated Supervisory Personnel on the project must be certified, in writing, by the Turf Manufacturer, as competent in the installation of this material, including sewing seams and proper installation of the infill mixture.

K. The Artificial Turf System Manufacturer shall have a representative on site to certify the entire installation and Warranty compliance on the turf itself.

L. Prior to the beginning of installation, the Installer of the synthetic turf shall inspect the sub-base and accept in writing the sub-base surface planarity (tolerance to grade).

M. All construction shall be performed in strict accordance with written instructions of the surfacing and equipment Manufacturers.

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1.06 SUBMITTALS

A. Submit manufacturer's specifications, catalog information and installation instructions for selected equipment and court, track and field surfacing systems.

B. Submit certified design details for softball foul line netting system support poles, showing construction details for the poles and foundations, designed for the required height and loading. Pole details shall be certified by a registered professional engineer.

C. Submit certified design details for manufacturer's recommended installation and foundation requirements for ground sleeve model ballstopper system and other cage system support poles, showing construction details for the poles and foundations, designed for the required height and loading. Pole and foundation details shall be certified by a registered professional engineer.

D. Submit certificates, signed by Contractor, that the installers of the equipment and/or court, track and field surfacing systems have a minimum of five (5) years experience in the installation of athletic equipment and/or court, track and field surface treatments.

E. Submit certificates stating that the Track and Field surfacing system installer is a builder member of the ASBA, and that the surfacing system manufacturer is a member of the ASBA.

F. Submit Authorized Applicator certificate from the Track and Field surface system manufacturer.

G. Submit certificate from the manufacturer of the binders and coatings stating that the materials have been produced specifically for the use in sports surfacing construction.

H. Submit a complete list of materials intended to be used in the construction of the running track system. All liquid quantities will be prior to dilution.

I. Submit current material safety data sheets (MSDS) for the liquid components.

J. Submit a 3”X5” representative sample of the Track and Field surfacing system to be installed with appropriate labeling for identification.

K. Submit a test report that the Track and Field surfacing system has been tested to IAAF standards for force reduction and modified vertical deformation. Force reduction shall be 35-50%. Modified vertical deformation shall be 0.6-1.8 mm.

L. Submit one sample, a minimum of 4x4 inches in size each, illustrating details of the finished artificial turf product.

M. Submit certified copies of independent laboratory reports on ASTM tests as follows for the synthetic grass carpet:

1. Pile Height, Face Width and Total Fabric Weight, Primary & Secondary Backing Weights, ASTM D418 or D5848.
2. Tuft Bind, **<<ASTM D1335>>**.
3. Grab Tear Strength, ASTM D1682 or D5034
4. Pill Burn Test, **<<ASTM D2859>>**.
5. Impact Attenuation, Gmax < 135 at installation

N. Submit recycled content certificates for paving materials and artificial turf materials in accordance with LEED requirements.

O. Submit certificates for the locations of manufacturers of the materials in accordance with LEED requirements.

P. Product substitution: If other than the product specified, the contractor shall submit at least 7 days prior to the bid date a complete type written list of proposed substitutions with sufficient data, drawings, samples and literature to demonstrate that the proposed substitution is of equal quality and utility to that originally specified. Information must include a QUV test of at least 1,000 hours and IAAF test information for the system to be installed.

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1.07 WARRANTIES

A. Provide Manufacturer's standard warranty on main support components to cover structural failure due to corrosion, deterioration or defects in workmanship.

B. Provide track surface Manufacturer's standard warranty covering defects in materials and workmanship for a period of not less than 5 years.

1.08 PRODUCT DELIVERY AND STORAGE

A. Deliver court and track surfacing products to the project site in unopened containers with labels attached. Store and handle to prevent damage or contamination.

B. Store material in accordance with manufacturer’s specifications and MSDS.

C. All surfacing materials shall be non-flammable.

D. Deliver and store athletic equipment in a manner to prevent damage during handling and storage. Damaged items will be replaced at no increase to the Contract sum.

E. Deliver Artificial Turf System products to project site in wrapped condition, when appropriate. Store products under cover when elevated above grade.

1.09 PROJECT CONDITIONS

A. Coordination Requirements: Contractor shall coordinate construction of fencing systems around athletic courts and track, and installation of other athletic court, track and artificial turf football/soccer field facilities with the requirements of court, track and artificial turf football/soccer field base or surface construction.

1. Fencing fabric shall be loosely hung on finished fence posts approximately one foot above the finished court surface, with a minimum opening of **<< 20 feet>>** left in the fencing for entrance of surfacing application equipment. Fencing shall be permanently placed after completion and curing of court surfacing system.
2. All athletic court facilities, such as backstops, goals, net posts, net ties, etc. shall be completely installed prior to beginning construction of court surfacing system.
3. Contractor shall carefully coordinate construction of all football/soccer field facilities, including goals and Lacrosse ballstopper system, with the artificial turf installer and with the Owner's Representative. Install foundations and sleeves prior to installation of artificial turf.

PART 2 PRODUCTS

2.01 ATHLETIC EQUIPMENT

A. Basketball Backstop System: Backstop, Pole and Goal system shall be as manufactured by AALCO, Model G66-901S with rectangular fiberglass backboard, or Model G66-601 with fan-shaped fiberglass backboard (Owner's choice), or approved equal.

1. All backstops shall have safety pin in post to prevent backstop slippage.
2. Provide system complete with goal hoop and net.
3. Quantity and location as indicated.

B. Basketball Goals: Backstop, Pole and Goal system shall be the PR77 Mega Duty Playground System as Manufactured by Bison, Inc. (www.bisoninc.com), or approved equal.

1. Backboards shall have 10-year limited warranty.
2. Goals shall be Heavy Duty Flex / Breakaway Goals, with unconditional lifetime replacement warranty.
3. Provide Steel Net for the Goal.
4. All backstops shall have safety pin in post to prevent backstop slippage.
5. Quantity and location as indicated.

C. Baseball/Softball Backstops: As manufactured by Anchor Fence/Master Halco (www.masterhalco.com), or by AALCO, Model BSBO-12, or approved equal.

1. Wire mesh shall be 2-inch chain link, 6 gauge minimum on lower panels, 9-gauge minimum on roof panels.
2. Quantity and location as indicated.

D. Baseball/Softball Foul Poles: Manufactured by Sportsfield Specialties, Inc., or approved equal. Install in accordance with Manufacturer's recommendations. Bottom of foul pole wing shall be even with the top of the outfield fence. Foul poles shall have padding manufactured by Beacon Athletics or approved equal, color to be selected by architect.

E. Softball Foul Line Netting System:

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1. Netting manufactured by Carron Net Company, Inc., P.O. Box 177, Two Rivers, Wisconsin, Phone 1-800-558-7768. Net shall be No. 77702 Flexabar Nylon Mesh, weather treated, colored green, with 5/8-inch rope binding on all edges, or approved equal. Mesh size shall be 1-3/4 inch. Net length shall be sufficient so that top shall be attached along suspension cable at 30 feet above grade, and bottom of net shall be attached to top of 10-foot high chain link perimeter fencing along the edge of the baseball field. Where no perimeter fence is required, netting shall be long enough to be attached to a ground cable run between support poles.
2. Support poles shall be structural wooden telephone poles, pressure treated with chromated copper arsenate, type C (CCA-C), length suitable for suspending net at a height of 30 feet above grade, or as otherwise directed by Owner's Representative..
3. Suspension cable, and ground cable where required, shall be 1/4-inc**<< 1/4 inch>>** prestressed aircraft cable, and as recommended by the net manufacturer.
4. Suspension hardware, consisting of "S" hooks, turnbuckles and hog-rings shall be as recommended by net manufacturer, and shall be galvanized. Net tie-down lacing shall be nylon lacing cord, as recommended by the net manufacturer.
5. Contractor's Option: Complete 30-foot tall Straight Ball Safety System featuring 6-inch diameter aluminum poles and heavy duty black #36 nylon mesh netting with 1-3/4 inch squares, as manufactured by Sportsfield Specialties Inc., Delhi, New York, Phone: 888-975-3343, e-mail: www.sportsfieldspecialties.com.
   a. Upright Posts Fabricated with 6" SCH 40 Aluminum Pipe:
      1) Height Above Ground equal to system height plus 1Ft (for hardware)
      2) Aluminum Mill Finish (TFBSS6XXP Powder Coated)
   b. Upright Post Ground Sleeves Fabricated with 7in OD (6.782in ID) Steel:
      1) 30.0-60.0 Feet in Length
      2) Steel Tube
      3) Aluminum Ground Sleeve Caps
   c. Ball Safety Net:
      1) Height x Length Specified by Customer
      2) #36 Black Nylon 1-3/4" Mesh
      3) Tethers 2X net height + 5Ft
   d. Accessories:
      1) Stainless Steel Assembly Hardware
      2) Shell Block Pulley System
      3) 9.0 inch Net Guide Rings
      4) Black Vinyl Coated Wire Rope

F. Tennis Steel Nets: Manufactured by Flex-L-Link, or by B.S.N. Sports, P.O. Box 7726, Dallas Texas, 1-800-527-7510, or approved equal.
   1. Quantity and location as indicated.

G. Tennis Net Supports, Tie Down Anchors, Etc.: Manufactured by B.S.N. Sports, P.O. Box 7726, Dallas Texas, 1-800-527-7510, or approved equal.
   1. Posts shall be Pronet tennis posts, 3 **<< 1/2 inch>>** galvanized steel, with 2 coats of surface paint.
   2. Provide "Safety Ratchet Reel" and all required hooks, caps and other installation hardware as required, by the same manufacturer.
   3. Quantity and location as indicated.

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H. Batting Cage System: Frames, netting and support system as manufactured by B.S.N. Sports, P.O. Box 7726, Dallas Texas, 1-800-527-7510, or Sportsfield Specialties, P.O. Box 231, Delhi, NY, 1-888-975-3343 (www.sportsfieldspecialties.com), or approved equal.
   1. Provide system components for baseball batting cage with minimum dimensions 70' long by 14' wide by 12' high, and softball batting cage with minimum dimensions 55’ long by 14’ wide by 12’ high.
   2. Netting shall be Nyothene Weather Treated Black #530 Knotless, 1-3/4 inch mesh (30 Thread), system no. BBT #514B, or equivalent.
   3. Frames and suspension system shall be manufacturer's standard outdoor unit design for permanent installation. Frame pipe shall be 2-3/8 inch heavy wall galvanized steel pipe, or 4-inch O.D. 1/8-inch wall aluminum tubing.
   4. Location as indicated.

I. Discus Throwing Ring System: Provide complete Discus Throw system including throwing ring and surrounding cage.
   1. Throwing Ring: Aluminum throwing circle, 8-foot to 8-foot, 2-1/2 inch diameter, preformed and designed for simple formation of concrete throwing pads that are recessed 3/4-inch, meeting all NCAA and IAAF rules. As manufactured by Aluminum Athletic Equipment, West Conshohocken, PA, 1-610-825-6565, or Sportsfield Specialties, P.O. Box 231, Delhi, NY, 1.888-975-3343, (www.sportsfieldspecialties.com), or approved equal.
   2. Discus Cage: Standard discus cage meeting or exceeding the designed application as set forth by the NFHS, NCAA, and IAAF. Discus Cage shall be as manufactured by Aluminum Athletic Equipment, West Conshohocken, PA, 1-610-825-6565, or Sportsfield Specialties, P.O. Box 231, Delhi, NY, 1.888-975-3343, (www.sportsfieldspecialties.com), or approved equal. Cage members shall be 4 in Schedule 40 aluminum poles featuring a 36 inch rolled offset, with Aluminum Mill finish. Standard cage nets shall be 14 feet above ground with #36 nylon for Discus application. Aluminum ground sleeves shall be included to allow for a semi-permanent design that may be removed as required.
      a. Ground Sleeves shall be fabricated with 4.30 in OD Aluminum Tube, minimum 30-inch length, with Aluminum Mill finish.
      b. Ground Sleeves shall be furnished with Ground Sleeve Caps.
      c. Discus Cage Netting shall be #36 Black Nylon 1-3/4 inch Mesh, 14 feet high by 54 feet length, with six (6) 33 foot tethers with loop ends.
      d. Provide full hardware kit including stainless steel assembly bolts, shell block pulley system and galvanized steel rope cleats.

J. Shot-Put Throwing Ring: Aluminum throwing circle, 7-foot diameter, preformed and designed for simple formation of concrete throwing pads that are recessed 3/4-inch, meeting all NCAA and IAAF rules. As manufactured by Aluminum Athletic Equipment, West Conshohocken, PA, 1-610-825-6565, or Sportsfield Specialties, P.O. Box 231, Delhi, NY, 1.888-975-3343, (www.sportsfieldspecialties.com), or approved equal.

K. Shot-Put Toe Board: Cast aluminum Toe Board meeting all NCAA and IAAF rules, matching recessed or non-recessed throwing circle indicated or specified. Toe board assemble shall be designed to be easily installed and removed for storage. As manufactured by Aluminum Athletic Equipment, West Conshohocken, PA, 1-610-825-6565, or Sportsfield Specialties, P.O. Box 231, Delhi, NY, 1.888-975-3343, (www.sportsfieldspecialties.com), or approved equal.

L. Long-Jump/Triple-Jump Take-Off Systems: Provide complete take-off system meeting all IAAF, NHSF and NCAA requirements and rules, with foundation tray constructed of 1/4-inch galvanized rust-resistant steel. Take-off board shall be designed to be removable for storage. System shall be as manufactured by Aluminum Athletic Equipment, West Conshohocken, PA, 1-610-825-6565, or by Sportsfield Specialties, P.O. Box 231, Delhi, NY, 1.888-975-3343

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(www.sportsfieldspecialties.com), or by UCS, Orangeburg, NY, 1-914-365-2333, or approved equal.

M. Football Goal Post: Provide single-post, slingshot design goal meeting all NFSHSA specifications (and designed for easy removal and re-installation). Goal post shall have an 8-foot offset in the gooseneck, designed for use with a soccer goal on the back of the endzone line. Provide complete goal installation system (including ground sleeve cap) as manufactured by Jaypro Sports, Inc., Waterford, CT., 1-860-447-3001 (permanent installation), by Sportsfield Specialties, P.O. Box 231, Delhi, NY, 1.888-975-3343 (www.sportsfieldspecialties.com), or by KWIKGOAL, Quakertown, PA, 1-215-536-2200 (removable installation) or approved equal.

N. Ground Sleeve Model Lacrosse Ballstopper System: Shall be as manufactured by AAE (Aluminum Athletic Equipment Co.), Royersford, PA., 1-800-523-5471, or approved equal.

1. AAE Model # HBS-1:
    a. Posts shall be straight uprights, 2-3/8" O.D. x 12'-6" long, 6063T6 aluminum extrusion with three pre-drilled heights at 9'-6"H, 10'-0"H and 10'-6"H. Posts to be spaced evenly approximately every 20 feet or less. Posts shall be designed so that as the nets expand over time, the higher holes can be used by moving the hardware. The poles shall have pre-drilled holes at the bottom of the posts for net attachment with hardware.
    b. Ground Sleeves: shall be 2-7/8 inch O.D. (2-1/2 inch I.D.) x 3/16-inch wall x 24 inches long, 6063T6 aluminum extrusion, and shall include LD polyethylene plugs with removable tabs.
    c. Net: Shall be 9'-6" high, #N361, 1-3/4" square black UV-treated knotted nylon net, 360-pound tensile strength, 1/4-inch MFP rope border all 4 sides, plus a 1/4-inch MFP rope border 6 inch offset from bottom of net for additional net to stop balls from going under, pre-attached sewn in 3/16-inch diameter galvanized clear coated cable.
    d. Tamper-Proof Ground Sleeve Plug: Model #GSP-2.50, UHMV tapered plug with removal slot, accessory plug for use when system is removed at end of season.
    e. Ground Sleve Plug Removal Tool: Model GSP-RT, stainless steel removal tool to be used with the GSP-2.50 Plug.

2.02 SCOREBOARDS

A. Scoreboards: Provide scoreboards in locations shown on drawings. Scoreboards shall be per Daktronics, or approved equal.

1. Baseball and Softball Scoreboard –BA-2005-21, Outdoor Baseball Scoreboard; Amber LED Digits; AS-5000 Controller. Provide 0A-1196-0039 battery power option. Provide hard-sided carrying case for AS-5000 controller. Provide Team Name in place of Home caption. Provide 24"x20' non-backlit sponsor/identification pane.
2. Football: MS-2009-21, with LED Option, Electronic Captions, ID Panel, and Arch Truss (DA-1001-25, with 50% lettering logo and screen backing). Provide battery power option for radio controlled All Sport consoles. Provide hard sided carrying case. Provide MS-2009-11/21 Sponsor/Logo Decoration. Provide TNMC LED Message center. Provide 8x32-34 mm Electronic captions for 18' and 25' long scoreboard. Provide 30"x25' non-backlit sponsor identification panel
3. Track: DVXMC, 120 x 375 (15.85mm) Outdoor Message Display. Provide Galaxy Message center and Sportsound 500HD sound cabinet (fixed rack) with SSR-100 Audio control system, to include two body packs, and one microphone.

B. Mounting: Boards shall be securely mounted in accordance with manufacturer's recommendations. Football Stadium to be 20' maximum to bottom of scoreboard; Soccer practice, baseball and softball field boards to be 14' maximum to bottom of scoreboard.

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C. Provide a year warranty for all scoreboards

D. Scoreboard poles shall have padding manufactured by Beacon Athletics or approved equal, color to be selected by architect.

2.03 PLAYER/TEAM BENCHES

A. Benches: Portable and permanent aluminum sideline benches with backs, as manufactured by Whitlam Paint Company, (www.whitlampaint.com), or approved equal. Provide portable (at football field) and permanent (at softball team areas and tennis courts) manufacturer's standard aluminum-plank team/player benches. Provide in manufacturer's maximum lengths to accommodate two 120-foot long benches at the football field, and the required length as indicated at the softball field dugouts. Install football field benches centered on midfield on each side of the football field. Install softball team benches as indicated.

1. Benches at tennis courts shall be 15 feet long (provide 2), permanent embedded installation.

2.04 TENNIS COURT SURFACING MATERIALS

A. Acceptable Systems: Provide a surfacing system by one of the following manufacturer's. Owner's Representative shall approve system and manufacturer prior to delivery of the system materials to the project site.

1. Copeland Latex-ite by American Tennis Courts, Inc.
2. Nova by Nova Sports, Framingham, Mass.
3. Court Masters by Sealmarters, Inc., Sandusky, Ohio

B. Any substituted system must be submitted for approval by the Owner's Representative.

C. Colors: Shall be as selected or confirmed by the Owner's Representative. Generally a green overall surface with red out-of-bounds lines and white court lines.

2.05 BASKETBALL COURT SURFACING MATERIALS

A. Surfacing shall consist of painted white lines on the finished asphalt pavement surface. Finished asphalt surface shall set and cool for a minimum of five days prior to application of line paint.

1. Court line painting templates/scheme shall be approved by the Owner's Representative prior to application of paint.

2.06 SOFTBALL DIAMOND SKINNED INFIELD SURFACING MATERIALS

A. Skinned Infield Soil Mix: Shall be a high-quality prepared mixture specifically formulated for skinned infields, with a mix of approximately 60% pulverized Red Clay and 40% sand, such as:

1. Regular Diamond Mix, by Dependable Sand Stone & Recycling, Easton, MD, 410-822-6363.
2. "Baseball Diamond Mix", as manufactured by Egypt Farms, White Marsh, Maryland, 410-335-3700 (http://www.egyptfarms.com)
3. "Diamond Dirt" Infield Mix as manufactured by Turf & Dirt, Hagerstown, Maryland, 410-952-5027, or approved equal.
4. Mix shall be free of crushed glass and any particles larger than 1/4" in any dimension.
5. For substitutions, Contractor shall submit a sample with a specification sheet for approval by the Owner's Representative.

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2.07 SOFTBALL DIAMOND WARNING TRACK MATERIALS

A. Warning Track Gravel Mix: Shall be a high-quality prepared gravel mixture specifically formulated for ball field warning tracks, as manufactured by Dependable Sand Stone & Recycling, Easton, MD, 410-822-6363, or by Egypt Farms, White Marsh, Maryland, 410-335-3700 (http://www.egyptfarms.com), or by Turf & Dirt, Hagerstown, Maryland, 410-952-5027, or approved equal.

2.08 TRACK AND FIELD EVENT SURFACING SYSTEM MATERIALS

A. Furnish and install a Plexitrac® Running Track “Lightning” polyresin resilient surfacing system, as manufactured by California Products Corporation on the accepted asphalt pavement.

B. Product substitution: If other than the product specified, the Contractor shall submit to the Owner’s Representative at least 7 days prior to the bid date a complete type written list of proposed substitutions with sufficient data, drawings, samples and literature to demonstrate that the proposed substitution is of equal quality and utility to that originally specified. Information must include a QUV test of at least 1,000 hours and IAAF test information for the system to be installed.

C. Any materials used must be an emulsion/water based product. Any products which require solvents such as MEK, Butyl Cellusolve or Acetone for clean up or mixing are not acceptable.

D. Materials must have a VOC less than 150g/lt. for binder products. Top coats shall have a VOC of less than 100g/lt. measured by EPA method 24.

E. Materials may not have a flash point of less than 200°F.

F. Court Patch Binder: Shall comply with Specification 10.14 of California Products Corporation. 100% Acrylic resin blended with Portland Cement and Silica Sand
   1. Percent solids by weight (minimum): 46%.
   2. Weight: 8.7-8.9 lbs./gallon.

G. CP-4125: Latex emulsion Primer. SBR emulsion
   1. Percent solids by weight (minimum): 50%.
   2. Weight: 8.35 lbs./gallon.

H. Plexitrac Binder: Shall comply with Specification 10.73 of California Products Corporation.
   1. High Viscosity Polyresin Blend, Color shall be Black.
   2. Percent solids by weight (minimum): 44.7%.
   3. Weight: 8.47 lbs./gallon.

I. Plexicolor Pigment: Water-borne dispersed pigment for enhanced color. Color shall be Black.

J. Plexitrac Coating: Shall comply with Specification 10.70 of California Products Corporation
   1. Highly Pigment Polyresin Top Coat, Color shall be Black.
   2. Percent solids by weight (minimum): 47.4%.
   3. Weight: 8.45 lbs./gallon.

K. Line Paint: Shall comply with Specification 10.4 of California Products Corporation.
   1. 100% Acrylic Resin containing no alkyds or vinyl copolymer constituents.
   2. Percent solids by weight (minimum): 53.1%.
   3. Weight: 11.6 lbs./gallon.

L. Rubber Granules: Specifically gradated 1-3MM SBR and/or EPDM particles for job mixing with the Plexitrac Binder.

M. Water: The water to be used in the mixture must be fresh and potable.

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N. Colors: Surface base color shall be Black. Line marking colors shall be in accordance with track and field standards, or as otherwise directed by the Owners' Representative.

2.09 ARTIFICIAL TURF SYSTEM

A. Provide per Section 321813.

B. Field Colors and Striping: The artificial turf field shall have five (5) sports inlaid into the green fabric. The Contractor shall coordinate with the Owner's Representative for samples used at other Schools. The field line layout and dimensions shall meet the current National Federation of State High School Associations guidelines. The sports and colors shall include:

1. Football (white)
2. Soccer (red)
3. Field Hockey (orange)
4. Boy's Lacrosse (yellow)
5. Girl's Lacrosse (blue)

C. Edge Detail: Provide an anchoring edge around the field perimeter in accordance with the artificial turf system manufacturer's recommendations and as noted. The edge shall normally be a 6-inch by 12-inch poured concrete curb. An exception may be made, by the artificial turf system Contractor, for the high school stadium field surrounded by a running track. The Contractor shall provide a full description and drawings of the edge detail for approval by the Owner's Representative and the Architect.

1. The edge detail shall be installed around the entire perimeter of the excavated field area prior to the installation of the stone to insure immediate play after installation without uprooting or disturbing the surrounding features.

D. Field Groomer: Provide the Owner with field grooming equipment in accordance with the artificial turf manufacturer's standards and recommendations, including a towing mechanism compatible with a field utility vehicle. Grooming device shall be a towed brush/rake designed to restore turf and infill to like-new conditions, relieve compaction, evenly redistribute fill material and lift the pile, leaving the fibers in an upright position.

2.10 TRACK ELECTRONIC STARTING GUN AND TIMING SYSTEM

A. Furnish and install a Competition Elite all-inclusive, single-camera, color photo finish starting and timing system as manufactured by Lynx System Developers, Inc., Haverhill, MA, 978-556-9780 (http://www.finishlynx.com).

B. The Contractor shall provide all necessary power and signal components to assure a complete and functioning system, positioned and installed in accordance with manufacturer's standards and specifications.

C. System shall be fully compliant with I.A.A.F. Rule 165:15 (2004-2005 Edition).

2.11 GRAVEL:

A. Gravel Base: Gravel Base shown or specified for athletic equipment shall be MSHA Graded Aggregate Base (GAB) material, Section 901.01.

B. Gravel Drainage Material: Stone shall be MDSHA, size 57 Coarse Aggregate, Section 901.01.

C. Geotextile Fabric (Filter Cloth): "Typar", manufactured by Remay Incorporated, Nashville, Tennessee, type 3341 or approved equal.

1. Contractor's Option: "Mirafi 140 N", manufactured by Mirafi Incorporated, Charlotte, North Carolina, or equal, as approved by the Soils Engineer (Owner's Representative) (Architect).

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2. Quality: Free of defects or flaws which affect strength or filtering properties.

PART 3 EXECUTION

3.01 INSPECTION

A. Installer and Owner's Representative shall examine the area and conditions under which the track and field equipment and surfacing will be installed. Do not proceed until all conditions which would be detrimental to the installation are corrected.

3.02 PROTECTION AND RESTORATION

A. Protect all improvements and facilities during installation of court surfacing systems to prevent overspray damage.

B. Protect completed surface from damage. Prevent access to the finished courts for the amount of time recommended by the surfacing system manufacturer, plus 24 hours. Restore damaged surfaces as directed by the Architect or Owner's Representative, at no increase to the Contract sum.

3.03 ATHLETIC EQUIPMENT

A. General: Install athletic equipment in accordance with manufacturer's written installation instructions, recommendations, and as indicated.

1. Contractor shall assure that all support members have sufficient bury depth and footing size to provide adequate support and protection against movement. Submit shop drawings for the footing designs for the batting cage system and the baseball foul line netting system.

B. Softball Foul Line Netting System: Bottom of netting shall extend a distance of no less than 12 inches below the top of the field perimeter fencing. Attach the bottom of the netting directly to the inside face of the chain link fencing fabric, along the top of the fence, with galvanized "hog-rings" or with nylon lacing. Space ties at 24 inches.

C. Football Goals and Ground Sleeve Lacrosse Ballstopper System: Coordinate installation and construction with artificial turf football/soccer field construction and the Owner’s Representative. All sleeves shall be set plumb and true to line and grade in Class B concrete per manufacturer’s recommendations. Provide certifications indicating that equipment has been tested and adjusted to conform to specified standards. Provide operating and maintenance instruction and manuals to Owner’s Representative.

3.04 ATHLETIC COURT BASE PREPARATION

A. Verify finished condition of prepared base pavements. Finished asphalt paved surface shall cure a minimum of 30 days prior to construction of court surfacing system. Clean and dry prepared asphalt pavement surface, with compressed air, removing debris, dust, foreign materials and moisture, prior to beginning construction of surfacing system.

B. Do not begin surfacing system construction until base paving has been accepted by the Architect or the Owner's Representative.

C. Verify that all fence posts have been installed and all bracing has been removed, all other athletic court facilities are completely installed, and that court fencing is properly prepared as specified above.

3.05 COURT SURFACING SYSTEM CONSTRUCTION

A. All work shall be done in strict accordance with manufacturer's written installation instructions.

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B. Flood prepared asphalt pavement surface with water in the presence of the Owner's Representative. Any areas holding water over 1/8" deep shall be leveled.

C. Complete construction of court surfacing systems in strict accordance with manufacturer's written installation instructions.

3.06 SKINNED INFIELD CONSTRUCTION

A. Subgrade Preparation: Verify subgrade elevations and correct discrepancies. Rake and remove stones exceeding **<< 1/4 inches>>** in any dimension.

B. Baseball Diamond Mix Placement: Place and uniformly spread the baseball diamond mix over prepared subgrade to an average depth of 4 to **<< 6 inches>>**. Lightly compact the finished installation. Do not place on frozen, muddy or excessively wet subgrade.

3.07 WARNING TRACK CONSTRUCTION

A. Excavation in the areas to receive Warning Track shall include removal of all soil, sod, roots, etc. to a depth of six inches below finished grade.

B. Verify subgrade elevations and correct discrepancies. Rake and remove stones exceeding 1/2 inch in any dimension.

C. Place filter cloth on prepared subgrade and extend up the walls of the excavation to the finished top of the gravel.

D. Warning Track Mix Placement: Place and uniformly spread the Warning Track mix over the installed filter cloth to a consistent depth of 6 inches. Lightly compact the finished installation. Do not place on frozen, muddy or excessively wet subgrade.

3.08 TRACK AND FIELD EVENT SURFACING SYSTEM CONSTRUCTION

A. All work shall be done in strict accordance with manufacturer's written installation instructions.

B. Weather Limitations:
   1. Ambient and surface temperatures must be 50 degrees F and rising.
   2. Installation should not be conducted during rainfall or when rainfall is imminent.
   3. Do not apply when surface temperature is in excess of 140 degrees F.

C. Surface Preparation:
   1. New asphalt shall be allowed to cure for a minimum of 14 days prior to the application of any surfacing materials.
   2. The surface must be thoroughly cleaned of all loose dirt and debris.
   3. Prior to the application of resilient surface materials, the entire surface shall be flooded and checked for depressions or irregularities in the asphalt. Any puddle area covering a nickel shall be marked and repaired with Court Patch Binder, according to California Products Specification 10.14. After patching, the asphalt surface shall not vary more than 1/4-inch in 10 feet, measured in any direction. Any depressions 1/4-inch or greater, shall be leveled using patch materials indicated. Slopes shall meet the guidelines of the ASBA and NFHS.

D. After curing and preparation the asphalt shall be primed/tack coated with CP-4125 at the rate of 0.04 gal/sy. by means of a dual diaphragm Weldon pump and spray unit. Do not allow material to puddle on the asphalt surface.

E. Apply dry 1-3 MM Black SBR to the tack coated surface by mechanical spreader or by hand. Avoid leaving dry rubber granules more than one layer thick.

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F. Apply Plexitrac Binder at the rate of one gallon per 18 lbs. of Black SBR granule by means of an air diaphragm pump. Care should be taken to uniformly spray the granule so they are fully encapsulated.

G. Apply additional layers of Black SBR granule and Plexitrac Binder until the specified thickness and weight of Black rubber has been applied. Each dry layer should be raked by hand to insure uniformity of thickness and density. In no case should a rubber layer be greater than 2.5 lbs./square yard prior to Plexitrac Binder Application.

H. Apply dry 1-3 Black EPDM granule at the rate not more than 2.5 lbs./sy. Additional layers and spray coats shall be applied to achieve the specified 1/2-inch thickness. Usually this is achieved in 5 lifts.

I. Apply Plexitrac Binder at the rate of one gallon for 25 lbs. of 1-3 MM Black EPDM granule. Add 5 gallons of Plexitrac pigment to each 55 gallon drum of Plexitrac Binder for added UV stability.

J. Prior to application of the UV protective coatings and line marking, the surface shall be tested for the required depth using SMG FT-3 Floor Tester depth gauge. The running track oval shall be tested in no less than 100 locations. The tests shall be performed at the center of both the outer and inner lane, as well as, the center of the oval. If at least 80% of the readings do not meet the required depth, additional layers of rubber and binder will be applied until the proper depth has been achieved.

K. Apply Plexitrac coating at the total rate of .1 gallon per square yard. Product shall be applied in two applications by an air diaphragm pump spray unit. One application shall be applied clockwise, the other counter clockwise.

L. Marking and Measurements: Wait 48 hours after surface completion before applying line marking. The installer shall:

1. Locate and establish all radius points.
2. Establish and set all necessary control points.
3. Layout all lines and markings to tolerances set forth by ASBA and governing body requirements.
4. Prepare all necessary drawings.
5. Provide all computations and measurements in organized form.
6. Establish all locations on the curves using a Transit or Theodolite capable of reading direct to 20 seconds.
7. Identify all markings, where appropriate, by painting the identification directly onto the track surface in 4-inch letters just below or in front of each mark in the right hand portion of the lane.
8. Paint all of the large, 3 feet high, lane numbers in two (2) colors, utilizing shadowed backgrounds.
9. All lines shall receive sufficient paint to assure complete opacity and uniformity of color.
10. Paints shall be used directly from original containers and shall be thinned only when hot temperatures dictate thinning for smooth applications.
11. Amount of paint used shall be as recommended by the manufacturer.
12. The paint used shall be a 100% acrylic latex line paint, Plexicolor Line paint, made especially for the painting of lines on sports surfaces
13. All measurements shall be made by competent, experienced and fully qualified personnel.
14. Upon completion of the track markings, a licensed professional engineer or registered land surveyor shall furnish an acceptable letter of or certificate of, accuracy to the Owner attesting to the accuracy of the track markings and measurements. This will also include copies of the computations, calculations and drawings that were used to obtain this

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accuracy. The Engineer or Surveyor should affix their stamp to the drawing and the certificate.

15. The markings shall include all events and marks required or recommended by the National Federation of State High Schools, the NCAA, or the I.A.A.F dependent on the end use of the facility.

M. Protection:
1. During construction the owner is responsible for limiting access of non-construction personnel to the site.
2. The owner shall coordinate any irrigation of fields with the installation contractor.
3. The installer shall protect curbs, fences and other structures from overspray.

N. Cleanup:
1. Remove all containers, surplus and debris and dispose of in accordance with local, state and Federal regulation.
2. Remove all spills and overruns.
3. Leave site in a clean and orderly condition.

O. Long-Jump / Triple Jump:
1. Take-off boards for men's runway shall be spaced in accordance with normal track standards, or at 12 feet, 32 feet, 36 feet, and 40 feet.
2. Take-off boards for women's runway shall be spaced in accordance with normal track standards, or at 8 feet, 12 feet, 32 feet, and 36 feet.
3. Track Contractor shall pour polyurethane surface material into the take-off board trays and cut out to be used as a tray cover when the jumping surface is not in use. Polyurethane cutout shall be made to be flush with the runway.

3.09 TRACK ELECTRONIC STARTING GUN AND TIMING SYSTEM

A. Install in accordance with manufacturer's written installation specifications.

B. Coordinate with Track construction to assure that installation will not disrupt construction of track base or surfacing courses, or cause damage to Track color coating.

3.10 ARTIFICIAL TURF SYSTEM CONSTRUCTION

A. Provide per Section 321813.

B. Field Colors and Striping: The artificial turf field shall have five (5) sports inlaid into the green fabric in a manner recommended by the Manufacturer of the turf. The procedure shall not include cutting the backing of the turf fabric. The Contractor shall coordinate with the Owner's Representative for samples used at other Schools. The field line layout and dimensions shall meet the current National Federation of State High School Associations guidelines. The sports and colors shall include:
1. Football (white)
2. Soccer (red)
3. Field Hockey (orange)
4. Boy's Lacrosse (yellow)
5. Girl's Lacrosse (blue)

C. Maintenance Service: The Contractor shall train the Owner's staff within two weeks after the installation is complete regarding the proper use of the artificial turf manufacturer's recommended grooming equipment.

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3.11 CLEANING

A. Clean improvements and facilities damaged by surfacing system application as directed by the Architect or the Owner's Representative.

B. Protect installed artificial turf from subsequent construction operations.

C. Contractor shall provide the labor, supplies, and equipment as necessary for final cleaning of surfaces and installed items.

D. All usable remnants of new material shall become the property of the Owner.

E. The Contractor shall keep the area clean throughout the project and clear of debris.

F. Surfaces, recesses, enclosures, etc., shall be cleaned as necessary to leave the work area in a clean, immaculate condition ready for immediate occupancy and use by the Owner.

END OF SECTION 321820

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SECTION 321823
SYNTHETIC RUNNING TRACK SURFACE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Conditions and Division One through Division Two Specification Sections, apply to Work of this Section.

1.02 RELATED SECTIONS

A. Section 321216 – Hot-Mixed Asphalt Paving

B. Section 323113 - Chain Link Fences and Gates

1.03 REFERENCE STANDARD

A. Applicable standards and details of Maryland Department of Transportation "Standards and Specifications."

1.04 WORK DESCRIPTION

A. Construct synthetic running track surface as indicated on civil drawings. Work of this section shall include following:

1. Excavation and preparation of sub-grade for area designated to receive track surfacing. Legally dispose of excess materials offsite.
2. Construction of a suitable base for track surfacing.
3. Construction of track surfacing, including lane striping.
4. Perimeter fencing is covered under Section 323113.

B. Track surfacing shall be uniform in thickness, texture, and color, in accordance with grades, cross sections, and pitch required by Drawings, and free of all depressions and ridges.

1.05 SUBMITTALS

A. Submit running track surfacing manufacturer's product data, catalog cuts, application specifications, maintenance information and office samples.

1.06 QUALITY ASSURANCE

A. Installer of running track shall be certified by approved manufacturer, and shall use only workmen who are trained and experienced in installation of track surface.

B. Running Track: Finished system shall meet following criteria:

1. Force Reduction: 30 percent to 50 percent, inclusive.
2. Modified Vertical Deformation: 0.6mm to 1.8mm, inclusive.
3. Resistant to scuffing and shedding of granules.

C. Single Source Responsibility: Track surfacing materials shall be supplied by one manufacturer. Track and field event surfacing and equipment construction shall be provided by a Contractor with a minimum of 5 years experience in construction of similar projects.

D. Construction shall be performed in strict accordance with written instructions of surfacing and equipment Manufacturers.

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1.07 WARRANTY:

A. Provide a minimum one (1) year warranty, covering materials and installation. Contractor shall repair or replace defective surface, at no cost to Owner during warranty period.

PART 2 PRODUCTS

2.01 RUNNING TRACK SURFACING

A. Running Track Surfacing: Provide vented latex surface consisting of a mixture of uniformly graded Styrene Butadiene Resin (SBR) base and intermediate layer rubber granules and EPDM surface layer rubber buffings, bound together with SBR polymer binder having a minimum of 50 percent resin solids content. Nominal thickness: 3/8 inch. Gradation of granules: Between 1 and 6 millimeters containing less than 4 percent dust when retained on a number 30 sieve.
   1. Approved Manufacturers:
      a. "Reflex-CT" Vented Latex Running Track Surface, American Tennis Courts, Inc., Baltimore, Maryland (basis of specification)
      b. "MaxflexBL," Precision Sports Surfaces, Inc., Charlottesville, Virginia.
      c. Pre-bid approved substitution in accordance with Section 01630.

B. Marking Paint: 100 percent acrylic line marking paint approved by the track surface manufacturer.

C. Track Surface Base: Asphalt Track Surface Base Course: SHA Hot Mix Asphalt Superpave: Section 901.01, 904.01 and 904. over 4 inch SHA Hot Mix Asphalt Superpave Base Course: SHA Sections 901.01, 904.01 and 904 (gradations shall be as shown on approved drawings) over 8 inch SHA Graded Aggregate Base Section 901.01 – Table B compacted to 95 percent proctor density and cement treated.

D. Any substituted system must be submitted for approval by the Owner's Representative.

E. Colors: Surface base color shall be black. Line marking colors shall be in accordance with track and field standards, or as otherwise directed by the Owners' representative.

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PART 3 EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which Work of this Section shall be installed. Correct conditions detrimental to proper completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Fill excavated areas to minimum depths of stone and bituminous concrete base as indicated in PART 2. Base shall be allowed to cure for a minimum of fourteen (14) days prior to application of running track surface. Base shall be clean, dry, free draining, and free of foreign materials.

B. Verify weather conditions before beginning installation of track surface. Do not place track materials when ambient nighttime temperature is expected to fall below 50 degrees F.

3.03 INSTALLATION

A. Once base has cured, and prior to installation of track surface, apply a prime coat of manufacturer's approved binder (one (1) part water to one (1) part binder). Apply in rate (gallons per yard) as specified by Manufacturer. Asphalt emulsions are not acceptable.

B. Base Layer: Evenly apply rubber granules manually or by means of mechanical spreader, at rate specified by Manufacturer. Base layer shall be saturated with approved binder, mixed and spray-applied in accordance with Manufacturer's specifications. Allow this layer to cure for a minimum of twenty-four (24) hours under dry weather conditions.

C. Apply second and third layers of rubber granules, installed in same manner as base layer, at rate as specified by Manufacturer. Saturate this layer with approved binder.

D. Surface Course: Apply rubber buffings in number of applications and rates (2.6 pounds per square yard) as required by Manufacturer's specifications. Final surface layer shall be pigmented black.

E. Line Marking:
   1. Using approved line marking paint, install all striping in accordance with National Federation of High Schools for 400 meter running surfaces. Required striping, including event markings and lane numbers, shall receive two (2) coats of paint.
   2. Lane striping shall be based on 42 inch lane widths measured center to center of lane lines.

3.04 POST CONSTRUCTION TESTING AND ACCEPTANCE

A. Finished running track surface shall be uniform in thickness and texture. Thickness shall meet Manufacturer's minimum recommended thickness. Owner reserves right to perform thickness testing, and if found non-compliant, require Contractor to install additional courses until recommended minimum is achieved. Owner also reserves right to reject installation based on non-uniform distribution of granule sizes.

3.05 PROTECTION

A. Protect running track surfaces from damage by work of other trades until accepted by Owner.

3.06 CLEAN UP

A. Remove all excess materials and debris associated with Work of this Section from project area and legally dispose of offsite.

END OF SECTION 321823

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SECTION 323113
CHAIN LINK FENCING AND GATES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM F668 - Standard Specification for Polyvinyl Chloride (PVC), Polyolefin and Other Polymer-Coated Steel Chain Link Fence Fabric.

1.02 RELATED DOCUMENTS

A. Drawings and General Provisions of Contract, including the General Conditions and other Division 1 Specification Sections, apply to the work of this Section.

1.03 DESCRIPTION OF WORK

A. Materials and Work Required to Construct Chain Link Fence and Gates and Related Accessories.

1.04 RELATED SECTIONS

A. Section 312000: “Earthmoving”

B. Section 321610: “Concrete Curbing”

C. Section 321216: “Hot-Mixed Asphalt Pavement”.

1.05 CODES

A. Existing Underground Utilities: Refer to Section 312000 "Earthmoving".

1.06 STANDARDS

A. Installation shall be per chain link manufacturer’s standards (CLFMI).

1.07 SUBMITTALS

A. Submit manufacturer's descriptive literature, specifications and installation instructions for chain link fence and gates.

1. Include location of product manufacture.

B. Submit samples of vinyl-coated fabric 12 by 24 inches.

C. Warranty:

1. Submit typewritten vinyl coated fence warranty signed by Manufacturer and Contractor.

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver chain link fencing to Project Site in original unopened containers bearing manufacturer's label.

1.09 QUALITY ASSURANCE

A. Provide complete fencing (of each type) produced by a single manufacturer.

1.10 PROJECT CONDITIONS

A. Refer to Section 312000 "Earthmoving" and as noted.

B. Limitations: Do not proceed with fencing installation until underground utility, bituminous concrete pavement and concrete curb and gutter construction is complete.

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1.11 WARRANTY

A. Warrant vinyl coated fencing for 10 years against peeling, cracking, and corrosion.

1.12 CONSTRUCTION SURVEYS

A. Retain the services of a registered land surveyor or professional engineer to provide horizontal alignment stakes for fencing located adjacent to site property lines. Horizontal stake interval 50 feet maximum, and at all angle points along property line.

B. Provide horizontal alignment stakes for project site fencing. Horizontal stake interval 50 feet maximum and at all corner points.

PART 2 PRODUCTS

2.01 CHAIN LINK FENCING

A. Acceptable Manufacturers, giving preference to products manufactured within a 500-mile radius of Project Site:
   1. Hercules Fence of Maryland, LLC
   2. Long Fence, Inc.
   3. Other pre-bid approved manufacturer(s) meeting the requirements of this Specification Section will be considered in accordance with Specification Section 012500: Substitutions Procedures.

B. General: Posts, rails, braces, and bracing assemblies shall be high tensile steel pipe, cold-rolled and electric resistance welded from steel conforming to ASTM A 569, and hot-dip galvanized to ASTM A 525 G-90 zinc weight both inside and outside pipe.

C. Finish: Outsides shall receive a conversion coating and fusion bonded polyester powder coating equivalent to "Lifecoat LCX" by P & H Tube. Coating color shall be black.
   1. Fencing except Tennis Courts shall have bottom tension wire.
   2. Fencing shall have continuous top rail.

D. Fabric: 9-gauge (0.148-inch) core size, finished steel wires, galvanized in accordance with ASTM A 641-71a. Finish shall be thermally bonded PVC over galvanized steel, Class 2B, in accordance with **<<ASTM F668>>**. Coating color shall be black. Fabric shall have 2-inch diamond mesh pattern, except where otherwise noted, with top and bottom selvages knuckled.
   1. Tennis Court, Basketball Court, and Playfield Fencing: Mesh size shall be 1-3/4 inches. Tennis Court and Basketball Court fencing shall have top rail, mid-rail, and bottom rail.
   2. Fences on top of retaining walls: Mesh size shall be 1-inch.

E. Posts, Rails and Braces:
   1. Terminal Posts (Corner Posts): Up to 6 feet: 2.375-inch O.D.; over 6 feet: 2.875-inch O.D.
   2. Line Posts: Up to 6 feet: 1.90-inch O.D.; over 6 feet: 2.375-inch O.D.
   3. Gate Posts (Hinge Posts): Leaf widths up to 6 feet: 2.875-inch O.D.; leaf widths 6 feet to 13 feet: 4-inch O.D.
   4. Top Rail and Bottom Rail: Manufacturer’s longest lengths, with expansion couplings (approximately 6 inches long) for each joint. Provide means of attaching top rail securely to each corner, end, and pull post.
   5. Terminal and Gate Post Bracing Assemblies: Manufacturer’s standard adjustable brace at end posts and at both sides of corner and pull posts, with horizontal brace located at mid-height of fabric. Use same material as top rail for braces. Brace line posts with 0.375-inch diameter rod and adjustable tightener.
   6. Mid-Rail: Provide mid-rail on all fences that are 6’ and taller.

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7. Stretcher Bars: One-piece lengths equal to full height of fabric, with minimum cross section of 3/16" x 3/4". Provide one stretcher bar at each end post and two for each corner and pull post, except where fabric is integrally woven into post.

F. Gates:
1. Gate framing shall be 2-inch square aluminum tube with fabric installed inside frame. “J” bolts shall not be used.
2. Hinges shall be Manufacturer’s standards.
3. Latches shall be butterfly type.
4. Height shall match adjacent fencing fabric, leaf swings 180 degrees.

G. Bottom Tension Wire: 7-gauge, O.D. = 0.177-inch core size, with PVC coating.

H. Post Tops (Caps): Weathertight closure caps, dome type, at each post, with openings to permit passage of top rails.

I. Hardware and Accessories: Galvanized per ASTM A 152 with manufacturer’s standard polyvinyl chloride (PVC) plastic resin finish over galvanizing, not less than 10 mils**<< 10 mil>>** thick.

2.02 CHAIN LINK FENCING HEIGHTS

A. Heights shall be as indicated or as specified:
1. Fencing around tennis courts shall be 10'-0" high.
2. Fencing around basketball courts shall be 8’-0” high, unless otherwise noted.

2.03 CONCRETE

A. Maryland Department of Transportation State Highway Administration Mix 3 for post foundations.

B. Maryland Department of Transportation State Highway Administration Mix 6 for no-mow strips.

2.04 NO-MOW STRIPS

A. Provide concrete no-mow strips along all playfield fencing.

B. No-mow strips shall be 12 inches wide and centered along the fence.

2.05 PANIC BARS

A. Provide Panic Bar hardware on all gates that are part of an enclosed fence area.

B. Panic Bars do not need to be connected to an alarm, unless noted otherwise on the drawings.

C. Installation needs to be approved by the Fire Marshal prior to occupancy. Contractor shall arrange for inspection.

PART 3 EXECUTION

3.01 PROTECTION AND RESTORATION

A. Refer to Section 312000 "Earthmoving" and as noted.

B. Existing Utilities: Verify utility locations prior to fencing excavation operation. Adjust horizontal fencing alignment to avoid utilities at no increase to Contract Sum.

3.02 GRADING

A. Grade fence lines to smooth and uniform surfaces, free of depressions and high spots exceeding four inches in ten feet.

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3.03 CHAIN LINK FENCING

A. General: Install in accordance with Manufacturer's installation instructions and as noted. Install corner posts at horizontal alignment changes exceeding 30 degrees. Install line posts at intervals not exceeding ten feet. Install gateposts on both sides of gate opening.

B. Post Installation:

1. Excavate post footings to minimum 18-inch diameters and 39-inch depths or as otherwise indicated.
2. Place and consolidate concrete in footing excavations. Install posts in concrete plumb to 1/4 inch in 10 feet. Provide bracing to prevent movement. Embed line post in concrete to 18 inches, terminal, and gate posts to 24 inches. Slope exposed concrete footing surface one inch with outside edge flush with ground surface. Trowel exposed concrete footing surface to smooth finish. Contractor shall allow concrete footings to cure a minimum of 14 calendar days before removing bracing or performing subsequent fencing operations.
3. Post foundations within grass areas shall be slightly raised above finish grade and sloped to drain away from the post
4. Post foundations adjacent to paved areas shall be flush with the finish surface, and sloped away from the post.

C. Terminal and Gate Post Bracing Assemblies, Truss Rods and Tighteners and Tension Wire and Post Tops: Install in accordance with Manufacturer's installation instructions and as specified.

D. Fabric: Each span shall be attached independently at pull and corner posts. Ends of fabric rolls and other section to be spliced shall be joined by weaving a single strand of fabric wire into ends of fabric to create a continuous pattern of mesh. Fabric shall be stretched taut and securely fastened to each post and rail. Fastenings at ends, gates, corners, and pull posts shall be with stretcher bars and metal bands.

3.04 MAINTENANCE

A. Refer to Section 312000 "Earthmoving".

END OF SECTION 323113

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SECTION 323119
ORNAMENTAL STEEL FENCING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

B. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

C. ASTM D523 - Standard Test Method for Specular Gloss.

D. ASTM D714 - Standard Test Method for Evaluating Degree of Blistering of Paints.

E. ASTM D1654 - Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.

F. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.

G. ASTM D2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).

H. ASTM D3359 - Standard Test Methods for Rating Adhesion by Tape Test.

I. ASTM F2408 - Standard Specification for Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.02 WORK INCLUDED

A. The contractor shall provide all labor, materials and appurtenances necessary for installation of the welded ornamental steel fence and gate system defined herein.

1.03 SYSTEM DESCRIPTION

A. The manufacturer shall supply a total fence system of Montage II® welded ornamental steel, Majestic design, by Ameristar Fence Products, Inc., of Tulsa, Oklahoma; or pre-bid approved equal. The system shall include all components (i.e., panels, posts, gates and hardware) required.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's product data, specifications, and installation instructions, including panels, posts, gates and hardware.

B. Shop Drawings: Submit shop drawings including the following:

1. Plans and elevations showing fence, post, and gate locations in relationship to surrounding buildings and site features.
2. Anchoring details and location of anchorage.

1.05 QUALITY ASSURANCE

A. The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

1.06 PRODUCT HANDLING AND STORAGE

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A. Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

1.07 WARRANTY

A. Provide manufacturer's standard 10-year warranty for materials.

B. Provide 2-year warranty for installation.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. The fence system shall conform to Montage II Welded ornamental steel Majestic design, flush bottom rail treatment, 3-Rail style, manufactured by Ameristar Fence Products, Inc., of Tulsa, Oklahoma; or pre-bid approved equal.

2.02 MATERIAL

A. Steel material for fence panels and posts shall conform to the requirements of **<<ASTM A653/A653M>>**, with a minimum yield strength of 45,000 psi and a minimum zinc (hot-dip galvanized) coating weight of 0.90 oz/ft^2 (276 g/m^2), Coating Designation G-90. A minimum of 62% of the steel material shall be derived from recycled scrap metal.

B. Material for pickets shall be 1" square x 14 Ga. tubing. The rails shall be steel channel, 1.75" x 1.75" x .105". Picket holes in the rail shall be spaced 4.715" o.c. Fence posts and gate posts shall meet the minimum size requirements of Table 1.

2.03 FABRICATION

A. Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre- punched to accept pickets.

B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by Ameristar's proprietary fusion welding process, thus completing the rigid panel assembly.

C. The manufactured panels and posts shall be subjected to an inline electrodeposition coating (E-Coat) process consisting of a multi-stage pretreatment/wash (with zinc phosphate), followed by a duplex application of an epoxy primer and an acrylic top- coat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils. The color shall be black. The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2.

D. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under **<<ASTM F2408>>**.

E. Swing gates shall be fabricated using 1.75" x 14ga Forerunner double channel rail, 2" sq. x 11ga. gate ends, and 1" sq. x 14ga. pickets. Gates that exceed 6' in width will have a 1.75" sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection. Cable kits will be pro- vided for additional trussing for all gates leaves over 6'.

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PART 3 EXECUTION

3.01 PREPARATION

A. All new installation shall be laid out by the contractor in accordance with the approved shop drawings.

3.02 FENCE INSTALLATION

A. Fence post shall be spaced according to Table 3, plus or minus 1/2-inch. For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to posts with brackets supplied by the manufacturer. Posts shall be set in concrete footers having a minimum depth of 36 inches. Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the in- tended application.

3.03 FENCE INSTALLATION MAINTENANCE

A. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces;
   1. Remove all metal shavings from cut area.
   2. Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry.
   3. Apply 2 coats of custom finish paint matching fence color.

3.04 GATE INSTALLATION

A. Gate posts shall be spaced according to the manufacturers' gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based on the application, weight, height, and number of gate cycles. The manufacturers' gate drawings shall identify the necessary gate hardware re- quired for the application. Gate hardware shall be provided by the manufacturer of the gate and shall be installed per manufacturer's recommendations.

3.05 CLEANING

A. The contractor shall clean the jobsite of excess materials; post-hole excavations shall be removed.

Table 1 – Minimum Sizes for Montage II Posts

Fence Posts	Panel Height
2-1/2" x 12 Ga.	Up to & Including 6' Height
3" x 12 Ga.	Over 6' Up to & Including 8' Height

Gate Leaf	Gate Height		
	Up to & Including 4'	Over 4' Up to & Including 6'	Over 6' Up to & Including 8'
Up to 4'	2-1/2" x 12 Ga.	3" x 12 Ga.	3" x 12 Ga.
4'1" to 6'	3" x 12Ga.	4" x 11 Ga.	4" x 11 Ga.
6'1" to 8'	3" x 12 Ga.	4" x 11 Ga.	6" x 3/16"
8'1" to 10'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
10'1" to 12'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
12'1" to 14'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"

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14’1” to 16’	6” x 3/16”	6” x 3/16”	6” x 3/16”

Table 2 – Coating Performance Requirements

Quality Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,500 hours (Scribed per D1654; failure mode is accumulation of 1/8” coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625” ball).
Weathering Resistance	D822 D2244, D523 (60˚ Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

Table 3 – Montage II – Post Spacing By Bracket Type

Span	For INVINCIBLE® 8’ Nominal (91-1/4” Rail)		For CLASSIC, GENESIS, & MAJESTIC 8’ Nominal (92-5/8” Rail)					
Post Size	2-1/2”	3”	2-1/2”	3”	2-1/2”	3”	2-1/2”	3”
Bracket Type	Industrial Flat Mount (BB301)		Industrial Universal (BB302)	Industrial Universal (BB303)	Industrial Flat Mount (BB301)		Industrial Swivel (BB304)*	
Post Settings ± ½” O.C.	94-1/2”	95”	96”	96-1/2”	96”	96-1/2”	*96”	*96-1/2”

*Note: When using BB304 swivel brackets on either or both ends of a panel installation, care must be taken to ensure the spacing.

between post and adjoining pickets meets applicable codes. This will require trimming one or both ends of the panel.

END OF SECTION 323119

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SECTION 323223
PRECAST MODULAR BLOCK RETAINING WALLS

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes precast concrete modular retaining walls, without soil reinforcement as noted in the civil drawings. Three precast concrete modular block manufacturers used as a basis of design are as follows:
   1. Redi-Rock:
      a. 46” wide by 18” high
      b. Kingstone stone texture (for pricing purposes only, Architect to select pattern)
   2. Stone Strong:
      a. 2’, 4’ or 8’ wide by 18” high
      b. Tennessee foothills pattern (for pricing purposes only, Architect to select pattern)
   3. Equivalent product may be submitted.
   4. If soil reinforcing with grid is required or is more efficient, notify engineer for approval prior to bidding.

B. Related Requirements:
   1. Section 312000 "Earthmoving" for excavation and backfill behind retaining walls.

1.02 REFERENCE STANDARDS

A. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).

B. ASTM D4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile.

C. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Precast modular block system brochure.
   2. Precast modular block concrete test results including compressive strength tests, air content, and slump.
   3. Geotextile fabric liner.

B. Samples: For each color and texture of concrete unit specified.

C. Shop Drawing Submittal: For precast concrete modular retaining walls.
   1. Retaining wall design calculations, signed and sealed by the manufacturer’s engineer.
   2. Retaining wall construction shop drawings, signed and sealed by the manufacturer’s engineer (licensed in the State of Maryland).
      a. Include sections and plan views indicating the plan layout, height, backfill slope, and construction details.
      b. Include sufficient information to show grading and drainage of the site is understood.
      c. Indicate that soil information in the supplemental geotechnical report and structural drawings is being utilized in design (soil bearing pressure, soil shear capacity, etc.).

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1.04 INFORMATIONAL SUBMITTALS

A. Contractor Qualifications: Retaining wall installer shall provide documentation showing experience on similar sized wall projects constructed in the past three (3) years.

B. Research/Evaluation Reports: For modular retaining wall units and soil reinforcement, from ICC-ES.

C. Preconstruction test reports.

D. Field quality-control reports.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to **<<ASTM E329>>** for testing indicated.

B. Bearing subgrade and backfill shall be tested by the testing agency for compliance with the shop drawing requirements for material properties and proper compaction.

C. Samples: Provide precast concrete block face shell samples for stain color and texture approval.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Basis of Design: Design of precast concrete modular retaining walls is based on products indicated in Section 1.01A. If comparable products of another manufacturer are proposed, provide design catalog to architect to select block size, shape, stain color, and surface pattern.

B. Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design precast concrete modular retaining walls.

C. Compliance Review: Qualified professional engineer responsible for precast concrete modular retaining wall design shall review and approve submittals and source and field quality-control reports for compliance of materials and construction with design.

D. Structural Performance: Engineering design shall be based on the loads listed in the structural drawing.

2.02 PRECAST CONCRETE RETAINING WALL BLOCKS

A. Concrete Units:

1. Wall units shall conform to ASTM C1776 - Standard Specification for Wet-Cast Precast Modular Retaining Wall Units.
2. Concrete for precast modular blocks shall have a minimum 28-day compressive strength of 4,500 psi. Entrained air content shall be between 5% and 7%.
3. Units shall be reinforced according to manufacturer’s requirements. All reinforcing shall have a minimum yield strength of 60 ksi. Minimum clear cover to reinforcement shall be 1-1/2 inches.
4. The face pattern shall be selected from the manufacturer’s standard molds. See Section 1.1A for preliminary selection of textures/patterns.
5. The color of the units shall be natural gray. A concrete stain shall be field applied to color the units as specified by the Engineer or Owner per Section 2.02C below.

B. Geogrid: If geogrid reinforcement is required, it shall be as shown in the plans or as detailed in the shop drawings. Substitution of a different type of geogrid shall not be allowed unless approved of the Architect/Engineer or Owner after submittal of shop drawings and test data.

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C. Color: Manufacturer to recommend stain color and to submit to Architect. Final stain will be selected by Architect from manufacturer's full range.

D. Shape and Texture: Provide units matching basic shape, dimensions, and face texture of basis-of-design product.

2.03 INSTALLATION MATERIALS

A. Pins and Clips: Product supplied by modular retaining wall unit manufacturer for use with units provided, made from nondegrading material (polymer reinforced with glass fibers, e.g.).

B. Cap Adhesive: Product supplied or recommended by precast concrete modular retaining wall unit manufacturer for adhering cap units to units below.

C. Drainage Fill: Coarse crushed stone or gravel with requirements in Section 312000 "Earthmoving" for drainage course.

D. Impervious Cap: Clayey gravel and sand mixture capable of compacting to a dense state.

E. Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent.

1. Apparent Opening Size: No. 70 to 100 (0.212- to 0.150-mm) sieve, maximum; **<<ASTM D4751>>**.
2. Minimum Grab Tensile Strength: 110 lb (49.9 kg); ASTM D4632.

PART 3 EXECUTION

3.01 RETAINING WALL INSTALLATION

A. General: Place units according to precast concrete modular retaining wall unit manufacturer's written instructions.

1. Lay units in bond pattern recommended for the units selected.
2. Form corners and ends by using special precast concrete corner or end units.

B. Wall Base: Provide concrete pad footing as noted in the Structural drawings.

1. Contractor’s Option: Granular Pad with Filter Fabric. If permitted by the manufacturer’s design engineer, in lieu of a concrete pad, a dense graded crushed aggregate pad may be utilized. The Granular Pad must be separated from the drainage backfill above by a soil separating filter fabric. Compact base material to thickness indicated and with not less than 95 percent maximum dry unit weight according to **<<ASTM D698>>**.

C. First Course: Place first course of precast concrete modular retaining wall units for full length of wall. Place units in firm contact with each other, properly aligned and level.

1. If Contractor’s Wall Base Option is used, tamp units into leveling base as necessary to bring tops of units into a level plane.

D. Subsequent Courses: Remove excess fill and debris from tops of units in course below. Place units in firm contact and properly aligned.

1. If precast units require unit fill, see Section 3.02.
2. Use standard minimum batter unless noted otherwise in the Structural drawings.

E. Cap Units: Place cap units and secure with cap adhesive.

3.02 FILL PLACEMENT

A. General: Comply with requirements in Structural drawings and with precast concrete modular retaining wall unit manufacturer's written instructions.

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B. Fill voids between and within units with drainage fill. Place fill as each course of units is laid.

C. Place, spread, and compact drainage fill and soil fill in uniform lifts for full width and length of embankment as wall is laid. Place and compact fills without disturbing alignment of units. Where both sides of wall are indicated to be filled, place fills on both sides at same time. Begin at wall, place and spread fills toward embankment.
   1. Use only hand-operated compaction equipment within 48 inches of wall, or one-half of height above bottom of wall, whichever is greater.
   2. Compact reinforced-soil fill to not less than 95 percent maximum dry unit weight according to **<<ASTM D698>>**.
      a. In areas where only hand-operated compaction equipment is allowed, compact fills to not less than 90 percent maximum dry unit weight according to **<<ASTM D698>>**.
   3. Compact nonreinforced-soil fill to comply with Section 312000 "Earthmoving."

D. Place drainage geotextile against back of wall, and place layer of drainage fill at least 24 inches wide behind drainage geotextile to within 12 inches of finished grade. Place another layer of drainage geotextile between drainage fill below and impervious soil fill above.

E. Place impervious fill over top edge of drainage fill layer.

3.03 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Comply with requirements in Section 312000 "Earthmoving" for field quality control.
   1. In each compacted backfill layer, perform at least one field in-place compaction test for each 24 inches of fill depth and each 50 feet or less of precast concrete modular retaining wall length.

END OF SECTION 323223

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SECTION 329000
TREE CONSERVATION

PART 1 GENERAL

1.01 DESCRIPTION

A. This section specifies labor, materials, and equipment and services necessary for and reasonably incidental to preservation, protection and care of trees as shown on Drawings, specified, or directed.

1.02 QUALITY ASSURANCE

A. Methods for tree preservation and protection shall conform to details shown on Drawings and pertinent nationally recognized standards.

B. Contractor shall during pre-construction activities, construction activities and post-construction activities employ an ISA (International Society of Arboriculture) certified Arborist & Licensed Tree Expert (LTE), and Maryland Qualified Tree Expert, referred to in this specification as “Arborist,” with a minimum of two years experience in tree preservation. Contractor shall submit documentation that Arborist has these qualifications.

C. An experienced tree service company that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified Arborist to Project Site during execution of Work.

D. Existing Conditions of trees and plantings to remain shall be documented to establish preconstruction conditions that might be misconstrued as damage by construction activities. Include photographs, plans and notation to indicate damage conditions of each tree or other plant designated to remain.

E. Arborist shall be on-site when Work is being performed in vicinity of trees to supervise implementation of procedures for tree protection, to monitor tree health during construction operations and installation of pipes, curbs, sidewalks, etc and to supervise repair of damages after construction.

F. It shall be Contractor's responsibility to diligently pursue approval of Forest Conservation or Tree Save Plan implementation from Forest Conservation Inspector, and to correct punch list inspection items, prior to Owner’s occupancy of new construction.

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1.03 SUBMITTALS

A. Provide written report by a certified Arborist identifying root, trunk, and canopy evaluations of trees, which are in potential conflict with construction to determine detailed corrective measures. Provide specifications from Arborist for individual tree protection and maintenance as required for trees and plants identified to be saved on Drawings.

B. Provide written report by a certified Arborist indicating best methods of construction, which will minimize impact on critical root zone within limits of disturbance of trees marked to be saved.

PART 2 PRODUCTS

2.01 TREE PROTECTION DEVICE

A. Provide in accordance with the approved Forest Conservation Plan or Tree Save Plan, and as indicated.

B. Fence Posts: Steel "T" or "U" channel, with punched or riveted lugs for fence attachment.
   1. Weight: 1.33 pounds per linear foot.

2. Length: 66 inches.
3. Bottom End Shape: Pointed.
4. Finish: Rust inhibitive primer paint.

C. Fence Fabric: 14 Gauge 2-inch x 4-inch Welded Wire Fence.
1. Fabric Height: Four feet, minimum.

D. Specimen Tree, Forest Conservation & Forestation Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:
1. Size and Text as required by the approved Forest Conservation or Tree Save Plan.
2. Lettering as required by the approved Forest Conservation or Tree Save Plan.

E. Forest Conservation Signage: Signage to meet current Authority Having Jurisdiction requirements. Signs should be placed at least 1 for every 100'. Prior to installation, flag locations for MCPS and Authority Having Jurisdiction approval.

2.02 SOIL AMENDMENTS

A. Suitable organic matter: See Section 329305, “Lawns and Grasses”.

B. Special soil mixture: See Section 329305, “Lawns and Grasses”.

PART 3 EXECUTION

3.01 PRECONSTRUCTION ACTIVITIES

A. Meetings shall be held in accordance with Forest Conservation Plan or Tree Save Plan. Contractor is responsible for organizing meetings of required participants and providing meeting minutes within three days for the pre-construction meeting.

B. Limits of disturbance shall be located and flagged by Contractor in field prior to stress reduction or construction activities. Limits of Disturbance shall be placed outside of critical root zones of trees to be preserved wherever possible.

C. As shown on Approved Drawings, and with approval from the Inspector, trees which are to be preserved shall have their roots pruned. Roots shall be cleanly cut to a depth of at least 24 inches using a vibratory plow (cable laying machine), tooth-chain trencher, or other acceptable equipment. Fill trench immediately with soil mixture herein described and pack to eliminate air pockets. If trenches remain open for longer than 24 hours, roots must be pruned again. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil. Cover exposed roots with burlap and water regularly.
1. Root pruning at edge of protection zone will take place 12 inches outside of Limits of Disturbance or as directed by Inspector and Arborist, by cleanly cutting roots.
2. Root pruning within Limits of Disturbance shall be performed by excavating to a depth of required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

D. Fertilize trees in construction area at rate specified by soil sample analysis for root zones impacted by not root pruned. Apply fertilizer to entire critical root zone out to root pruning trench. Water critical root zone immediately after applying fertilizer to saturate top 6 inches of soil.

E. Mulch 4 inches deep comprised of weed-free straw, woodchips, shredded bark, or leaves shall be applied in critical root zone adjacent to pruning trench. Mulching shall not extend farther than 20 feet from pruning trench. Moisture monitoring is to take place during construction.

F. Prune branches that are affected by construction as directed by Arborist.

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G. Trees which are dead or dying or are in poor condition prior to start of construction shall be flagged and recorded on plan. Notify Inspector immediately for possible removal or repair.

H. Tree Protection Fence:
   1. Tree Preservation Areas shall be surrounded by fence as detailed on plan or required by Inspector at pre-construction meeting.
   2. Boundaries of fencing shall be staked, flagged, and approved prior to installation.
   3. Fencing shall be installed prior to construction activities.
   4. Fences shall be firmly anchored at a spacing no greater than eight (8) feet and constructed in a manner which precludes sagging.
   5. Fencing shall be maintained in a good condition and promptly repaired or restored as situation warrants.

3.02 CONSTRUCTION PHASE

A. On-site decisions regarding conditions or activities which may be injurious to health of trees in vicinity of construction area shall be made in consultation with specified Arborist and carried out with approval by the Forest Conservation Inspector.

B. Excavated and backfill material shall not be placed or side cast outside of Limits of Disturbance within critical root zones of trees to be preserved.

C. Construction equipment shall not be driven into or through protected trees, nor shall swinging cranes or backhoes be allowed in their canopies.

D. There shall be no stacking or storing supplies outside of Limits of Disturbance within critical root zones of trees to be preserved.

E. Trees to be removed shall be taken out without damaging protected trees.

F. There shall be no burning in or close to protected trees.

G. Changing site grades causing drainage to flow into or to collect near protected trees shall be prohibited. Grading shall take place outside critical root zone of trees to be protected.

H. Equipment shall be kept outside fencing.

I. In event of drought, protected trees shall be monitored for signs of stress and watered as needed or as directed by Arborist.

J. Certified Arborist shall also monitor trees to be preserved for other conditions or activities not mentioned above which may be injurious to their health.

3.03 POST-CONSTRUCTION ACTIVITIES

A. Repair & Care of Tree Damages:
   1. Ends of additional roots damaged or cut during construction phase of Project which have not already been pruned and dressed at outset of Project shall be cut off smoothly. Then peat moss or other suitable organic matter shall be added to backfill material at a ratio of 1-part organic matter to 6 parts backfill. Fill and pack around roots to avoid air spaces. Restore grades to preconstruction elevations.
   2. Damaged limbs and dead limbs shall be removed if a safety hazard or if injurious to health of tree. Tree crown reduction procedures may be employed to promote health of a tree and shall be performed by a certified Arborist.
   3. If a tree is wounded during construction, under direction of Arborist, wounds should be cleaned, torn bark cut, and if possible, wounds dressed in a shape like a vertical ellipse, to facilitate rapid healing. Pruning knife shall be sharp and clean.

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4. Unless directed otherwise by Arborist, any compacted soil within critical root zone of trees to be preserved shall be mechanically aerated to a depth of twelve inches at 24 inches on center. Aerate 10 feet beyond drip line and no closer than 36 inche **<< 36 inches>>** to tree trunk.
5. Arborist shall inspect and review trees for a period of time as outlined on the approved forest conservation plan following completion of construction. After completion of construction, Arborist shall perform pruning on trees to remove any damaged, dead, interfering, and objectionable limbs. Arborist shall selectively thin trees to properly shape canopy, reduce wind resistance and possibility of storm damage.

3.04 REMOVAL OF TEMPORARY STRUCTURES

A. Remove temporary fencing, with approval from MCPS and Inspector.

B. Stabilize disturbed areas in accordance with Contract Documents.

END OF SECTION 329000

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SECTION 329305
LAWNS AND GRASSES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract including General and Supplementary Conditions and Division 1 through 33, Specifications Section, apply to Work in this section.

1.02 DESCRIPTION OF WORK

A. Section specifies materials, equipment and Work required to perform seeding and sodding operations.

1.03 RELATED WORK

A. Section 311000 "Site Clearing"

B. Section 312000 "Earthmoving"

C. Section 329500 "Trees, Shrubs and Groundcover"

1.04 STANDARDS

A. Maryland Department of the Environment Erosion and Sediment Control Handbook.

B. Maryland Standards and Specifications for Soil Erosion and Sediment Control, current edition.

C. MDOT-SHA Standards and Specifications Manual, current edition.

D. Federal Seed Act.

E. American Sod Producers Association (ASPA) and Maryland Certified.

F. Any fertilizers applied onsite must follow University of Maryland recommendations and soil samples. Anyone applying fertilizer must be certified or under supervision of a certified applicator.

1.05 SUBMITTALS

A. Submit certificates, signed by producer and contractor, stating that soil amendments, seed and sod comply with this specification.

B. Upon request, submit square yard of sod to project site for inspection by Architect and owner’s representative.

C. Submit statement of certification from local nursery from which sod shall be obtained.

D. Certificates to include following:

1. Limestone: Type, percentage of calcium magnesium carbonates or oxides, and gradation.
2. Fertilizer: Type and analysis.
3. Sod: Mixture percentages and classification.

E. Submit copy of laboratory test results and soil amendment recommendations for review by the Architect and the Owner’s Representative.

F. Submit the name and qualifications of a Professional Lawn Care Firm to perform lawn maintenance during the maintenance period. The firm shall be one whose primary business is lawn care. The firm must be approved by the Owner prior to completion of sod installation.

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G. Submit a proposed Lawn Maintenance Plan, detailing scheduled maintenance and compliance with the requirements of this specification. The plan shall include the name and location of the selected professional lawn care firm that will be performing the maintenance.

1.06 PRODUCT DELIVERY AND STORAGE

A. Sod: Deliver sod in time for planting within 24 hours of harvesting. Protect from breakage and drying. Harvest, deliver, store, and handle sod in compliance with the requirements of TPI's "Specifications for Turfgrass Sod Materials," and "Specifications for Turfgrass Sod Transplanting and Installation" contained in the "Guidelines Specifications to Turfgrass Sodding."

B. Bulk Material: Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates. Provide erosion control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

C. Storage: Store products in accordance with producer's recommendations. Store seed in dry locations. Store sod by stacking roots to roots and grass to grass, protected from exposure to wind, sun, and freezing temperatures.

1.07 PROJECT CONDITIONS

A. Sod Requirements: Sod shall be required on all areas of the site.

B. Limitations:

1. Site and Utility Construction: Do not proceed with lawn preparation until site and utility construction is complete.
2. Environmental: Do not proceed with lawn preparation when ambient air temperature is below 32° F.
3. Sodding: Deliver and install sod within 24 hours of harvesting. Do not use dormant or frozen sod.

1.08 QUALITY ASSURANCE

A. All sod shall be transplanted within 24 hours from the time it is harvested, unless stacked at the project site in a manner approved by the Owner's Representative. Stacked sod shall be kept moist and protected from exposure to wind and sun. Any sod permitted to dry out shall be rejected.

B. Plant only during periods of favorable weather when conditions are suitable. Do not place sod at any time temperature is below freezing. No frozen sod shall be used, and no seed or sod shall be placed on frozen, powder-dry, or excessively wet soil.

C. Soil amendments and rate of application shall be determined by laboratory test on soil.

1. Areas to be seeded or sodded shall have a soil pH range of 5.8 - 7.0. Contractor shall be responsible for ensuring correct soil pH.
2. Test pH level in at least five equidistant locations on the site. Review with the Owner's Representative or Architect who will determine whether the average soil pH value is within acceptable range. If existing soil pH is adequate, no soil amendments are required.
3. If average pH value is greater than 7.0, add a commercial grade sulfur at rate derived from lab test, over area to be seeded.
4. If average soil pH value is less than 5.8, then agricultural limestone shall be applied at rate derived from lab test.

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1.09 GUARANTEE

A. Guarantee that at end of ninety (90) days after sodding, a healthy first-class lawn shall exist.

PART 2 PRODUCTS

2.01 TOPSOIL

A. Topsoil: Refer to Section 312000 "Earthmoving".

2.02 SOD

A. Sod: Shall be free of disease, soil borne insects, clover, broadleaf weeds, and noxious weeds. Sod shall be considered free of such weeds if less than 2 such plants are found per 100 square feet of area.
   1. Classification: Maryland "Certified Sod" nursery grown in nearby area, well rooted, free from disease, defects, insect infestation, or any unhealthy or abnormal condition, and free of weeds.
   2. Sod that is grown with any type of plastic netting in the root zone, field net, will not be acceptable for placement anywhere on site. Sod that is transplanted as big roll sod that is wrapped with plastic netting, sold wrap, to help in transport must have plastic removed at installation.
   3. Mixture:
      a. General Site: Tall Fescue (Drought Tolerant, Full Sun Mixture)
         1) Certified Tall Fescue Cultivars, a mixture of at least two different types - 95%
         2) Certified Kentucky Bluegrass - 5%
      b. Playfields: Bermuda Grass
   4. Sod shall be relatively free of thatch. Thatch buildup which significantly detracts from the appearance of the sod may be sufficient cause for rejection.
   5. Submit statement giving locations of property from which sod is to be obtained and submit square yard sample of sod to site if requested.
   6. Sod shall conform to the approved sample. Non-conforming sod shall be removed from the project site and replaced at no increase to the contract sum.
   7. Sod shall have been mowed prior to stripping and have been maintained for a minimum of three months at or near height of final clipping at nursery. Maximum height 2-1/2 inches.
   8. Sod shall be machine stripped at a uniform soil thickness of 3/4-inch thick, excluding top growth and thatch.
   9. Pad sizes shall be supplier's standard width and length. Maximum allowable deviation from supplier's standard sizes shall be 5%. Broken pads or pads with uneven ends will not be acceptable.
   10. Root development to be such that standard size pieces of sod will support their own weight and retain their size and shape when suspended vertically from a firm grasp on uppermost 10% of the pad area.
   11. Under moderate moisture conditions, pad weight not to exceed 7 pounds per square foot. Minimum pad weight not less than 4 pounds per square foot.

2.03 MISCELLANEOUS PRODUCTS

A. Mulch for Seeding (Fiber Mulch):
   1. Unweathered and unchopped small grain straw, free of noxious weeds. Biodegradable, dyed wood, cellulose fiber mulch, non-toxic, free of plant growth or germination inhibitors, maximum moisture content 15%, pH range 4.5 to 6.5.

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2. Contractor's Option: Paper Fiber Mulch, manufactured of recycled paper products, by Central Fiber Corporation, Wellesville, Kansas. Type: “Second Nature” or approved equal.
3. Contractor's Option: Fiber Mulch manufactured by Weyerhaeuser Company, Tacoma, Washington. Type: “Silva-Fiber” or approved equal.

B. Fiber Mulch Anchoring Products:
1. Organic Binder manufactured by Grass Growers, Plain Field, New Jersey. Type "Terra Tack I” or approved equal.
a. Organic Binder Mixture: One-part organic binder to 20 parts water.
2. Contractor's Option: Synthetic binder additive manufactured by American Hoechst Corporation, Summerville, New Jersey. Type: “Curosol AH” or approved equal.

C. Straw Mulch: Air dried, clean, mildew and seed free salt hay.

D. Tackifier: Non-asphatic, colloidal tackifier, recommended by biber-mulch manufacturer for slurry application, non-toxic and free of plant growth or germination inhibitors.

E. Hydroseeding Equipment: Provide equipment with agitation system, which maintains mixture of solids in complete suspension and spray nozzles, which produce even distribution of slurry mixture.

F. Sod Stakes: Biodegradable, softwood; 1/2 by 1 by 8 inches.

G. Water: Refer to Section 0150000 "Temporary Facilities and Controls" and as noted. Obtain water from approved source and transport to the project site, in the event public water supply shortage occurs and moratorium is adopted, at no increase to contract sum.

PART 3 EXECUTION

3.01 FINISH GRADE

A. Refer to Section 312000 "Earthmoving”.

3.02 APPLICATION OF SOIL AMENDMENTS

A. If soil amendments are required, apply at specified rates. Bond topsoil mix to subgrade and mix soil amendments uniformly into topsoil by tilling, disking, or harrowing to five-inch depth. Adjacent to existing trees, adjust depth to avoid disturbances of tree roots.

3.03 FERTILIZING

A. Incorporate fertilizer with soil in same manner as lime and apply and incorporate with soil simultaneously with liming operations. Type of fertilizer and rate of application shall be as specified by testing.

3.04 SUBGRADE PREPARATION

A. Unpaved areas, Section 312000 "Earthmoving" and as noted.

B. Verify subgrade elevations and correct discrepancies. Mow, rake, and remove temporary stabilization provided to control soil erosion. Apply soil amendments at rate indicated by the soil analysis recommendations. Mix amendments uniformly into subgrade, and break up subgrade by tilling, disking, or harrowing to five-inch depth. Rake subgrade, removing debris and stones exceeding one inches in any dimension.

3.05 TOPSOIL MIX PLACEMENT

A. See Section 312000 "Earthmoving”.

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B. Where sod is to be placed, topsoil depth shall be decreased by 1" to 1 ½" to allow for the thickness of the sod mat.

3.06 HYDRAULIC SEEDING (FOR TEMPORARY STABILIZATION ONLY)

A. Protect improvements and facilities during hydroseed application to prevent over-spray damage. Restore lawns, damaged by construction operations, as directed by the Owner's Representative or the Architect.

B. Subgrade Preparation: See Section 312000 "Earthmoving."

C. Topsoil Mix Placement: See Section 312000 "Earthmoving."

D. Hydraulic Seeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed applications. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
   1. Mix slurry with nonasphaltic tackifier.

E. Slurry Preparation: Slurry mixture for 1,000-gallon tank:
   1. Seed Mixture: Set for minimum application rate of 450 pounds per acre or 95 pounds per tankful.
   2. Fertilizer: 182 pounds.
   3. Fiber Mulch: 310 pounds.
   4. Binder Additive: 20 gallons.
   5. Water: Fill tank.

F. Proportionally adjust mixture quantities for tanks of different capacities.

G. Slurry Application: Apply slurry uniformly to all areas to be seeded in a one-step process. Hydraulic application rate shall be 110 gallons per 1000 square feet and at a rate so that mulch component is deposited at not less than 1500 lbs/acre dry weight, and seed component is deposited at not less than the specified seed sowing rate. Application dates shall be 01 March to 15 May and 15 August to 31 October. Apply slurry mixture uniformly to prepared topsoil, in one continuous hydraulic operation. Do not begin hydraulic application until completion of topsoil preparation.

3.07 SODDING

A. Sod Installation:
   1. All sod shall be transplanted within 24 hours from the time it is harvested, unless stacked at its destination in a manner approved by the Owner's Representative. Stacked sod shall be kept moist and protected from exposure to air and sun, and from freezing. Any sod permitted to dry out shall be rejected whenever, in the judgment of the Owner's Representative or the Architect, it's survival after placement is doubtful. No payment will be made for rejected sod. In no event shall more than forty-eight (48) hours lapse between cutting and planting of sod.
   2. Do not place sod at any time temperature is below freezing. No frozen sod shall be used, and no sod shall be placed on frozen, powder-dry, or excessively wet soil.
   3. Lightly moisten prepared topsoil mix, in the event ambient air temperature exceeds 90° F, during installation.
   4. Sod shall be lifted from trucks or stacks by hand. Begin installation with first row in straight line (e.g., walk edge, curb, etc.). Install, subsequent rows parallel to first row, with tight joints. Stagger lateral joints one-half pad length. Do not stretch or overlap joints.
   5. Sod shall be laid smooth, edge to edge, with staggered joints and immediately pressed firmly into contact with sod bed by rolling to eliminate air pockets. True and even surface

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shall be provided to ensure knitting without displacement of sod or deformation of surfaces of sodded areas. In ditches or swales, sold shall be placed with longer dimension perpendicular to flow of water in ditch.

6. Slopes (exceeding 4 feet horizontal to 1 foot vertical): Begin installation with first row at top of slope and parallel to slope contour. Install subsequent rows parallel to first row. Set and drive sod stakes flush with top of sod. Use two stakes per square yard or as directed by the Owner or the Architect.
7. Moisten sod immediately after installation. Compact sod upon completion of installation with light rollers and thoroughly water.
8. Following compaction, screened topsoil of good quality shall be used to fill cracks, and excess soil worked into grass with rakes or other suitable equipment. Grass shall not be smothered with excess fill soil. Exposed edges of sod shall be buried flush with adjacent soil.
9. Adequate water and watering equipment must be on hand before sodding begins, and sod shall be kept moist until root system adheres to underlying soil, and sod becomes established and is accepted by the Owner or the Architect.

3.08 CLEANING

A. Clean improvements and facilities damaged by hydraulic seed application over-spray as directed by the Owner’s Representative or the Architect.

3.09 ACCEPTANCE

A. Acceptance of sodded areas shall not be considered until the approximate date the Fall school session begins. Planted areas shall be properly maintained from the time of planting or placing of sod until one year beyond the acceptance date.

B. The contractor shall request in writing an on-site inspection with the Architect and Owner to determine acceptability.
   1. A stand of grass shall be deemed acceptable if after a minimum of sixty (60) days, there is a uniform stand. (95% germination minimum) of weed free turf composed of the specified grasses with an average height of 3" and no bare spots.

C. Upon written request from Contractor, at least ten days before date of inspection, Owner or Architect will perform an inspection of seeded and sodded areas.

D. After inspection, list of deficiencies or omissions requiring correction will be proposed. Items shall be corrected and are subject to same guarantee and final inspection until found acceptable. Be responsible for continued maintenance of that portion of the lawn which, after ninety days, has not been accepted by Owner.

E. Notwithstanding punch list items, Owner will certify in writing substantial completion of lawns and acceptance of work. Upon completion, reinspection of repairs or renewals necessary, Owner will assume responsibility for continued maintenance of lawn.

3.10 WARRANTY/MAINTENANCE

A. Ensure the establishment of a healthy, first-class lawn. Be responsible for all maintenance, protection, and repair until Owner accepts planted area. Include watering, rolling, fertilizing, and mowing.

B. Maintenance shall be performed by a professional lawn care firm, whose primary business is lawn care. The Contractor shall submit the name of the lawn care firm to the Owner for approval.

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C. Maintenance and protection of seeded and sodded areas shall continue until Owner accepts lawn. Barriers, sign, and/or flags shall be used on established pedestrian circulation ways as determined by Owner to indicate areas where trespassing is not allowed.

D. During the maintenance period repair or re-work washouts, dry areas, dead areas, or erosion. Repair damage by vandalism at no cost.

E. Warranty and maintenance shall be simultaneous for one (1) year after acceptance. All turf and lawn plantings shall be alive and in satisfactory growth at the end of the warranty period.

F. The following shall be included as a part of the contractors one-year maintenance agreement
   1. Periodic sampling of soil to monitor and maintain a pH of 6.8 (+/- 0.5).
   2. Mowing/Edging:
      a. Mow lawn and turf areas as necessary to maintain a grass height between 2-1/2- to 3-1/2-inches throughout the mowing season and remove grass clippings during or immediately after mowing, if needed to preclude clumping or thick deposits of clippings that may damage the turf. Regular mowing at three (3) inch height and before four (4) inch growth occurs, will preclude the need for clippings removal. Maintain a high-quality cut, sharpened mower blade. Mowing to be completed between 6:00 a.m. and 6:00 p.m. on any day except Saturdays, Sundays, and holidays. Coordinate with school schedule.
      b. Trim around all obstacles, raking excessive grass clippings and removing debris from walks, curbs, and parking areas. NOTE: Weed eaters shall not be used to trim around trees with smooth bark in the trunk area.
      c. Edge all sidewalks, curbs, and paved areas once every other mowing and remove debris from edging operations and sweep paved areas clean upon completion of work. NOTE: Caution shall be used to avoid flying debris, and safety glasses shall be worn during this operation.
   3. Provide nine (9) monthly (Dec, Jan, and Feb exempt) turf inspections and reviews to be completed by a qualified turf agronomist.
   4. Contractor shall irrigate all the seeded/sodded site areas to ensure continuous growth throughout the growing season. The contractor shall furnish water and necessary irrigation equipment.

END OF SECTION 329305

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SECTION 329500
TREES, SHRUBS AND GROUNDCOVER

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 through 33, Specification Sections apply to work in this section.

1.02 DESCRIPTION OF WORK

A. Section specifies materials and work required to perform landscape planting and related site landscaping operations.

1.03 RELATED SECTIONS

A. Section 312000 "Earthmoving”

B. Section 329305, "Lawns and Grasses".

1.04 STANDARDS

A. American Joint Committee on Horticultural Nomenclature - 1942 Edition of Standardized Plant Names (SPN).

B. American Association of Nurserymen - American Standard for Nursery Stock, latest edition

C. MDOT-SHA Standards and Specifications Manual, current edition

D. MDE Erosion and Sediment Control Handbook

1.05 JOB CONDITIONS

A. Prior to beginning work, Contractor is required to schedule and attend an on-site meeting with Owner and Architect, to verify site conditions and scope of Work.

B. Complete landscape work as rapidly as portions of Site become available, working in cooperation with Contractor and within seasonal limitations for each kind of landscape Work required.

C. Utilities: Determine location of underground utilities and perform work in a manner that will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is authorized.

D. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Architect or Owner before planting.

E. Coordination with Lawns: Refer to Section 329305. Plant trees and shrubs after final grades are established and prior to seeding and sodding. If planting of trees and shrubs occurs after seeding and sodding, protect lawn areas and promptly repair damage to lawns resulting from planting operations.

F. Extent of landscape development Work is shown on Drawings, schedules, and specified herein.

G. Work shall include, but not necessarily be limited to following:

1. Disposal of unused excavated material from planting excavations only.
2. Furnishing, protecting, and planting trees and shrubs of specified types and sizes.
3. Pruning, trimming, feeding, and mulching trees where trees are marked to be saved.
4. Mulching new planting stock.

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5. Staking new planting stock.
6. Watering new planting stock.
7. Furnishing and installing portable drip irrigation bags at each new tree.
8. Providing mulched areas for pedestrian walkways.
9. Providing timber edging along disturbed play areas and pedestrian walkways

H. Sub-grade elevations: Excavation, filling, and grading required to establish elevations shown on drawings are specified elsewhere. Refer to Section 312000 "Earthmoving”.

1.06 QUALITY ASSURANCE

A. Experience: Landscaping Contractor shall have been in related Work for a minimum of three (3) years.

B. Subcontracted landscape Work to a single firm specializing in landscape Work and with a record of satisfactory performance on similar projects.

C. Installer is required to maintain an experienced full-time supervisor on Project site while Work is in progress.

D. Installer shall be a member in good standing with Professional Landcare Network or American Nursery and Landscape Association.

E. Quality Control:
1. Comply with sizing and grading standards of latest edition of "American Standard for Nursery Stock". A plant shall be dimensioned as it stands in its natural position.
2. Plants shall be nursery grown under climatic conditions similar to those in locality of Project for a minimum of 2 years.
3. Stock furnished shall be at least the minimum size indicated. Provide plants indicated with a measurement range so that only a maximum of 50 percent are of the minimum size indicated and 50 percent are of the maximum size indicated.
4. Plants will be inspected and approved at place of installation, for compliance with specification requirements for quality, size, and type of specimen.

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1.07 DELIVERY, STORAGE AND HANDLING

A. Packaged Materials: Deliver materials in original packaging showing weight, analysis, and name of Manufacturer. Protect materials from deterioration during delivery and storage on Site.

B. Trees and Shrubs: Provide freshly dug trees and shrubs. Do not prune prior to delivery. Do not bend or bind-tie trees or shrubs in manner to damage bark, break branches or destroy natural shape. Provide protective covering during delivery.

C. Deliver trees and shrubs after preparation for planting have been completed, and plant immediately. If planting is delayed more than 6 hours after delivery, set trees and shrubs in shade, protect from weather extremes and mechanical damage, and keep rootball moist.

1.08 SPECIAL PROJECT WARRANTY

A. It shall be the Contractor's responsibility to water, fertilize and otherwise maintain plant materials in healthy condition, free of stress and insect infestation, until such time as landscaping is formally accepted in writing by Owner. One-year warranty shall not commence until such formal notice is given by Inspector.

B. Warranty new trees and shrubs for a period of one year after date of Inspector's acceptance, against defects including death and unsatisfactory growth, except for defects resulting from neglect by Owner, abuse or damage by others, or unusual phenomena or incidents which are beyond Landscape Installer's control.

C. Remove and replace unsatisfactory trees or plants or those found to be dead or in unhealthy condition during warranty period. Make replacements during growth season following end of warranty period. Replace in kind and size specified and plant in accordance with this Section.

1.09 SUBMITTALS

A. Submit name and qualifications of Professional Landscape Firm to perform Landscape installations and plant maintenance during maintenance period. Firm must be approved by Owner prior to beginning landscape Work.

B. Submit a proposed Planting Maintenance Plan, detailing scheduled maintenance and compliance with requirements of this Specification. Plan shall include name and location of selected professional Landscape firm that will be performing maintenance.

C. Maintenance Instructions: Submit typewritten instructions prior to expiration of required maintenance period(s) to be used by Owner for maintenance of landscape work for one full year after termination of maintenance period.

D. Submit Manufacturer’s catalog information and installation instructions for flexible plastic landscape edging and mulch for pedestrian walkways.

E. Submit Manufacturer’s catalog information and installation instructions for portable drip irrigation bags for new trees.

1.10 GUARANTEE

A. Guarantee trees for a period of one year from date of acceptance by Owner, against defects including death and unsatisfactory growth, except for defects resulting from neglect by Owner, abuse or damage by others, unusual phenomena or incidents which are beyond Contractor's control.

B. Remove trees found to be dead or in unhealthy condition during guarantee period. Make replacements during growth season following end of guarantee period. Furnish and plant replacements which comply with requirements shown and specified. Also replace trees which are in doubtful condition at end of guarantee period unless, in opinion of Owner, it is advisable to extend guarantee period for a full-growing season. Owner will make another inspection at end of guarantee period, to determine acceptance or rejection. Only one replacement will be required at end of guarantee period, except for losses or replacements due to failure to comply with specified requirements. At end of guarantee period, Contractor shall remove stakes, guy wires and tree wrappings unless otherwise approved.

1.11 CERTIFICATES

A. Certificates of inspection shall accompany invoices for each shipment of plants as required by law for transportation. Submit certificates to Owner prior to acceptance of materials. Inspection by federal or local governments at place of growth does not preclude rejection of plants at Project Site.

PART 2 PRODUCTS

2.01 TOPSOIL

A. Refer to Section 312000 "Earthmoving.”

2.02 PLANTS

A. Plants shall be true to species and variety specified and nursery-grown in accordance with good horticultural practice under climatic conditions similar to those in locality of Project for at least two years. Plants shall have been root-pruned within last two years and freshly dug. No

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heeled-in plants or plants from cold storage will be accepted. Unless specifically noted otherwise, plants shall be symmetrical or equal specimen quality, sound, healthy, vigorous, well-branched and densely foliated when in leaf, free of disease, insects, eggs, or larvae, and have healthy, well developed root systems. Plants shall be free from physical damage or conditions that will prevent thriving growth. Plant materials shall be classified as per "American Standard for Nursery Stock", as adopted by American Association of Nurserymen. Plant materials not meeting this standard shall be rejected.

1. Conform to requirements of plant list.
2. Plant materials shall be nursery growth stock.
3. Trees shall be well branched, with full crown.
4. Each plant shall be free from disease, insect infestation, and dead branches.
5. Each plant shall be balled and burlapped (B&B), with rootball fully intact.
6. Substitutions may be made only after submission of evidence substantiating to Architect's and Owner's satisfaction, non-availability of specified plant items and only if approved by Architect.
7. Substitutions may be made only with Architect or Owner's approval, at same price as unavailable contract item or at lower, approved price with a credit provided.

B. Plants shall conform to measurements indicated, except larger plants may be used if approved by Architect. Larger plants shall not increase the Contract price. If larger plants are approved, the root ball shall be increased in proportion to the size of the plant. Plants that meet measurements, but do not possess a normal balance between height and spread, will be rejected.

2.03 TREES

A. Trees shall be measured when branches are in their normal position. Height and spread dimensions specified refer to main body of plant and not from branch tip to top. Caliper measurement shall be taken at a point on trunk six inches above natural ground line for trees up to four inches in caliper and at a point twelve inches above natural ground line for trees over four inches in caliper.

B. No part of the trunk shall be conspicuously crooked as compared with normal trees of same variety. Trunk shall be free from sunscald, frost cracks, or wounds resulting from abrasions, fire, or other causes. No pruning wounds shall be present having a diameter exceeding two inches, and such wounds must show vigorous bark on edges.

2.04 SHRUBS

A. Shrubs shall meet the requirements for spread or height indicated. Measurements for height shall be taken from the ground level to average height of top of shrub, not the longest branch. Thickness of each shrub shall correspond to trade classification "No. 1". Thin plants will not be accepted. Side branches must be generous, well twigged, and plant as a whole, well bushed to ground. Plants shall be in a moist, vigorous condition, free from dead wood, bruises, or other root or branch injuries.

2.05 PORTABLE DRIP IRRIGATION BAGS

A. Portable drip irrigation bags shall be UV treated polyethylene bags, reinforced with nylon webbing, with nominal capacity of 20 gallons. Bags shall be designed to be connected together to form larger units for larger trees, if needed. Bags shall be designed to be easily filled with a standard garden hose, and to release water into root ball of tree over sufficient time to prevent runoff. Drip irrigation bags shall be “Treegator” bags, as manufactured by Spectrum Products, Inc., Raleigh, North Carolina, 1-866-treegator (web page treegator.com), or approved equal.

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2.06 MISCELLANEOUS MATERIALS

A. Topsoil: Refer to Section 312000 "Earthmoving".

B. Sand: Refer to Section 312000 "Earthmoving".

C. Organic Matter: Refer to Section 329305 "Lawns and Grasses".

D. Planting Soil Mix: Planting soil mix shall be composed of 60 percent topsoil, 30 percent organic matter and 10 percent sand. Make adjustments based on soils report and recommendations.

E. Anti-desiccant: "Wiltpruf", Manufactured by Nursery Specialty Products, Inc., Greenwich, Connecticut, or approved equal.

F. Fertilizer: Refer to Section 329305, "Lawns and Grasses". Fertilizer shall be uniform in composition, dry and free flowing, delivered to Site in original, unopened containers, bearing Manufacturer's guaranteed analysis. Fertilizer, which becomes caked or otherwise damaged, making it unsuitable for use, will not be accepted. Composition shall be Nitrogen, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

G. Stakes for supporting trees: Hardwood stakes two by two inches, structurally sound, at length indicated on plans, rough sawn stakes are acceptable if free from long slivers, bark, or other defects.

H. Wires for guying trees: No. 12 gauge pliable galvanized steel. Webbing shall be UV resistant polypropylene or nylon webbing with brass grommets. Guy cables shall be five strand, 3/16-inch diameter, galvanized steel cable, with zinc coated turnbuckles, a minimum of **<< 3 inches>>** long with two 3/8-inch galvanized eyebolts.

I. Mulch: Shall consist of sound, non-decomposed double shredded hardwood bark, free of branches, twigs, leaves, chunks of bark, soil, or injurious materials.

J. Mulch for Grade Protection: as specified in Section 329305 "Lawns and Grasses".

2.07 DIGGING AND HANDLING OF PLANT MATERIALS

A. Apply anti-desiccant to plant materials in full leaf immediately before digging, providing an adequate film over trunks, branches, twigs, and foliage. Dig balled and burlapped (B and B) plants with firm, natural balls of earth, of diameter not less than that recommended by American Standard for Nursery Stock, and of sufficient depth to include fibrous and feeding roots. Plants moved with a ball will not be accepted if ball is cracked or broken before or during planting operations.

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PART 3 EXECUTION

3.01 PLANTING OPERATIONS

A. No planting will be permitted while ground surface or prepared backfill is frozen.

B. Lay out individual tree and shrub locations and areas for multiple plantings. Location of planting pits shall be staked out and multiple planting areas outlined by Contractor prior to excavation and shall be approved by Owner before planting operations can proceed. Make minor adjustments as may be requested. Prior to excavation of planting areas or plant pits, ascertain location of electrical cables, conduits, utility lines, and gas supply lines so that proper precautions may be taken not to disturb or damage any sub-surface improvements. In event sub-surface improvements are uncovered, arrange to relocate plant material. Failure to follow this procedure will require Contractor to make all requisite repairs to damaged utility lines at no increase to Contract Sum. Circular pits with vertical sides shall be excavated for plants. Diameter of pits shall be twice width of ball for ball sizes up to two feet. For ball sizes over two feet, width of pit shall be at least two feet greater than diameter of ball. Depth of pits for trees

and shrubs shall be enough to accommodate ball or roots when plant is set to finished grade. Bottom of root ball shall rest on firm sub-grade soil.

C. Planting beds shall be prepared by either of following methods:
   1. Excavate and dispose of 12 inches of existing soil from planting bed area and backfill with prepared planting soil mix to a depth of 18 inches, scarifying subsoil to prevent two distinct layers of soil.
   2. Amend the existing soil by adding 24 cubic feet of organic matter and make adjustments based upon soils report and recommendations per 100 square feet of surface area, thoroughly mixing to a depth of 18 inches.
   3. Prepare in accordance with Drawings and dispose of soil removed from hole.

D. Protect plants at times from sun or drying winds. Plants that cannot be planted immediately on delivery shall be kept in shade, well protected with soil, mulch or other acceptable material and kept well-watered. Plants shall not remain unplanted for longer than three days after delivery. Plants shall be lifted and handled from bottom of ball only.

E. Set plants at same relationship to finished grade as they bore to ground from which they were dug. Plants shall be set plumb and braced rigidly in position until prepared planting soil mix has been tamped solidly around all and roots.

F. Cut and remove ropes, strings, containers and/or wrapping from ball without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during digging operation.

G. Plant pits shall be backfilled with equal portions of prepared planting soil mix and existing subsoil immediately after placing plants in pits. When plant pits have been backfilled approximately 2/3 full, water thoroughly eliminating air pockets. After watering, install planting soil mix to top of pit and repeat watering.

H. Form saucer or water basins at least four inches deep with diameter equal to that of plant ball. Mulch shall be placed on all tree pits and shrub beds within 24 hours after planting and shall be applied to a uniform depth as indicated on planting detail. Thoroughly water plants immediately after planting and mulching

I. Guy with stakes as described in articl 3.02A.

J. Prune as described in article 3.02B.

K. Plant material beds shall be neatly edged to lines indicated, with a clean line between soil of plant bed and lawn grass surface.

L. Provide and install portable drip irrigation bags at each new tree. Provide single unit bags (20-gallon) for trees with 1-inch to 4-inch trunks and combine bags to form a 50-gallon set for trees with 4-inch to 8-inch trunks. Install in accordance with Manufacturer’s instructions. Fill bags and begin scheduled maintenance.
   1. Bags shall be kept full and checked every day to confirm they are filled with water.

3.02 STAKING AND PRUNING

A. Staking shall be completed immediately after planting. Plants shall stand plumb after staking. Stake trees as indicated. Stakes shall be equally spaced about each tree and driven vertically into ground to a depth of 2-1/2 to 3 feet in such manner as not to injure ball or roots. Trees shall be fastened to each stake at a height of about five feet by means of two strands of #12 galvanized steel wires. Stakes shall be uniform in height and placed according to diameter of tree trunk as follows:
   1. 2 inches or less: 1 stake.
   2. 2 to 3 inches: 2 stakes.

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3. 3 to 6 inches: 3 stakes.

B. Stake trees as indicated immediately after planting and maintain stakes and wires until acceptance.

C. Prune plants only at time of planting and according to standard horticultural practice to reserve natural shape of plant. Remove dead wood, suckers and broken or badly bruised branches. Remove only dead, broken or rubbing branches on flowering and specimen trees and shrubs. Use only clean, sharp tools. Do not apply pruning paint to wounds.

3.03 CLEANUP AND PROTECTION

A. During landscape work, keep adjacent paved areas clean, and work area in an orderly condition.

B. Protect landscape work and materials from damage due to landscape operations, operations by other Contractors and trades and trespassers. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged landscape work as directed.

3.04 MAINTENANCE

A. Contractor shall maintain plants in healthy condition. Contractor's maintenance responsibilities shall consist of pruning, watering, fertilizing, cultivating, weeding, mulching, tightening and repairing of staking, setting plants to proper grades or upright position, restoration of planting saucer, and furnishing and applying sprays or other items as are necessary to keep planting free of insects and disease and in thriving condition.

B. Maintenance shall begin immediately after each plant is planted and shall continue for a period of 60 days from the date of acceptance by Owner.

3.05 INSPECTION AND ACCEPTANCE

A. Written notices requesting inspections shall be submitted to Owner 10 days prior to anticipate inspection dates.

B. Contractor shall notify Owner when planting is completed and shall request an inspection to determine whether or not plant material is acceptable as to size, quality, meeting specifications, and in a healthy growing condition. If materials are acceptable, a written notice will be provided by Owner stating that guarantee period begins from date of acceptance.

C. Where inspected landscape work does not comply with requirements, replace rejected work and continue specified maintenance until reinspected by Architect and Owner and found to be acceptable. Remove rejected plants and materials from project site and replace them with healthy specimens.

D. It shall be Contractor's responsibility to diligently pursue approval of regulatory landscaping from the Forest Conservation Inspector, and to correct punch list inspection items, prior to Owner’s occupancy.

END OF SECTION 329500

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SECTION 330840
COMMISSIONING STORMWATER UTILITIES

PART 1 GENERAL

1.01 SUMMARY

A. This section includes requirements for commissioning of stormwater management and storm drainage systems.
   1. Commissioning is a third-party quality assurance process. It does not take the place of or duplicate the Contractor's quality control services required per Section 014000 "Quality Requirements" or other quality control testing or inspections required in individual Sections and normally the responsibility of the Contractor.
   2. Stormwater Management Commissioning: It will be the responsibility of the General Contractor and/or the Construction Manager to hire the Civil Engineer of Record and the Geotechnical Engineer of Record to perform and document any and all inspections, observations, as-built surveys and measurements required to prepare complete and accurate stormwater management as-built plans, provide required certifications and obtain approval thereof from the authority having jurisdiction.
      a. Required services include, but are not limited to, providing and certifying the accuracy and correctness of all information and as-built plans in strict conformance with the most current applicable as-built record drawing plan review checklist.
      b. These services must be performed by and/or under the direct supervision of the Civil Engineer of Record and the Geotechnical Engineer of Record and must be based upon direct observations and information obtained in the field by and/or under their direct supervision.

B. Related Sections:
   1. Section 334100 "Storm Drainage".

C. Scheduling
   1. Notify Civil Engineer of Record or Geotechnical Engineer of Record when inspections are required, with at least 48-hours notice being required.
      a. Notices with less than 48-hours notice may result in additional costs to the Contractor by the Engineer.
   2. Representative of Engineer must be present to inspect stormwater management facilities.

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PART 2 PRODUCTS

2.01 TESTING EQUIPMENT

A. General: Provide test equipment, instrumentation, and tools necessary to perform testing. Use test equipment and instrumentation that has been calibrated, certified, and properly maintained.

PART 2 EXECUTION

3.01 CIVIL ENGINEER OF RECORD AND GEOTECHNICAL ENGINEER OF RECORD RESPONSIBILITIES

A. Meetings:
   1. Attend stormwater management pre-construction meetings.
   2. Attend as-built pre-submission meeting arranged by the General Contractor and/or the Construction Manager.

B. The Civil Engineer of Record and the Geotechnical Engineer of Record shall confirm and document to the Owner, via physical measurement and survey, that all pipes, structures, and facilities have been set to the approved final design grade prior to being backfilled. In the event that the structures have not been set to the approved elevations and configuration, the General Contractor and/or the Construction Manager shall remove and reset the structure and/or pipes to the approved elevations and provide the appropriate documentation of that work at no additional cost.

C. The Civil Engineer of Record shall provide to the Owner electronic files, in pdf format, of all submittals and of all review comments received from the authorities having jurisdiction.

D. Checklists: The Civil Engineer of Record and the Geotechnical Engineer of Record shall sign off on a record set of documents provided by the General Contractor and/or the Construction Manager after each successful inspection.

3.02 CONTRACTOR RESPONSIBILITIES

A. Meetings:
   1. Attend stormwater management pre-construction meetings.
   2. Prior to the Civil Engineer of Record submitting any as-built documentation, the General Contractor and/or the Construction Manager shall arrange and attend a site meeting with the Civil Engineer of Record, the Sediment Control Inspector and the Owner to observe the stormwater management facilities and site conditions/stabilization and to obtain Stormwater Inspector approval to submit as-built documents and certifications to authority having jurisdiction for review. All required documentation will be submitted for review within forty-five (45) calendar days of that meeting.

B. Checklists: The General Contractor and/or the Construction Manager shall maintain on a record set of documents for signature by the Civil Engineer of Record and the Geotechnical Engineer of Record after each successful inspection.

C. The General Contractor and/or the Construction Manager shall collect and provide any and all supporting certifications required by the Civil Engineer of Record and the Geotechnical Engineer of Record to satisfy all authority having jurisdiction checklist requirements. The General Contractor and/or the Construction Manager shall provide certifications from suppliers for materials used in the construction of the stormwater facilities:
   1. Material tickets and certifications including: planting media, sand, stone, underdrain pipe, root barrier geotextile, geotextile, porous paving concrete, soil stabilization matting, riprap, plants, etc.
      a. To be provided in one document by the contractor at the end of construction.
   2. Media composition certification within 90 days of installation, and certified geotechnical reports
   3. Porous paving concrete testing reports
   4. Concrete and Steel Certificates for concrete (poured in place or precast) stormwater management structures.
   5. Vegetative Roof Planting Tickets, including certification indicating actual square footage installed.
   6. Complete Inspection check-off lists

D. The General Contractor and/or the Construction Manager shall be responsible for any and all costs, damages and delays arising from or in connection with corrective measures, re-designs, re-approvals, re-reviews, and the like required for as-built approval thereof by the authority having jurisdiction.

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E. The General Contractor and/or the Construction Manager shall provide the following documentation to the Owner in hard copy and electronic format.
   1. Date/time-stamped digital (.jpg) photographs documenting the chronology of the construction of all stormwater management facilities (including vegetative roof if applicable) from beginning to end. This shall include a photo of each layer of media installed in stormwater facilities.
   2. Electronic files, AutoCAD and/or .pdf format, of the stormwater management facilities as-built construction including, but not limited to, authority having jurisdiction signed/approved as-built certifications and the like.

3.03 DEVIATIONS AND CORRECTIONS

A. Under no circumstances shall any construction or materials deviate from the approved stormwater management/sediment control plans without prior approval of the Civil Engineer of Record and the authority having jurisdiction.

B. Any changes to the designs or construction shown on the approved stormwater management plans must be appropriately pre-approved and permitted by the Civil Engineer of Record and authority having jurisdiction prior to being implemented in the field and/or submitted for review and approval as an as-built condition. Changes in design will require the General Contractor and/or the Construction Manager to hire the Civil Engineer of Record to implement at no additional cost to the Owner.

C. Any and all corrections, either to plans or construction, identified during review of the as-built documents shall be made, re-inspected and corrected as-built documentation must be re-certified by the Civil Engineer of Record and re-submitted to the authority having jurisdiction such that final as-built approval will be obtained within two (2) weeks of the Civil Engineer of Record's receipt of authority having jurisdiction comments on the initial submittal at no additional cost to the Owner. Any fees to be paid by the General Contractor and/or the Construction Manager at no additional cost to the Owner.

3.04 FINAL INSPECTION

A. Once the as-builts are approved, the Civil Engineer of Record shall provide a pdf copy of the approved as-builts to the General Contractor and/or the Construction Manager. The General Contractor and/or the Construction Manager shall make a hard copy of the approved as-builts and provide it to the Inspector during a final inspection arranged for by the General Contractor and/or the Construction Manager.

B. The General Contractor and/or the Construction Manager shall make any adjustments to the stormwater facilities as requested by the Inspector at no additional cost to the Owner.

C. After the Inspector has accepted the stormwater facilities, the General Contractor and/or the Construction Manager shall contract with a Montgomery County Department of Environmental Protection (MCDEP) approved Inspector to perform a confined space certification of the stormwater facilities. Coordinate final Cleaning of the system with the inspector.
   1. Deficiencies noted during the inspection shall be corrected by the General Contractor and/or the Construction Manager at no additional cost to the Owner.

3.05 CLEANING

A. Clean all storm drains by flushing with water and removing sheeting, bracing, shoring, forms, soil sediment, concrete, or other debris manually or by vacuum truck as directed by Engineer prior to testing. Material shall not be flushed to an off-site storm drain system or to any stormwater management facility. All debris removed from the drains, including the flushing water, shall be legally disposed of off-site.

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B. Video Inspection
   1. Video inspection of all new and rehabilitated storm sewers shall be conducted by the Contractor, at their own expense.
   2. Inspection Procedure:
      a. Prior to video inspection, the drain will be cleaned by the Contractor to remove all debris and sediment. Sufficient water shall be run through the pipe so as to saturate any potential low spots so that they may be detected during inspection.
      b. The inspection will be performed with closed circuit video equipment.
      c. The inspection will begin at one end of the project and will continue in the same direction until the inspection is complete.
      d. All lateral connections and other observations shall be inspected at right angles utilizing the pan and tilt capabilities of the camera.
   3. Low spots (bellies) in excess of 1” for pipe diameters 18” or less and 5% of the pipe diameter for pipes 24” and larger shall be considered unacceptable. If unacceptable low spots exist, as indicated by standing water during video inspection, the contractor shall remove and replace defective installations as necessary and re-inspect at their cost.

3.06 MAINTENANCE

A. The General Contractor and/or the Construction Manager shall be responsible for maintenance of all stormwater management facilities until the facilities have been accepted by the MCDEP Inspector.
   1. Maintenance shall be in accordance with authority having jurisdiction and MDE requirements, including weeding.

PART 4 CIVIL ENGINEER PROPOSAL

4.01 SCOPE OF WORK

A. The Civil Engineer will perform a one-time field run survey of the installed stormwater management facilities as can be accessed. Civil Engineer will make recommendations for any required modifications or corrections to resolve any witnessed discrepancies between the design and as-built drawings. The General Contractor and/or the Construction Manager will be responsible for implementing these modifications and corrections to the as-built / installed stormwater management structures. Lastly, the Civil Engineer will perform inspection services at periodic events as stipulated on the drawings. The General Contractor and/or the Construction Manager will be responsible for providing any OSHA required equipment, and any required testing equipment during said inspections. The Civil Engineer will be reimbursed for any failed or unprepared inspections on a per-visit basis. The Civil Engineer has assumed that this project will require no more than _____ inspections (this amount includes any inspection: passed, failed, or unprepared inspections). The Civil Engineer will be reimbursed for any inspections that exceed this amount on a per visit basis by the General Contractor and/or the Construction Manager.

4.02 ENGINEERING CHARGES

A. Civil Engineer’s compensation for the services outlined above will be a fixed fee of $__ (_____ dollars), based on the scope listed above.
   1. The following is a breakdown of the fee:

      SWM Inspections $_____
      SWM As-Built Survey $_____
      SWM As-Builts – Engineering $_____

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TOTAL $_____

2. Additional inspections beyond those outlined above will be billed at $___ (___dollars) per inspection.
3. A non-refundable, initial payment of $____ (____ dollars) is required prior to the commencement of any work by the Civil Engineer on this project. Payment shall be submitted with the original signed copy of this proposal. Civil Engineer will invoice for the work in progress. Payment of the invoices for progress billings of work being performed on monthly basis shall be due within 30 days of the date of the invoice. The retainer credit will be applied to the final payment of the invoice.
4. The Civil Engineer's fee is not subject to any retention for the progress billings or until the project is closed out.

END OF SECTION 330840

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SECTION 331000
UTILITY STANDARDS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions, and Division 1, Specification Sections apply to work in this section.

1.02 DESCRIPTION OF WORK

A. Section specifies materials, work and standards for site and utility construction materials and work.

1.03 RELATED SECTIONS

A. Section 312000 "Earthmoving"

B. Section 331005 “Water Distribution System”

C. Section 333000 “Sanitary Sewerage”

D. Section 334100 "Storm Drainage "

E. Division 22 "Plumbing”

1.04 STANDARDS

A. Washington Suburban Sanitary Commission's (WSSC) current "General Conditions and Standard Specifications".

B. City of Rockville current Water and Sewer Standards.

C. Maryland Department of Transportation - State Highway Administration current “Standard Specifications for Construction and Materials,” measurement and payment clauses do not apply.

D. American Concrete Institute (ACI).

E. Other utility purveyors’ standards as applicable. Contractor to coordinate with other utility purveyors.

F. Montgomery County Department of Permitting Services Requirements as applicable.

1.05 SUBMITTALS

A. Products:

1. Submit typewritten list of selected products, when options are specified, within 10 calendar days after Contract execution. Submit detailed shop drawings of utility modifications required by selection of options.
2. Submit manufacturer's descriptive literature of structure castings.
3. Submit Portland cement concrete mix design formula for each class specified.
4. Submit certificates, signed by manufacturer or producer and Contractor, stating the following comply with this specification:
    a. Portland cement.
    b. Fine aggregates.
    c. Coarse aggregates.
    d. Portland cement concrete.

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e. Concrete masonry units.
f. Brick.
g. Foundation materials.
h. Bedding materials.

5. Submit shop drawings, of the following, indicating concrete reinforcement locations, size, and placement:
   a. Cast in place reinforced concrete structures.
   b. Pre-cast reinforced concrete structures.
6. Submit location of product manufacture and of extraction/recovery of primary raw materials.
7. Submit recycled-content data, designating percentages of post-consumer and post-industrial recycled material.
8. Submit certification of FSC-certified sustainably harvested wood formwork materials, if applicable.

B. Compaction Equipment: Submit compaction equipment data prior to start of controlled fill earthwork operations.

C. Testing: Submit test reports of testing specified.

D. “As-Built” Plans: Submit “as-built” plans for water, sanitary sewer, storm drainage, and stormwater management systems within 60 days of achieving substantial completion. Submit to Owner and to controlling utility agencies as required.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Schedule delivery operations to avoid unnecessary re-handling.

B. Storage:
1. General: Store in accordance with manufacturer's recommendations and as noted.
2. Portland cement: Store on platforms above ground and protect from adverse environmental conditions.
3. Aggregates: Store to prevent foreign material contamination.
4. Utility Joint Materials and Lubricants: Store in cool and dry location free of oil, grease, excessive heat, and direct sunrays.

C. Handling:
1. General: Comply with manufacturer's recommendations and as noted.
2. Aggregates: Handle to prevent segregation.
3. Pre-cast Concrete Structures: Handle to prevent damage. Utilize lifting holes provided by structure manufacturer.

1.07 DEFINITIONS

A. Refer to Section 312000 "Earthmoving".

1.08 REFERENCE STANDARDS

A. ASTM C32 - Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale).

B. ASTM C55 - Standard Specification for Dry-Cast Concrete Building Brick.

C. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

D. ASTM C858 - Standard Specification for Underground Precast Concrete Utility Structures.

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E. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).

F. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).

1.09 PROJECT CONDITIONS

A. Refer to Section 312000 "Earthmoving" and as noted.

B. Traffic: Maintain pedestrian and vehicular traffic during utility construction operations.

C. Environmental Limitations: Do not place Portland cement products or erect masonry when ambient air temperature is below 40 degrees Fahrenheit or air temperature has been below 35 degrees Fahrenheit for three or more consecutive days or between 15 November and 01 March without written authorization from Owner or Architect.

D. Certifications, Inspections and As-Built Documents: Contractor shall provide "as-built" plans of on-site water, sanitary sewer service and storm sewer work by a State of Maryland Licensed Surveyor, or Professional Engineer. Contractor shall notify Architect within 15 calendar days of signing Contract identity of Licensed Surveyor or Registered P.E. who will certify as-built water and sewer plan. Show any changes and include ties for location of valves, bends, manholes, fire hydrants, and laterals accompanied by qualifying air test date and certification of compliance.

E. Stormwater Management As-Built Inspections, Certifications and As-Builts: See Section 330840 “Commissioning of Stormwater Utilities”.

PART 2 PRODUCTS

2.01 MATERIALS

A. Provide products manufactured of primary raw materials extracted/recovered within a 500-mile radius of Project Site.

B. Portland Cement Concrete: MDOT-SHA Section 902, Portland Cement Concrete and Related Products.

1. Water: Clean and free of oil, acid and injurious amounts of vegetable matter, alkalis, and salts. River, stream, or lake water is prohibited.
2. Forms: Wood, steel or as specified. Form materials to produce smooth surfaces, free of irregularities. Nonrented wood formwork shall be made of FSC-certified sustainably harvested wood materials.

C. Mixes:

1. Class "A" Concrete: MDOT-SHA Mix No. 4, Table 902 A. 28-Day compressive strength 3500 P.S.I. Maximum 50 percent GGBF slag replacement for Portland cement, per MDOT-SHA Specification 902.06.05.
2. Class "B" Concrete: MDOT-SHA Mix No. 3, Table 902 A. 28-Day compressive strength 3500 P.S.I. Maximum 50 percent GGBF slag replacement for Portland cement, per MDOT-SHA Specification 902.06.05.

D. Concrete Reinforcements:

1. Steel bars: ASTM A 615, Grade 60, deformed, designation as indicated or specified. Minimum 99 percent recycled content, of which minimum 60 percent shall be post-consumer, and the remainder may be post-industrial material.
2. Steel Wire Mesh: ASTM A 185 welded wire mesh, roll type, size as indicated or specified.

E. Brick:

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1. Type A: **<<ASTM C55>>** Concrete Building Brick, type I, grade N, standard manufacture size.
2. Type B: **<<ASTM C32>>** Clay or Shale Brick, grade SS or as specified, solid, 2-1/4 by 3-3/4 by **<< 8 inches>>**.

F. Cement Mortar: SHA Section 902.05, Masonry Cement.
   1. Water: As specified for Portland cement concrete.

G. Cast-in-Place Reinforced Concrete Structures:
   1. Structure Bases: Class "B" Portland Cement Concrete.
   2. Structure Walls and Top Slabs: Class "A" Portland Cement Concrete.
   3. Concrete Reinforcement, Structural Steel, Structure Castings and Appurtenances: As indicated and specified.

H. Pre-Cast Reinforced Concrete Structures:
   1. Square and Rectangular Structures: **<<ASTM C858>>**.
   2. Structural Design Loading: **<<ASTM C858>>**, live load designation A-16.
   3. Circular Structures: ASTM C 478.
   4. Structure Joints: **<<ASTM C443>>**.

I. Foundation Materials:
   1. Type I: ASTM C 33 Coarse Aggregate, size No. 8 **<< 3/8 inch>>** to No. 8).
   2. Type II: MDOT-SHA Coarse Aggregate Size No. 57 stone (1 **<< 1/2 inch>>** to No. 8).
   3. Type III: Earth material free of debris, waste materials, frozen materials, vegetable matter, clay, rocks, or stones exceeding **<< 1 inch>>** in any dimension. Obtain Type III material from on-site excavations or off-site borrow areas approved by Soils Engineer.

J. Bedding Materials:
   1. Type A: ASTM C 33 Fine Aggregate.
   2. Type B: ASTM C 33 Coarse Aggregate, size No. 6 **<< 1 inch>>** to No. 4).
      a. Contractor's Option: MDOT-SHA Coarse Aggregate Size No. 57 stone (1 1/2 to No. 8.)
   3. Type C: Earth material free of debris, waste materials, frozen materials, vegetable matter, clay and rocks or stones exceeding one inch in dimension.

K. Bedding Material Schedule:
   1. Storm drainage system: Type B, or as per manufacturers' recommendations.
   2. Water Distribution System: W.S.S.C. Standards, City of Rockville Standards or Type A if there are no standards.
   3. Sanitary Sewer System: W.S.S.C. Standards, City of Rockville Standards or Type B if there are no standards.
   4. All other utilities: Type C.

L. Backfill Materials: As specified for Fill or Backfill, Section 02100 "Earthwork and Grading", and as noted.
   1. Utility Trenches:
      a. Phase I: Earth material free of debris, waste materials, frozen materials, vegetable matter and rock or stones exceeding one inch in any dimension.
      b. Phase II: Earth material free of debris, waste material, frozen material, vegetable matter and rock or stones exceeding one inch in dimension.

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2. Utility Structures: Earth material free of debris, waste material, frozen material, vegetable matter and rock or stones exceeding two inches in any dimension. Obtain backfill material from the following: Excavated material approved by Soils Engineer or Owner.

PART 3 EXECUTION

3.01 PROTECTION AND RESTORATION

A. Refer to Section 312000 "Earthmoving" and as noted.

B. General: Provide support systems (e.g., sheeting, shoring, sheet piling, cribbing, etc.) at no increase to Contract Sum. Cut off timber when using timber support systems above top of utility to prevent utility displacement. Exercise care when using trench shields or boxes during shield movement to prevent utility displacement.

3.02 EXISTING UTILITIES

A. Refer to Section 312000 "Earthmoving", and as noted. Contractor shall notify "Miss Utility" at least 48 hours prior to start of construction.

B. Provide test pits at existing utility crossings well in advance of system construction. Verify utility inverts for review by Architect or Owner to determine potential conflicts prior to start of system construction.

3.03 DEWATERING

A. Refer to Section 312000 "Earthmoving".

3.04 EXCAVATION

A. Refer to Section 312000 "Earthmoving" and as noted.

B. Trench Excavation: Open cut method or as specified. Excavate materials encountered to sub-grade elevations indicated or specified.

1. Trench width below top of utility not to exceed the following clearances on each side of utility:

Utility Exterior Width, Diameter or Span	Clearance
1 thru 30 inches	24 inches
30 inches and higher	36 inches

2. Excavate utility trenches to following depths:
   a. Circular storm drainage pipe: Six inches below bottom of pipe.
   b. Water distribution pipe: W.S.S.C. Standards or four inches below bottom of pipe, whichever is greater.
   c. Sanitary sewer pipe: W.S.S.C. Standards or six inches below bottom of pipe.
   d. All other utilities: Bottom of utility.

C. Structure Excavation:

1. Utility structure excavation to produce a minimum 12-inch clearance between exterior structure walls and excavation walls or support systems.
2. Extend excavation to following:
   a. Cast in place reinforced concrete structures: Minimum Six inches beyond structure base.
   b. Pre-cast reinforced concrete structures: Minimum Six inches below bottom of pre-cast structure base.

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c. Pre-cast reinforced concrete structure with cast in place concrete base: Bottom of structure base.
d. Masonry structures: Bottom of structure base.

3.05 OVER-EXCAVATION

A. Refer to Section 312000 "Earthmoving", except as noted.
B. Utility Trenches:
   1. Correct over-excavation of water distribution, storm drainage, and gravity flow sanitary sewer systems by backfilling over-excavated trenches with Type II foundation (Type B bedding) material and compacting.
   2. Correct over-excavation of other utilities by backfilling over-excavated trenches with Type III foundation (Type C bedding) material and compacting.
   3. Place material in loose lifts not exceeding eight inches. Compact each lift to 98 percent maximum dry density. Density test method: **<<ASTM D698>>**.
C. Structures: Correct utility structure over-excavation by backfilling over-excavation with Type II foundation (Type B bedding) material and compacting.
   1. Place material in loose lifts not exceeding eight inches. Compact each lift to 98 percent maximum dry density. Density test method: **<<ASTM D698>>**.

3.06 UNSUITABLE EARTH

A. Refer to Section 312000 "Earthmoving", except as noted.
B. Restore unsuitable earth excavation as specified for over-excavation.

3.07 EXCAVATED MATERIAL STORAGE

A. Refer to Section 312000 "Earthmoving" and as noted.
B. Stockpile select excavated materials required for backfill operations.

3.08 PORTLAND CEMENT CONCRETE CONSTRUCTION

A. Mixing:
   1. Ready-Mixed Concrete: ASTM C 94.
   2. Project Site Batch Mixing: ACI 301, Chapter 7.
B. Formwork: ACI 301, Chapter 4.
C. Reinforcement: ACI 301, Chapter 5.
D. Joints and Embedded Items: ACI 301, Chapter 6.
E. Placement: ACI 301, Chapter 8.
F. Surface Defects: ACI 301, Chapter 9.
G. Finishes: ACI 301. Non-Exposed: Section 10.2.1. Exposed: Section 10.2.2.
H. Curing and Protection: ACI 301, Chapter 12.
I. Cold Weather Concreting: ACI 306R.
J. Hot Weather Concreting: ACI 305R.

3.09 STRUCTURES

A. Cast in Place Reinforced Concrete Structures: Construct cast in place concrete structures as indicated and specified.

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B. Pre-cast Reinforced Concrete Structures:
   1. Pre-cast structure base: Place Type I foundation material, on excavation sub-grade, to bottom of structure base and compact to 98 percent of maximum dry density by **<<ASTM D698>>**. Install pre-cast structure base, on compacted foundation material, level to **<< 1/8 inch>>** in **<< 5 feet>>**. Clean and lubricate structure joints, immediately prior to installation, in accordance with manufacturer's recommendation. Install pre-cast reinforced structure sections, on structure base, plumb to **<< 1/4 inch>>** in **<< 10 feet>>**. Position structure sections on previously installed section and push joints tightly together. Position concrete top slabs on structure as indicated. Plug lifting holes with cement mortar. Install frames and covers to finished grade with bricks and cement mortar.

C. Masonry Structures:
   1. Erect structure walls with masonry materials specified. Wet each masonry unit thoroughly before placement. Shove each unit into place in full bed of cement mortar. Horizontal and vertical joints not to exceed **<< 1/2 inch>>**.
   2. Bond and Coursing: Brick Masonry - Common Bond.
   3. Fill joints completely with cement mortar. Fit masonry units tightly around utilities projecting through structure walls. Space, set and bond structure appurtenances as indicated or specified during masonry erection. Point up interior structure joints and clean removing excess cement mortar. Parge exterior structure walls with 1/2-inch-thick cement mortar and finish with smooth trowel. Masonry construction tolerances not to exceed **<< 1/4 inch>>** in **<< 10 feet>>** vertical from plumb.

3.10 BEDDING

A. Storm drainage pipe: Place bedding material, on excavated trench sub-grade to bottom of pipe and compact. Upon completion of pipe installation, place, and compact bedding material to springline of pipe.

B. Other Utilities: Bedding not required. Install utilities on excavated trench sub-grade as indicated or specified.

3.11 BACKFILL

A. Backfill utility trenches in two consecutive phases as follows, or as specified by the utility purveyor, whichever is more stringent:
   1. Phase I - Backfill to 12-inch depth above top of utility. Place backfill material in loose lifts not exceeding six inches. Compact each lift to 98 percent maximum dry density. Density test method: **<<ASTM D698>>**.
   2. Phase II - Unpaved Areas: Place backfill material to grade in loose lifts not exceeding **<< 24 inches>>**. Compact each lift to 90 percent maximum dry density. Density test method: **<<ASTM D698>>**
   3. Phase II - Paved Areas: Place backfill material to grade in loose lifts not exceeding eight inches. Compact each lift to 98 percent maximum dry density. Density test method: **<<ASTM D698>>**.

B. Backfill utility structures as follows: Place backfill material carefully and in loose lifts not exceeding **<< 12 inches>>** in depth. Compact each lift to 95 percent maximum dry density. Density test method: **<<ASTM D1557>>**. Do not backfill masonry structures until cement mortar parge attains initial set.

3.12 EXCAVATED MATERIAL DISPOSAL

A. Refer to Section 312000 "Earthmoving".

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3.13 WASTE MANAGEMENT

A. Recycle waste materials in accordance with Section 017419 “Construction Waste Management and Disposal” requirements.

END OF SECTION 331000

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SECTION 333000
SANITARY SEWERAGE

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

B. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions, and Division 1, Specification Sections apply to work in this section.

1.03 DESCRIPTION OF WORK

A. Section specifies materials and work required to construct gravity flow sanitary sewer system.

1.04 RELATED SECTIONS

A. Section 31 20 00 "Earthmoving"

B. Section 33 10 00 "Utility Standards"

C. Section 33 41 00 "Storm Drainage"

D. Division 22 "Plumbing".

1.05 STANDARDS

A. Refer to Section 331000 "Utility Standards", and as noted.

B. Washington Suburban Sanitary Commission's (WSSC) current "General Conditions and Standard Specifications" and "Standard Details".

C. Washington Suburban Sanitary Commission's current "Regulations Governing Installation of Plumbing and Sewer Cleaning in Washington Suburban Sanitary District".

D. Washington Suburban Sanitary Commission's current "Plumbing and Gasfitting Regulations.

E. City of Rockville current Water and Sewer Standards.

1.06 SUBMITTALS

A. Refer to Section 331000 "Utility Standards" and as noted.

B. Products: Submit product manufacturer's specifications and installation instructions and certificates of compliance signed by manufacturer and Contractor stating that products comply with this specification to Architect. Certificates of compliance must be notarized, signed by an officer of Manufacturer, and shall include Project Contract Number or On-site number, job location, Contractor’s name, types, classes and strengths of pipe and fittings, and Manufacturer’s name.

C. Options: Submit typewritten list of selected products when options are specified within 10 calendar days after Contract execution. Submit detailed shop drawings of system modifications required by selection of options.

D. Submit shop drawings of precast structures indicating concrete reinforcement location, size and placement.

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E. Submit As-built drawings to Architect, prior to submission to authority having jurisdiction. As-builts must conform to current authority having jurisdiction as-built requirements. Contractor responsible for all review, and re-review fees required by authority having jurisdiction for processing of the as-builts.

F. Service Connection Permit: Contractor shall submit to Architect all items required by authority having jurisdiction to obtain a Service Connection Permit including but not limited to: All required Bonds, Letter indicating Utility Contractor, and Certificate of Insurance. It is the responsibility of the contractor to confirm the bond amount with authority having jurisdiction prior to application of the Service Connection Permit. Architect will obtain Service Connection Permit once all these items are received.

1.07 PRODUCT, DELIVERY, STORAGE AND HANDLING

A. Refer to Section 331000 "Utility Standards".

1.08 PROJECT CONDITIONS

A. Refer to Section 331000 "Utility Standards" and as noted.

B. Existing Sanitary Sewer System: Provide, install, operate and maintain pumps and related equipment required to divert sewage (bypass pumping) during system construction. Extend pump discharge lines to existing sanitary sewer structures. Surface flow is prohibited.

C. Traffic: Maintain vehicular and pedestrian traffic during system construction.

1.09 CONSTRUCTION SURVEYS

A. Provide survey equipment and qualified personnel for construction surveys. Provide combined horizontal and vertical alignment stakes for system construction. Horizontal stake interval to be 25 feet maximum and at structures. Provide construction cut sheet preparation as required.

PART 2 PRODUCTS

2.01 MATERIALS

A. All materials shall meet authority having jurisdiction standards and shall meet most current applicable requirements indicated.

B. Polyvinyl Chloride (PVC) Pipe: Standards indicated as indicated on the drawings.
   1. Pipe Joints: ASTM D 3212 bell and spigot type, with flexible elastomeric gasket seals. Gaskets shall meet requirements of **<<ASTM F477>>**.
   2. Fittings shall be as indicated and required.

C. Cleanouts: authority having jurisdiction standards indicated.
   1. Cleanouts For Use in Paved Walk Areas: Refer to Section 334100 "Storm Drainage", and as noted.
      a. Expansion Joint: ASTM D 994, bituminous preformed joint filler, 1/2-inch thick.
   2. Furnish Owner with one cleanout wrench.

D. Structures: Authority having jurisdiction standards specified and indicated.

E. Foundation and Bedding Materials: Refer to Section 331000 "Utility Standards".

F. Concrete: Refer to Section 331000 "Utility Standards".

G. Miscellaneous Products:

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1. Underground identification type manufactured by Allen Systems, Houston, Texas. "Detectatape" type, three inches wide, marked "Caution Sewer Line Buried Below", "Safety Green" color.

PART 3 EXECUTION

3.01 DEWATERING, EXCAVATION, OVER-EXCAVATION AND UNSUITABLE EARTH:

A. Refer to Section 331000 "Utility Standards".

3.02 EXISTING SYSTEM CONNECTION

A. Notify authority having jurisdiction no less than 48 hours prior to start of system construction.

B. Excavate and expose existing pipe at connection location indicated. Adjust connection location, as required, in event of conflicts with existing pipe joints. Neatly cut existing pipe and prepare cut end as required for connection with new pipe. Make connections with existing pipe using fittings designed for purpose, in accordance with manufacturer's installation instructions.

3.03 PIPE

A. General: Install in accordance with manufacturer's installation instructions and as noted. Inspect each pipe laying length and pipe joint materials for defects. Remove defective products from project site. Install pipe to horizontal and vertical alignment indicated. Begin with installation at lowest system elevation and proceed up-grade. Field cut pipe only where required to complete structure-to-structure closures, install fittings or as specified. Cut pipe to smooth square end with equipment designed for cutting pipe.

B. Polyvinyl Chloride (PVC) Pipe: Install pipe in accordance with **<<ASTM D2321>>**, manufacturer's installation instructions, and as noted.

1. Install with pipe spigot end pointing in flow direction. Begin installation of pipe, with vertical gradient exceeding 10 percent, at lowest elevation and proceed up-grade. Clean bell and spigot interior and exterior surfaces, removing oil, grit and foreign matter. Lubricate pipe ends and gasket in accordance with manufacturer's instructions. Position each laying length of previously installed pipe and manually push joint tightly together.
2. Field Pipe Cutting: Shape spigot end of cut pipe to resemble manufactured spigot end, with a pipe-beveling tool designed for PVC pipe. Copy the full insertion mark provided on manufactured spigot end onto prepared field cut end.

3.04 EXISTING PIPE/STRUCTURE CONSTRUCTION

A. Excavate and expose existing pipe at structure location indicated. Adjust structure location as directed by Architect or Owner in event existing pipe joint interferes with structure walls, or as required to obtain required invert, at no increase to Contract Sum. Manually excavate below existing pipe prior to structure base placement. Place concrete structure base and construct structure as specified. Neatly cut and remove upper half of existing pipe and construct invert flow channel.

3.05 STRUCTURES

A. Refer to Section 331000 "Utility Standards" and as noted.

B. Pipe Connections: Install pipe opening sleeves in accordance with manufacturer's installation instructions. Neatly cut pipes flush with interior structure walls except as otherwise indicated or specified.

C. Structure Joints: Apply liberal coat of joint coating material to each structure section joint in accordance with manufacturer's application instructions.

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D. Invert Flow Channels: Construct invert flow channels smooth and semicircular in shape. Shape channels with horizontal circular curve radii as large as structure will permit. Neatly form channels in structure base with bricks and cement mortar.

3.06 CLEANOUTS

A. Refer to Section 334100 "Storm Drainage", and as noted.

B. Install cleanouts in accordance with manufacturer's installation instructions and as indicated.
   1. Construct concrete pads of Class "A" concrete as indicated.
   2. Cleanouts in paved walk shall be installed without a concrete pad. Top shall be cast into and set flush with finished walk surface.

3.07 BACKFILL

A. Refer to Section 331000 "Utility Standards", and as noted.

B. Sanitary Sewer mains must be inspected by Engineer of Record prior to completion of backfill operations. Contractor shall provide a minimum of 48 hours notice to Engineer of Record before completion of backfill operations.

C. Underground Identification Tape: Install tape during backfill operations. Tape shall be centered over pipe, located 12 inches above top of pipe.

3.08 SYSTEM TESTING

A. Provide equipment, materials and labor required to test system. Conduct low pressure air tests in accordance with authority having jurisdiction standards. Provide a minimum of 48 hours notification of planned testing. Test observation by authority having jurisdiction personnel.

B. Repair or replace defective products and system construction, which fails tests as directed by local jurisdiction approving agency. Provide additional corrective work and retesting until system is approved and accepted. Provide corrective work and retesting at no increase to Contract Sum.

3.09 SYSTEM INSPECTION

A. Provide additional corrective work, determined necessary by video inspection, as specified for system testing.

B. Video Inspection:
   1. Video inspection of all new and rehabilitated sewers shall be conducted by the Contractor, at their own expense.
   2. Inspection Procedure:
      a. Prior to video inspection, the sewers will be cleaned by the Contractor to remove all debris and sediment. Sufficient water shall be run through the pipe so as to saturate any potential low spots so that they may be detected during inspection.
      b. The inspection will be performed with closed circuit video equipment.
      c. The inspection will begin at one end of the project and will continue in the same direction until the inspection is complete.
      d. All lateral connections and other observations shall be inspected at right angles utilizing the pan and tilt capabilities of the camera.

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3. Low spots (bellies) in excess of 1 inch shall be considered unacceptable. If unacceptable low spots exist, as indicated by standing water during video inspection, the contractor shall remove and replace defective installations as necessary and re-inspect at their cost.

END OF SECTION 333000

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SECTION 334100
STORM DRAINAGE

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

B. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

C. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

D. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

E. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract including the General and Supplementary Conditions and Division 1, Specifications Section, apply to work in this section.

1.03 DESCRIPTION OF WORK

A. This section specifies materials and work required to construct storm drainage system.

1.04 RELATED WORK

A. Section 311000 "Site Clearing"

B. Section 312000 "Earthmoving"

C. Section 331000 "Utility Standards"

D. Section 321600 "Concrete Walks"

E. Section 330840 “Commissioning of Storm Water Utilities”

F. Division 22 "Plumbing".

1.05 STANDARDS

A. Washington Suburban Sanitary Commission (WSSC) current "General Conditions and Standard Specifications" and "Standard Details".

B. Montgomery County Department of Transportation current "Design Standards".

C. Maryland Department of Transportation State Highway Administration current "Standard Specifications for Construction and Materials".

D. Maryland Standards and Specifications for Soil Erosion and Sediment Control, current edition.

E. City of Rockville current Water and Sewer Standards.

F. American Concrete Pipe Association (ACPA).

1.06 SUBMITTALS

A. Products:

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1. Submit certificate signed by manufacturer and contractor stating that pipe and pipe joint materials comply with this specification.
2. Submit shop drawings of pre-cast reinforced structures and cast in place reinforced concrete structures indicating location, size and placement of concrete reinforcement.

1.07 PROJECT CONDITIONS

A. Refer to Section 312000 "Earthmoving" and as noted.

B. Existing Storm Drainage System: Provide, install, operate and maintain pumps and related equipment required to divert storm water during system construction.

C. Traffic: Maintain pedestrian and vehicular traffic during system construction.

D. As-Built Documents:
   1. Refer to Section 331000 “Utility Standards."

1.08 CONSTRUCTION SURVEYS

A. Provide survey equipment and qualified personnel for construction surveys. Provide combined horizontal and vertical alignment stakes for system construction. Horizontal stake interval to be **<< 25 feet>>** maximum and at all structures. Provide construction cut sheet preparation as required.

1.09 TESTING AND INSPECTIONS FOR BACKFILL

A. Refer to Section 312000 “Earthmoving”.

PART 2 PRODUCTS

2.01 MATERIALS

A. Polyvinyl Chloride (PVC) Pipe: **<<ASTM D2466>>**, Schedule 40 PVC gravity sewer pipe, size as indicated, standard manufacture laying length.
   1. Pipe Joints: ASTM D 3212, bell and spigot type, with flexible elastomeric gasket seals. Gaskets shall meet the requirements of **<<ASTM F477>>**.
   2. Fittings shall be as indicated and required.

B. Concrete Pipe: **<<ASTM C76>>**, Class IV, standard manufacture laying length.
   1. Pipe Joints: Rubber gaskets, **<<ASTM C443>>** with vegetable oil soap joint lubricant.
   2. Mortar Joints: Modified tongue and groove pipe with cement mortar.

C. Corrugated Steel Pipe: ASTM A 819 and AASHTO M 274 Aluminized Steel Type 2 pipe, corrugations and thickness as specified on plans.
   1. Pipe Joints: Shall be watertight joints, made with bands gaskets as specified on plans.

D. High Density Polyethylene Pipe: ADS Type N-12, or approved equal.
   1. Pipe Joints: All joints must meet a modified ASTM 3212 at 3.5-psi held for 10 minutes as certified by an independent testing laboratory.
   2. Pipe Joints: Plastic Cement Welding Solvents shall have a VOC content not to exceed 250 g/l.

E. Structures: Standards specified and as indicated.

F. Structure Castings: MDOT-SHA or Montgomery County Standards.
   1. Grates for storm drain inlets with grate tops shall be waffle shaped for wheelchair and bicycle safety. Slots shall not exceed ADA Guidelines.

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G. Filter Fabric: "Mirafi 140N" manufactured by Mirafi Incorporated, Charlotte, North Carolina. Contractor's Option: "Typar", type 3341 manufactured by Remay Incorporated, Nashville, Tennessee, or approved equal.
   1. Quality: Free of defects of flaws, which affect strength or filtering properties.

H. Cleanouts:
   1. Cleanout Ferrules and Plugs: Josam Series No. 58540 with cast iron body and bronze countersunk flanged plug. Size matching pipe size indicated. Contractor shall provide Owner with two "T" handles for recessed plugs.
   2. Cleanouts For Use in Paved Walk Areas: Josam Series No. 58360 adjustable floor cleanout with cast iron body and bronze plug and top. Size matching pipe size indicated. Contractor shall provide Owner with one cleanout wrench.
      a. Expansion Joint: ASTM D 994, bituminous preformed joint filler, **<< 1/2 inch>>** thick.
   3. Fittings: Shall be as specified for PVC pipe (for pipe materials indicated).

I. Sand: ASTM C33 Fine Aggregate.

J. Concrete: Refer to Section 331000 "Utility Standards".

K. Reinforcing Steel and Hardware: Refer to Section 331000 "Utility Standards", and as noted:
   1. Size and type of steel and hardware shall be as indicated.
   2. Exposed reinforcing steel shall be hot dip galvanized, ASTM A 767, Coating Class I.
   3. Hardware shall be hot dip galvanized, ASTM A 153.

L. Miscellaneous Products
   1. Underground identification tape manufactured by Allen Systems, Houston, Texas. Tape shall be three inches wide, "Detectatape" type, "Safety Green" color, and marked "Caution Sewer Line Buried Below".

PART 3 EXECUTION

3.01 DEWATERING, EXCAVATION, OVER-EXCAVATION AND UNSUITABLE EARTH:

A. Refer to Section 331000 "Utility Standards".

3.02 CONNECTIONS TO EXISTING SYSTEM

A. For structure construction over existing pipe, excavate and expose existing pipe at structure location indicated. Adjust structure location as directed by the Owner's Representative in the event existing pipe joint interferes with structure walls, at no increase to Contract Sum. Manually excavate below existing pipe prior to structure base placement. Place concrete base and construct structure as specified. Neatly cut and remove upper half of existing pipe and construct invert flow channel.

B. For pipe connections to existing structures, excavate and expose existing structure. Cut and remove portion of existing structure wall required for pipe connection. Install pipe, through existing structure wall, flush with interior wall surface. Remove portion of existing invert flow channel required for connection and reconstruct as specified. Fill joint between pipe and existing structure wall with cement mortar.

3.03 PIPE

A. General: Install in accordance with manufacturer's installation instructions and as noted. Inspect each pipe laying length and pipe joint materials for defects. Remove defective products from project site. Install pipe to horizontal and vertical alignment indicated. Begin installation at

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lowest system elevation and proceed up-grade. Field cut pipe only where required to complete structure-to-structure closures, install fittings or as specified. Cut pipe to smooth square end.

B. Concrete Pipe: Install with tongue end of pipe pointing in direction of flow. Clean and thoroughly wet joints immediately prior to joining pipe. Apply thick liberal coat of mastic to groove and tongue. Position each laying length in previously installed pipe and pull joint tightly together with mechanical device designed for pipe jointing.
   1. Clean interior of each joint removing excess cement mortar and finish flush with surface. Fill exterior upper half of pipe joint with cement mortar.

C. Polyvinyl Chloride (PVC) Pipe: Install pipe in accordance with **<<ASTM D2321>>**, manufacturer's installation instructions, and as noted.
   1. Install with pipe spigot end pointing in flow direction. Begin installation of pipe, with vertical gradient exceeding 10 percent, at lowest elevation and proceed up-grade. Clean bell and spigot interior and exterior surfaces, removing oil, grit and foreign matter. Lubricate pipe ends and gasket in accordance with manufacturer's instructions. Position each laying length of previously installed pipe and manually push joint tightly together.
   2. Field Pipe Cutting: Shape spigot end of cut pipe to resemble manufactured spigot end, with a pipe-beveling tool designed for PVC pipe. Copy the full insertion mark provided on the manufactured spigot end onto the prepared field cut end.

D. High Density Polyethylene Pipe: Install and Bed in accordance with manufacturer’s recommendations.

3.04 CLEANOUTS

A. Refer to Section 331000 "Utility Standards" and as noted.

B. Install cleanouts and construct concrete pads of Class "A" concrete as indicated.

C. Cleanout in paved walk area shall be installed without a concrete pad. Top shall be cast into and set flush with finished walk surface.

3.05 STRUCTURES

A. Refer to Section 331000 "Utility Standards" and as noted. Neatly cut pipes flush with interior structure walls. Construct invert flow channels smooth and semicircular in shape. Shape channels with horizontal circular curves, with radii as large as structure will permit or as indicated. Neatly form channels in structure base with bricks and cement mortar. Provide steps in structures exceeding **<< 3.0 feet>>** in depth. Vertical step spacing per standards specified.

3.06 BACKFILL

A. Refer to Section 331000 "Utility Standards", and as noted.

B. Polyvinyl Chloride (PVC) Pipe: Conduct backfill operations when pipe temperature is below 60 degrees Fahrenheit or during early morning hours to prevent excessive contraction.

C. Underground Identification Tape: Install during backfill operations. Center tape horizontally over pipe, **<< 12 inches>>** above top of pipe.

3.07 SYSTEM INSPECTION

A. Provide additional corrective work, determined necessary by video inspection, as specified for system testing.

B. Video Inspection
   1. Video inspection of all new and rehabilitated drains shall be conducted by the Contractor, at their own expense.

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2. Inspection Procedure:
   a. Prior to video inspection, the drains will be cleaned by the Contractor to remove all debris and sediment. Sufficient water shall be run through the pipe so as to saturate any potential low spots so that they may be detected during inspection.
   b. The inspection will be performed with closed circuit video equipment.
   c. The inspection will begin at one end of the project and will continue in the same direction until the inspection is complete.
   d. All lateral connections and other observations shall be inspected at right angles utilizing the pan and tilt capabilities of the camera.
3. Low spots (bellies) in excess of 1” for pipe diameters 18” or less and 5% of the pipe diameter for pipes 24” and larger shall be considered unacceptable. If unacceptable low spots exist, as indicated by standing water during video inspection, the contractor shall remove and replace defective installations as necessary and re-inspect at their cost.

3.08 WASTE MANAGEMENT

A. Recycle waste materials in accordance with Section 017419 “Construction Waste Management and Disposal” requirements.

END OF SECTION 334100

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Attachment E –

MSDE Submission Checklists (SD, DD, and CD phases)

SCHEMATIC DESIGN (SD) SUBMISSION CHECKLIST FOR MSDE/IAC REVIEW

Date: _____ **(Original Submission Date, if this is a Revision:** _____**)**

Project Type: New☐; Replacement☐; Reno☐; Lmtd Reno☐; Addition☐; Modular☐; Other_____

School Name: _____**Grade Level:**_____

School System:_____ **PSC # (If any):**_____

SCHEMATIC DESIGN PROCESS

Authority: *Maryland Education Article §2-303(f)* as regulated by *COMAR 13A.01.02.03* and the *IAC Administrative Procedures Guide* (APG).

Purpose: Submission process for the Local Educational Agency (LEA) to request the Maryland State Department of Education (MSDE) State Superintendent's approval of the Schematic Design (SD) of a facility to serve to educate public school students.

Applies to: Projects involving renovation or new construction more than $1,000,000 in estimated cost. The Interagency Commission for School Construction (IAC) staff may also provide review input on projects utilizing State funds.

Procedure: SD submission will not be approved by the State Superintendent until all outstanding issues asked by MSDE are satisfactorily addressed.

SEND SD SUBMISSION & CHECKLIST TO: *(Charter schools need not send to IAC)*

Email to: *osfsubmissions.msde@maryland.gov* and *iac.pscp@maryland.gov*

Address to: Jillian Storms, AIA
Executive Director, Office of School Facilities
Maryland State Dept of Education
200 West Baltimore Street, Baltimore MD 21201

PDF FORMATTING (see examples of Bookmarking on last page)

PDF file shall be named per the file name convention of:

- LEA name, School Project, (PSC #), Phase, Date Submission

Example:

- AACPS Hillsmere E. REPL (02.084) SD 2022.12.20

SD PDF document shall be indexed for ease of finding required materials.

- Index should indicate items shown in the checklist under "INCLUDE IN A SINGLE PDF" subject heading on the following page.
- All the main items mentioned in the Index shall be bookmarked. Examples of applicable bookmarks would be: **Transmittal checklist, Local Board of Education Action, SD, Program Space Summary, TCO,** and so on.

See next page for SD Checklist to be included with the submission.

SD SUBMISSION CHECKLIST FOR MSDE/IAC REVIEW

Use the Appropriate Checklist below:

STATE = State-Supported (Project has IAC Approval of Local Planning or Funding)
OR Forward-Funded (Project will be or has been requested for CIP or BTL approval by IAC)
LOCAL = Locally-Funded (Project will only be funded locally with no intention to receive State funds)
NA = Not Applicable

LOCAL	STATE	**TAB 1 - SCOPE DESCRIPTIONS in PDF Format U.N.O. (can be Bookmark in Brochure)**
☐	☐	Transmittal includes this checklist
☐	☐	LEA Response to MSDE Educational Specifications Review letter (If required) **NA:** ☐
☐	☐	Any Revisions to the Educational Specifications (If applicable) **NA:** ☐
☐	☐	Intended student capacity (i.e. the number of students the school can accommodate) and proposed core capacity (Core spaces typically seen as Cafeteria, Gym, Library Media Center, & Health Suite). Include estimated # of future teaching stations to meet core capacity and indicate locations of proposed additions(s).
☐	☐	IAC Form 202.1 If Locally-funded or 21c City project - Need only provide: PSC #, type project, Summary of space that includes the total area of the following: the existing building, proposed new construction, proposed renovation, and proposed total demolition (footings to roof). (Column 1 * Required only if leasing LEA-owned bldg)
☐	☐	Net Square Feet (NSF) Summary of Program Spaces **(PROVIDE ALSO IN EXCEL)** ● Include comparison to the Ed Spec program requirements & % difference. ● Include NSF Total, GSF Total, and NSF/GSF efficiency %. ● Please review the definitions on pages 1 & 2 of the Facilities Planning Guide for Maryland Public Schools to determine what to include in the Net Spaces versus what is part of the Tare that makes up the total Gross Area. ● The NSF areas for Cooperative Use Spaces should also be totaled separately and include their GSF Total based on a 70% efficiency. ● Has column that indicates spaces serving as Teaching Stations as part of a State Rated Capacity take-off per APG Appendix 102B
	☐	If High School, CTE Support letter & Attachment 1 **NA:** ☐
	☐	If have Regional Special Education program, provide Support letter or waiver **NA:** ☐
☐	☐	Project Schedule including major target dates for design development, construction documents, bidding, Award, construction phases, Occupancy, & Project Completion.
☐	☐	Narrative Descriptions for all Design Disciplines
	☐	High-Performance evaluation standard & target goal, if new or repl. school **NA:** ☐
	☐	Net Zero Energy Add-On Incentive Request Form (If applicable) **NA:** ☐

SD SUBMISSION CHECKLIST FOR MSDE/IAC REVIEW

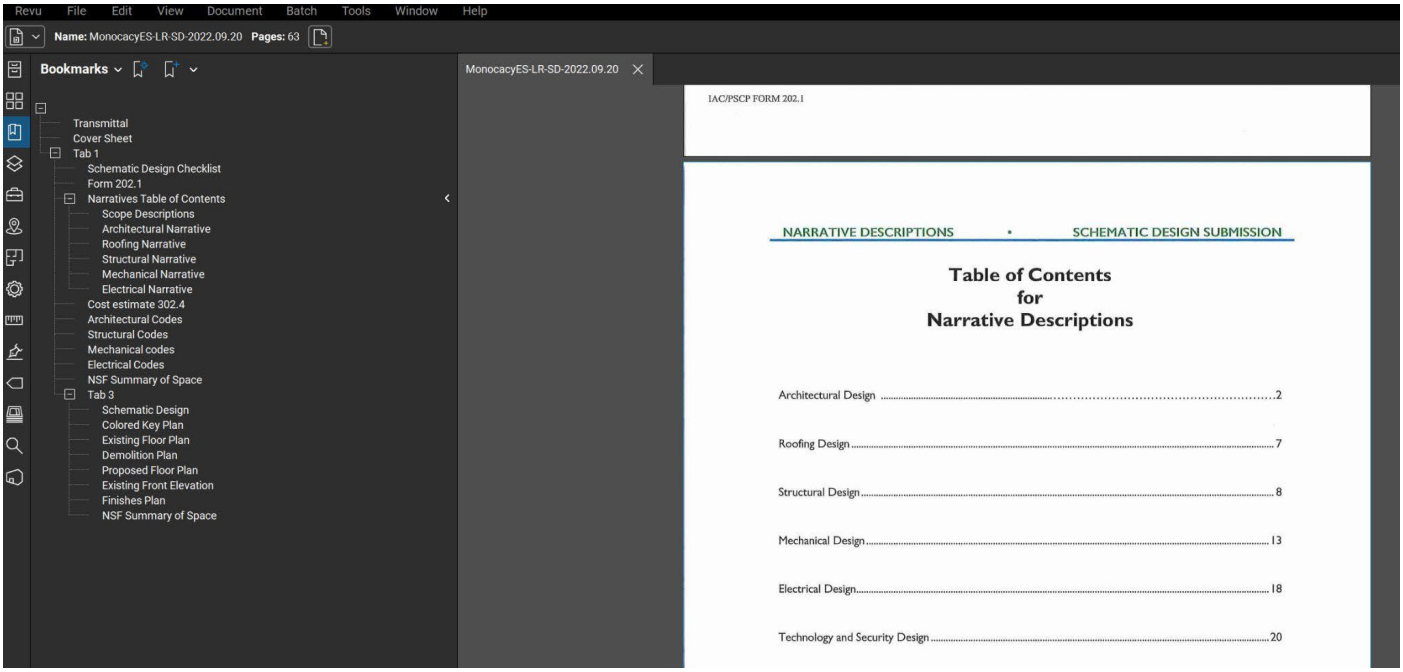
LOCAL	STATE	TAB 1 Continued
☐	☐	List of applicable codes including accessibility regulations
☐	☐	Estimated cost of construction including escalation factor
LOCAL	**STATE**	**TAB 2 - SUPPORT MATERIAL**
	☐	Cooperative Use Space (CUS) Info - If the project will be requesting additional State funds to support up to 3,000 gsf in CUS area, provide support material from partner agency or outside group that includes the spaces they will be using. **NA:** ☐
☐	☐	Regional Special Education (SE) - If project has Regional SE program(s) that are new or will change in size or program delivery, then provide an approval letter from MSDE Division of Early Intervention/Special Education Services (DEI/SES) **NA:** ☐
☐	☐	Career and Technical Education (CTE) **-** If this is a high school with new or changed CTE programs, provide an approval letter from MSDE Office of Career & College Pathways (OCCP) and *Attachment 1 - Facilities Utilization Table* from the application request or letter asking support of OCCP **NA:** ☐
	☐	If the facility was built before 1960 or is listed as Category I or II in Attachment A of the Programmatic Agreement between the Maryland Historical Trust (MHT) and the IAC, provide a copy of the MHT's determination of the project's impact on an historic property. The project review process and submission form are provided at: *https://mht.maryland.gov/projectreview.shtml* **NA:** ☐
LOCAL	**STATE**	**TAB 3 - DRAWINGS**
☐	☐	Proposed Site Plan (40th scale min.) & Existing Site Plan if a renovation, addition, or replacement project. Site plan should show outline of any master planned additions to meet core capacity and any accessibility improvements (locations of accessible parking spaces and Accessibility Passenger Loading Zone).
☐	☐	Teaching Stations & Cooperative Use Table w. Floor Plans - Totals # of Teaching Stations by Type and CUS (if applies) w/colored floor plans to show locations. Should reflect the total school, not just the addition or renovation.
☐	☐	Architectural drawings (⅛" scale minimum) - Bookmarked like example on next page ● Proposed Floor plans (if renovation or addition project, include existing floor plans. Include diagram that indicates date of construction of existing areas) ● Proposed Elevations ● Proposed Sections

SD SUBMISSION CHECKLIST FOR MSDE/IAC REVIEW

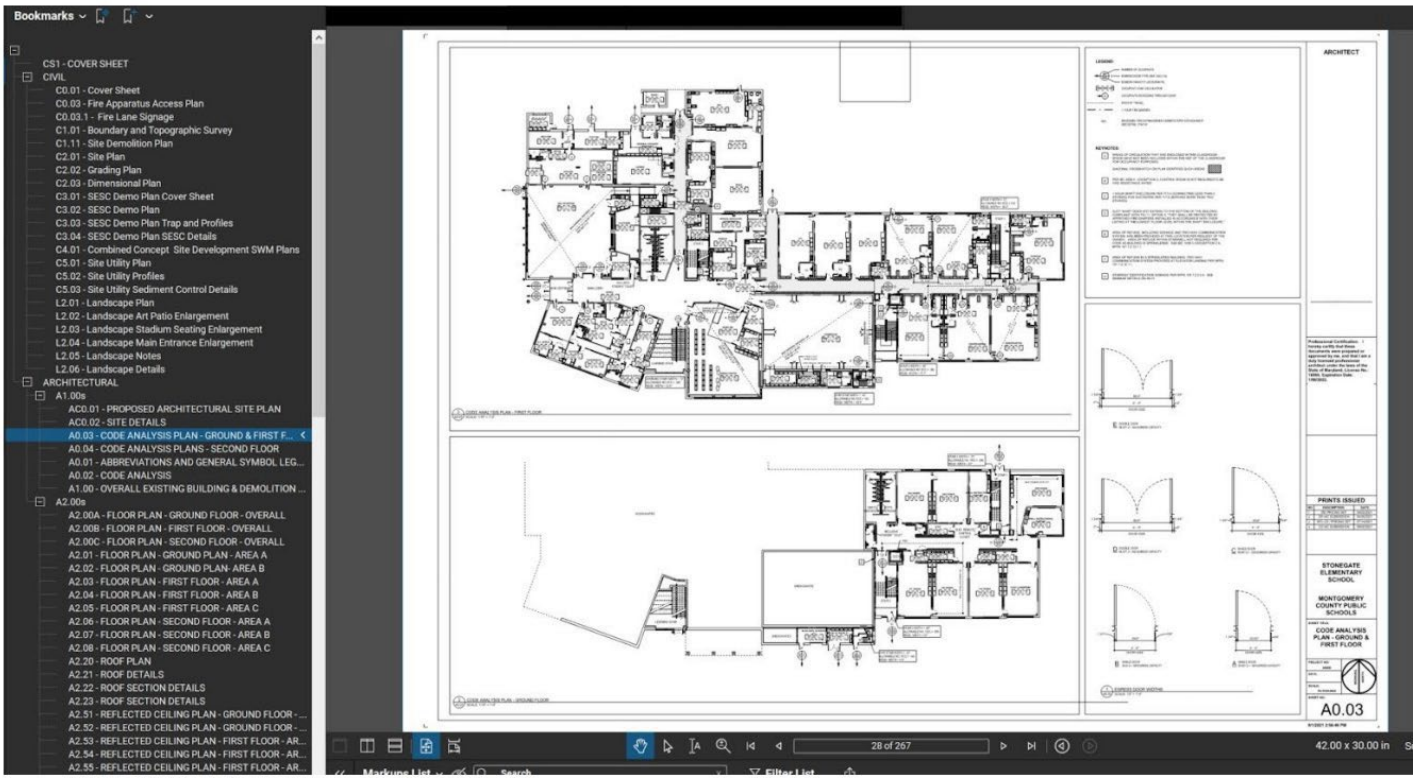
Bookmarking

All the items mentioned in the checklist above shall be bookmarked in the PDF provided. Examples of applicable bookmarks would be: Transmittal checklist, LEA response, IAC form 202.1, NSF Summary, etc.

Bookmarking for a PDF brochure:



Bookmarking for a PDF drawing set: Please indicate each page number and page title of the drawing sheet that can be seen in the bookmarks of the PDF file. Please see the image below for reference.



CHECKLIST FOR DESIGN DEVELOPMENT (DD) SUBMISSIONS TO MSDE & IAC

Date: _____ **(Original Submission Date, if this is a Revision:** _____**)**

Project Type: New ☐; Replacement ☐; Addition ☐; Reno ☐; Limited Reno ☐;
Other_____

School Name: _____**Grade Level:**_____

School System:_____**PSC # (If any):**_____

Design Document PROCESS

Authority: *Maryland Education Article §2-303(f)* as regulated by *COMAR 13A.01.02.03* and the *IAC Administrative Procedures Guide* (APG).

Purpose: The following requirements shall be provided by a Local Educational Agency (LEA) to request the Maryland State Department of Education (MSDE) State Superintendent's approval of the Design Development (DD) documents of a facility to serve to educate public school students.

Applies to: Projects involving renovation or new construction more than $1,000,000 in estimated cost. The Interagency Commission for School Construction (IAC) staff may also provide review input to those projects requesting State funds. If a State Project (see definitions next page), use Maryland Department of General Services (MDGS) form as they will need to provide approval to proceed to the next phase.

Procedure: DD submissions will not be approved by the State Superintendent until all outstanding issues asked by MSDE and MDGS are satisfactorily addressed.

SEND DD SUBMISSION & CHECKLIST TO:

Email to: *osfsubmissions.msde@maryland.gov* and *iac.pscp@maryland.gov*

Address to: Jillian Storms, AIA
Executive Director, Office of School Facilities
Maryland State Dept of Education
200 West Baltimore Street, Baltimore MD 21201

PDF FORMATTING

PDF file shall be named per the file name convention of:

- LEA name, School Project, (PSC #), Phase, Date Submission

Example:

- AACPS Hillsmere E. REPL (02.084) Ed Spec 2022.12.20

DD PDF document shall be indexed for ease of finding required materials.

- Index should indicate items shown in the checklist under "INCLUDE IN A SINGLE PDF" subject heading on the following page.
- All the main items mentioned in the Index shall be bookmarked. Examples of applicable

bookmarks would be: **Transmittal checklist, Drawings, Program Space Summary, TCO**, etc.

CHECKLIST FOR DD SUBMISSION FOR MSDE-LEAD REVIEWS

Use the Appropriate Checkbox below:

STATE = State-Supported - **USE DGS FORM ONLY** - See IAC Website
FF = Forward-Funded (Project will be or has been requested for CIP or BTL approval by IAC but is not yet State-Supported (ie. IAC has not voted to approve BTL funds or approve LP or State funds in the 100%)
LOCAL = Project will only be funded locally with no intention to receive State funds.
NA = Not Applicable (Check to indicate submission is not required due to type of project or unchanged)

LOCAL	FF	TAB 1 - SCOPE DESCRIPTIONS (in PDF Form)
☐	☐	Transmittal includes this checklist
☐	☐	LEA Response to MSDE SD Review letter (If response required)
☐	☐	Narrative Descriptions (All Design Disciplines)
☐	☐	High performance narrative, LEED Scorecard, or Green Building Plan
☐	☐	Net Square Feet (NSF) Summary of Program Spaces **(PROVIDE ALSO IN EXCEL)** • Include comparison to the SD & Ed Spec program requirements and the percentage difference. • Include NSF Total, Gross Square Feet (GSF) Total, and NSF/GSF efficiency %. • Please review the definitions on pages 1 & 2 of the Facilities Planning Guide for Maryland Public Schools to determine what to show in the Net Spaces (versus what is part of the Tare within the total Gross Area). • The NSF areas for Cooperative Use Spaces (CUS) should also be totaled separately and include their GSF Total based on a 70% efficiency. • GSF totals for new construction, renovation, and demolition areas if those exist for the project.
☐	☐	If facility will serve as an emergency management shelter, provide plan diagram of areas to serve this purpose
LOCAL	**STATE**	**TAB #2 - IAC/PSCP Signed Forms:**
	☐	Form 302.1 - Design Development Document Submission
	☐	Form 302.2 - Life Cycle Cost Analysis Summary
☐	☐	Form 302.3 - Design Development Document Analysis

☐	☐	Form 302.4 - Cost Estimate Summary & Worksheets
LOCAL	**STATE**	**TAB #3 - Engineering Reports & Calculations:**
☐	☐	Local Soils Conservation Services approval letter (if applicable)
☐	☐	Structural Calculations
☐	☐	Mechanical Calculations
	☐	Mechanical Life Cycle Cost Analysis (4 systems compared including Geothermal)
☐	☐	Electrical Calculations & Power Requirements including: Load & Demand Analysis, Load Analysis for Standby Power Systems, Lighting Power Budget and Lightning Risk Assessment
☐	☐	Geotechnical Report
	☐	Energy Consumption Certification Letter
	☐	Evaluation of the use of Solar Technologies (e.g. photovoltaic or solar water heating, based on life cycle costs OR if N/A, then a report explaining why not appropriate)
LOCAL	**STATE**	**TAB #4 - Specifications:**
☐	☐	Outline Specifications (bookmarked to the Table of Content)
☐	☐	List of Alternates
LOCAL	**STATE**	**TAB #5 - DD Drawings:**
☐	☐	Colored Floor Plans showing Teaching Station by Type and location of CUS. Include Legend for colors used and Table that talleys Number of Teaching Stations by Type (Please see on IAC website:
☐	☐	Architectural Drawings (should include furniture and fixture layout). For existing buildings to be renovated, provide Life Safety/Code Analysis with diagrammed floor plans for clarification as well as Sprinkler drawings. If a renovation or replacement, include demolition drawings
☐	☐	All other applicable drawings

CONSTRUCTION DOCUMENT (CD) SUBMISSION CHECKLIST FOR MSDE-LED REVIEW

Date: _____ **(Original Submission Date, if this is a Revision:** _____**)**

Project Type: New ☐; Replacement ☐; Addition ☐; Reno ☐; Limited Reno ☐; Other_____

School Name: _____**Grade Level:**_____

School System:_____**PSC # (If any):**_____

CONSTRUCTION DOCUMENT PROCESS

Authority: *Maryland Education Article §2-303(f)* as regulated by *COMAR 13A.01.02.03* and the *IAC Administrative Procedures Guide* (APG).

Purpose: Submission process for the Local Educational Agency (LEA) to request the Maryland State Department of Education (MSDE) State Superintendent's approval of the Construction Documents (CD) of a facility to serve to educate public school students.

Applies to: Projects involving renovation or new construction more than $1,000,000 in estimated cost. The Interagency Commission for School Construction (IAC) staff may also provide review input to those projects requesting State funds. If a State Project (see definitions next page), use Maryland Department of General Services (MDGS) form as they will need to provide approval to proceed to the next phase.

Procedure: CD submission will not be approved by the State Superintendent until all outstanding issues asked by MSDE (and MDGS, if applicable) are satisfactorily addressed.

SEND CD SUBMISSION & CHECKLIST TO: *(Charter schools need not send to DGS or IAC)*

Email to: *osfsubmissions.msde@maryland.gov*, *dgs.pscpsubmissions@maryland.gov* & *iac.pscp@maryland.gov*

Address to: Jillian Storms, AIA
Executive Director, Office of School Facilities
Maryland State Dept of Education
200 West Baltimore Street, Baltimore MD 21201

PDF FORMATTING

PDF file shall be named per the file name convention of:

- LEA name, School Project, (PSC #), Phase, Date Submission

Example:

- AACPS Hillsmere E. REPL (02.084) CD 2022.12.20

CD PDF documents shall be indexed for ease of finding required materials.

- PDF should be bookmarked/indexed for each item shown in Checklist on the following page.
- All the main items mentioned in the Index shall be bookmarked. Examples of applicable bookmarks would be: Transmittal checklist, Drawings, Program Space Summary, TCO, etc.

See next page for CD Checklist to be included with the submission.

CD SUBMISSION CHECKLIST FOR MSDE-LEAD REVIEW

Use the Appropriate Checkbox below:
STATE = State-Supported - **USE DGS FORM ONLY -** See IAC Website
FF = Forward-Funded (Project will be or has been requested for CIP or BTL approval by IAC but is not yet State-Supported (ie. IAC has not voted to approve BTL funds or approve LP or State funds in the 100%)
LOCAL = Locally-Funded (Project will only be funded locally with no intention to receive State funds)
CHARTER = Charter Schools or other non-traditional schools
NA = Not Applicable (Check to indicate submission is not required due to type of project or unchanged)

LOCAL	STATE	SCOPE DESCRIPTIONS (INCLUDE IN A SINGLE PDF)
☐	☐	**Transmittal including this Checklist**
☐	☐	**Response to prior MSDE Design Review** (If response requested); **NA:** ☐
☐	☐	**Response to prior MDGS courtesy DD Technical Review** (If provided); **NA:** ☐
☐	☐	**Narrative Descriptions** in all Disciplines, if changed from DD Submission; **NA:** ☐
☐	☐	**Net Square Feet (NSF) Summary of Program Spaces** (If revised since DDs) (PROVIDE ALSO IN EXCEL - separate check box below) ● Include comparison to the Ed Spec program requirements and % difference. ● Include NSF Total, GSF Total, and NSF/GSF efficiency %. ● Please review the definitions on pages 1 & 2 of the *Facilities Planning Guide for Maryland Public Schools* to determine what to show in the Net Spaces (versus what is part of the Tare within the total Gross Area). ● The NSF areas for Cooperative Use Spaces (CUS) should also be totaled separately and include their GSF Total based on a 70% efficiency. ● GSF totals for new construction, renovation, and demolition areas if those exist for the project.
	☐	**High-Performance Evaluation** & Goal (if new or replaced school) **NA:** ☐
	☐	**Net Zero Energy Add-On Incentive Request Form** (If applicable) **NA:** ☐
	☐	**Emergency Management Shelter (EMS)** - If this facility will serve as an EMS, provide correspondence with MEMA and plan diagram of agreed upon areas to serve this purpose (if not submitted previously or has been updated) **NA:** ☐
☐	☐	**Teaching Stations & Cooperative Use Table w. Floor Plans** - Totals # of Teaching Stations by Type and CUS (if applies) w/colored floor plans to show locations.
☐	☐	**IAC/PSCP Form 303.1** Construction Document Submission **NA:** ☐
	☐	**IAC/PSCP Form 303.2** Construction Document Analysis **NA:** ☐
☐	☐	**IAC/PSCP Form 302.2** Life Cycle Cost Analysis, if updated since DDs **NA:** ☐

CD SUBMISSION CHECKLIST FOR MSDE-LEAD REVIEW

LOCAL	STATE	IAC/PSCP SIGNED FORMS (INCLUDE IN A SINGLE PDF)
☐	☐	IAC/PSCP Form 302.4 Cost Estimate, if updated from DD Submission; **NA:** ☐ (PROVIDE ALSO IN EXCEL - separate check box below)
	☐	MBE Goal Setting Model Analysis Form, if updated since DD submission; **NA:** ☐
LOCAL	**STATE**	**ENGINEERING REPORTS & CALCULATIONS** (INCLUDE IN A SINGLE PDF)
☐	☐	**Structural Calculations**, if updated since DD submission; **NA:** ☐
☐	☐	**Mechanical Calculations**, if updated since DD submission; **NA:** ☐
☐	☐	**Electrical Calculations & Power Requirements,** if updated since DDs; **NA:** ☐
LOCAL	**STATE**	**CONSTRUCTION SPECIFICATIONS** (INCLUDE IN A SINGLE PDF)
☐	☐	**Project Manual & Specifications** in CSI Master Format, including: ● Table of Contents - bookmarked throughout ● Divisions 0 & 1 ● Bid Form ● Section on Alternates ● Section on Allowances, if have any ● MBE requirements (if a STATE project) ● Prevailing Wage Rates (if a STATE project)
☐	☐	**Geotechnical Report**, if not previously submitted or has been updated; **NA:** ☐ (Can be within the Project Manual & Specifications)
LOCAL	**STATE**	**CONSTRUCTION DRAWINGS** (INCLUDE IN A SINGLE PDF unless need to break into separate Volumes so PDF file size is less than 100MB)
☐	☐	**Site Drawings** (Charter School need only provide site plan); **NA:** ☐
☐	☐	**Architectural** (Charter School need only provide floor plans); **NA:** ☐
☐	☐	**Structural Drawings**; **NA:** ☐
☐	☐	**MEP Drawings and all others**

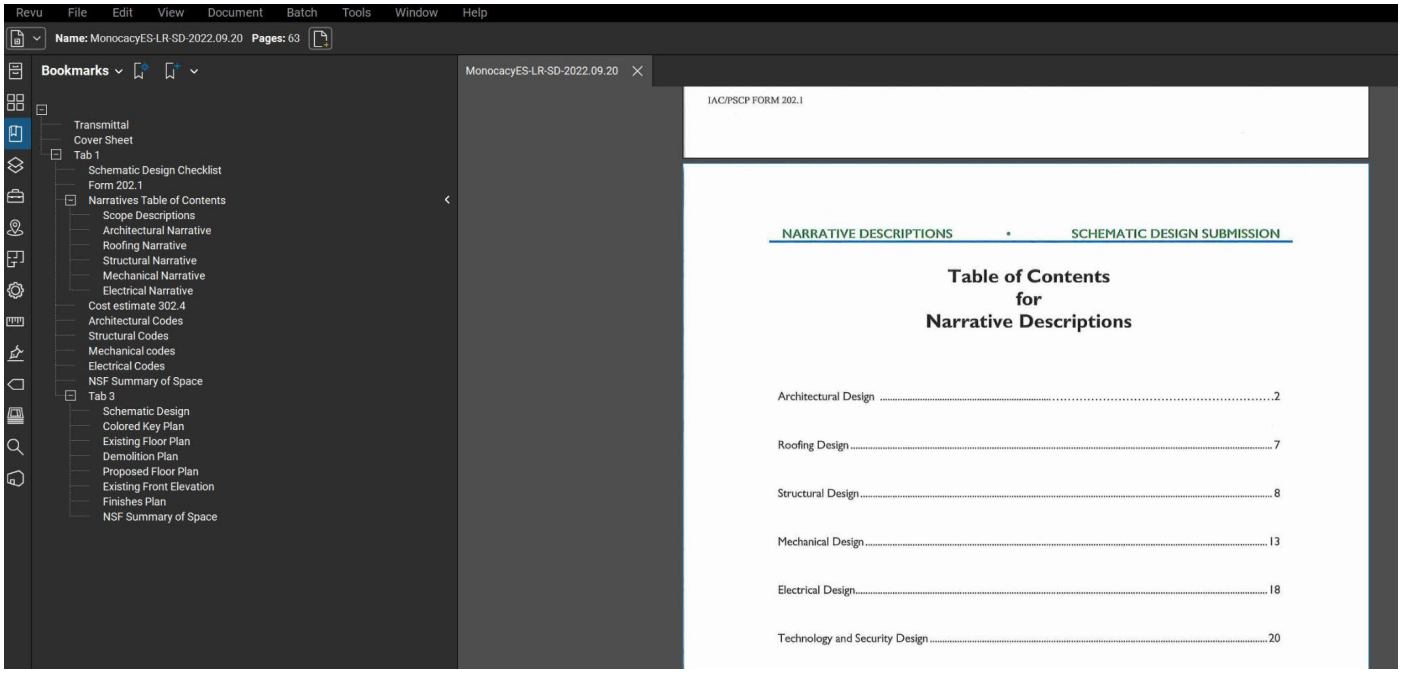
LOCAL	STATE	SEPARATE FILES IN MICROSOFT EXCEL or GOOGLE SHEETS
	☐	**NSF Summary of Program Spaces**, if revised since DD Submission; **NA:** ☐
	☐	IAC/PSCP Form 302.4 Cost Estimate, if updated since DD Submission; **NA:** ☐

CD SUBMISSION CHECKLIST FOR MSDE-LEAD REVIEW

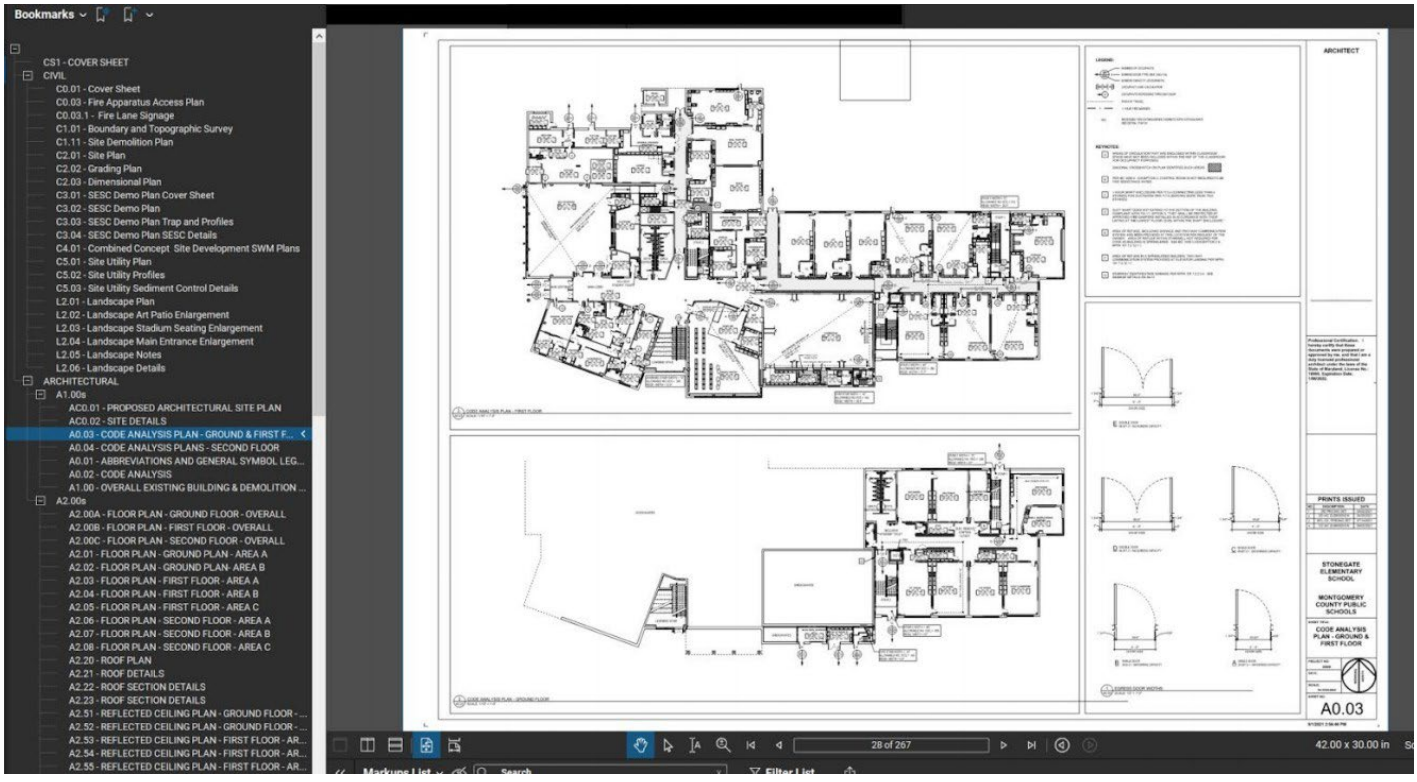
Bookmarking

All the items mentioned in the checklist above shall be bookmarked in the PDF provided. Examples of applicable bookmarks would be: Transmittal checklist, LEA response, IAC form 202.1, NSF Summary, etc.

Bookmarking for a PDF brochure:



Bookmarking for a PDF drawing set: Please indicate each page number and page title of the drawing sheet that can be seen in the bookmarks of the PDF file. Please see the image below for reference.



Attachment F –

MOU Between M-NCPPC and MCPS

MEMORANDUM OF UNDERSTANDING BETWEEN MONTGOMERY COUNTY PUBLIC SCHOOLS AND THE MARYLAND-NATIONAL CAPITAL PARK AND PLANNING COMMISSION REGARDING RESPECTIVE PLANNING PROCESSES

THIS MEMORANDUM OF UNDERSTANDING ("MOU") is entered into as of November 30, 2023 (the "Effective Date") by and between MONTGOMERY COUNTY PUBLIC SCHOOLS, a system of public schools operated by the Board of Education of Montgomery County (hereinafter referred to as "MCPS"), and the MARYLAND-NATIONAL CAPITAL PARK AND PLANNING COMMISSION (hereinafter referred to as the "Commission") on behalf of the MONTGOMERY COUNTY PLANNING DEPARTMENT (hereinafter referred to as "Planning") and the MONTGOMERY COUNTY PARKS DEPARTMENT (hereinafter referred to as "Parks"), each referred to individually as a "Party" and collectively as the "Parties." For good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Parties agree as follows:

ARTICLE I: PURPOSE AND IDENTIFICATION OF PARTIES

This MOU represents an agreement between MCPS and the Commission, concerning the coordination of roles and responsibilities to be undertaken by each party while conducting certain policy, planning and development processes. The Montgomery County Planning Board and Board of Education have review and approval authority described by law and are not included in or subject to this MOU.

ARTICLE II: COMMISSION MASTER AND SECTOR PLANNING PROCESS

A. Roles and Responsibilities

This article describes the roles and responsibilities of Planning and MCPS as it relates to the coordination of efforts in a Commission master plan process.

Roles

Planning is the Lead Agency in the administration, engagement, development, quality assurance, and production of all deliverables through all phases of the master plan process. Planning will have final approval of all engagement, communications, and deliverables (as described below).

MCPS will provide support and collaborate in the engagement, development, quality assurance, and production of applicable deliverables through various phases of the master planning process.

Responsibilities

Planning maintains ultimate responsibility for and control of all plan elements through all phases of the master plan process, except after the Planning Board public hearing and subsequent preparation of the Planning Board Draft Plan, when the Planning Board asserts ultimate control, and again after delivery of the Planning Board Draft Plan to the County Council, when the County Council asserts ultimate control.

MCPS will actively engage with Planning during the master plan development process as a partner agency and key stakeholder for public schools, assisting with outreach efforts, sharing data for existing conditions analyses, and providing input on recommendations relevant to schools.

B. Plan Stages, Expectations, and Desired Outcome

The table below identifies the MCPS roles and responsibilities within the Commission master plan process. MCPS commits to fulfilling these roles and Planning commits to engaging MCPS staff accordingly.

Master Plan Stage	MCPS Roles and Responsibilities	Desired Outcomes
Kick-Off / Scope of Work	• Identify staff to represent MCPS as needed throughout master plan process. • Participate in meeting w/master plan team to discuss: – MCPS's short-term plans and long-term aspirations for the general vicinity; – whether specific school site(s) should be included within Plan boundary; – interest/demand for additional school sites.	• Long-term school planning efforts are initiated. Direction of MCPS capital planning is set forth beyond limitations of CIP funding and incorporated into Planning's master plan efforts.
Listening	• Assist with reaching stakeholders at individual Plan area schools as appropriate (staff, students, PTA, etc.). • If there are community comments received through Planning staff's outreach efforts that are more relevant to MCPS's operations, assist in transmitting to appropriate department or staff.	• School communities are recognized as key stakeholders and their input is actively sought after for consideration. • Input collected from community that is outside the jurisdiction of Planning is not lost.
Existing Conditions	• Confirm list of nearby schools to be included in collective trend analysis. • Provide latest enrollment and projections data as they become available. • Review sites identified and provide input/feedback regarding suitability, constraints, etc.	• Planning's existing conditions analysis approach for public schools is in alignment with MCPS's capital and non-capital priorities or strategies. • MCPS is involved in potential school site considerations at earliest opportunity.

Visioning and Preliminary Recommendations	• Review and confirm recommendations relevant to MCPS. • Participate in meeting(s) with Planning and relevant stakeholders to discuss potential site options in Plan area that may include: – adaptive reuse school facility; – possible program integration with institution or employer based in plan area for co-location opportunity; – additional school sites. • Proactively communicate expectations of candidate site(s) with relevant stakeholders.	• The estimated enrollment impacts of the preliminary land use and housing recommendations are acknowledged as potential factors for change in existing enrollment trends and reflected in MCPS's educational facilities strategies, as appropriate. • MCPS is engaged in potential school site acquisition discussions and process early on for better implementation.
Working Draft	• Review language of working draft and provide feedback as necessary.	• MCPS is in general agreement with plan language and recommendations regarding schools.
Planning Board and Council Work Sessions	• Prepare to participate in work session to respond to Planning Board/Council if deemed necessary.	• MCPS is available to actively engage in dialogue if/when a schools-related issue is discussed during Work Sessions.
Plan Implementation	• When a school site recommended by a master plan is ready to be dedicated, MCPS will be actively engaged throughout the process to ensure the site is transferred in an acceptable condition for MCPS to take possession of the site.	• School sites that are dedicated to MCPS as a result of a master plan recommendation are transferred in a condition suitable for use as a school facility.

C. Schedule

For each master plan, Planning's master planning staff will lay out a meeting and communication plan appropriate to the specific context and agreed to by MCPS to coordinate the joint efforts and process.

ARTICLE III: COMMISSION PARK PLANNING PROCESS

A. Roles and Responsibilities

This article describes the roles and responsibilities of Parks and MCPS as it relates to the coordination of efforts in a Commission park planning process.

Roles

Parks is the Lead Agency in the administration, engagement, development, quality assurance, and production of all deliverables through all phases of the park planning process. Parks will have final approval of all engagement, communications, and deliverables (as described below).

MCPS will provide support and collaborate in the engagement, development, quality assurance, and production of applicable deliverables through various phases of the park planning process.

Responsibilities

Opportunities for MCPS and Parks collaboration occur throughout the park planning and development process. Early and consistent communication and coordination helps align priorities and facilitates implementation.

B. Processes, Expectations, and Desired Outcome

The tables below identify the MCPS roles and responsibilities within the Commission park planning process. MCPS commits to fulfilling these roles and Parks commits to engaging MCPS staff accordingly. The first table describes the Parks Planning Process and the roles and responsibility for MCPS. The second table describes steps related to proposed school projects that impact parkland.

Parks Planning Process	MCPS Roles and Responsibilities	Desired Outcomes
Parks, Recreation, and Open Space Plan (PROS)	• Provide/confirm information for fields inventory High School Student Survey (done in 2021).	• School-related park needs are incorporated in systematic planning.
Planning Master Plans and Sector Plans	• Identify park locations that would serve MCPS students, including sites adjacent to MCPS schools. (also see Article II)	• Park and school needs are considered in tandem.
Park-Specific Plans (e.g. Park Master Plans)	• **Existing Conditions:** Provide input into existing park use by MCPS schools and students. • **Visioning:** Identify anticipated future needs. • **Recommendations:** Review recommendations.	• School-related park needs are considered in park planning.

Process for Projects Impacting Parkland	MCPS Roles and Responsibilities	Desired Outcomes
Concept Review	• Submit preliminary concept for project that impacts parkland.	• Key considerations, challenges, and opportunities are identified early to make implementation easier.
Park Permit	• Receive an approved Park Permit prior to construction.	• Project meets requirements and is implemented.

C. Schedule

For future PROS plans and any park-specific plan, Parks staff will lay out a meeting and communication plan appropriate to the specific context and plan and work with MCPS to coordinate the joint efforts and process.

The schedule for school projects that impact parkland is initiated by MCPS and will proceed according to the school planning, and parks concept review and park permitting processes.

ARTICLE IV: MCPS CAPITAL PROJECT PROCESS

A. Roles and Responsibilities

This article describes the roles and responsibilities of Planning, Parks and MCPS as it relates to the coordination of efforts in the MCPS capital project process.

Roles

MCPS is the Lead Agency in the administration, engagement, development, quality assurance, and production of all deliverables through all phases of the school capital project process, with the exception of the mandatory referral process, which is detailed separately in Article V, MCPS will have responsibility for all engagement, communications, and deliverables (as described below) pertaining to the school capital project process.

Planning and Parks will provide support and collaborate in the engagement and development of deliverables, as applicable, through various phases of the school capital project process.

Responsibilities

MCPS maintains ultimate responsibility for and control of all plan elements through all phases of the school planning process. Opportunities for Planning and Parks collaboration occur throughout the feasibility planning process to be inclusive of current county policies and initiatives when in alignment with MCPS requirements and policies. MCPS will keep open communication and coordination with Planning and Parks to implement agency goals to the maximum extent possible.

B. Process Phases, Expectations, and Desired Outcome

The table below identifies the Planning and Parks roles and responsibilities within the MCPS school capital project process. Planning and Parks commit to fulfilling these roles and MCPS commits to engaging Planning and Parks staff accordingly.

School Capital Project Phase	Planning and Parks Roles and Responsibilities	Desired Outcomes
Facility Planning	• Participate in feasibility study meetings for projects approved for facility planning in adopted CIP. • Provide residential development information in specific areas/cluster associated with the feasibility study. • Provide input regarding MCPS site related specifications. • Provide feedback on community comments/concerns/issues shared during the facility planning process.	• Key considerations, challenges, and opportunities are identified early in the facility planning process. • Incorporate residential development information to identify possible future growth in the specific service areas being studied.

Planning and Design Feasibility	• Provide all restrictions, issues and policies that may impact a proposed site selection. • Review preliminary concepts through an interactive Development Review Committee working session to identify site specific impacts: – regulatory restrictions; – environmental protection; – utility infrastructure; – transportation infrastructure; – county policies; – permitting agencies.	• Facilitate initial design approach. • Identify priorities and coordinate a unified best project approach. • Coordinated options for establishing project budgets based on agency goals.
Mandatory Referral	(see Article V)	(see Article V)
Construction	• Where applicable, participate in review of field construction and elements.	• Improve acceptance process at completion of project.

C. Schedule

For each feasibility study MCPS will lay out a meeting and communication plan appropriate to the specific context. Planning and Parks will coordinate the joint efforts with all agencies as identified in the Development Review Committee for a detailed collaborative work session.

ARTICLE V: MANDATORY REFERRAL PROCESS

A. Roles and Responsibilities

This article describes the roles and responsibilities of Planning, Parks and MCPS as it relates to the coordination of efforts in the mandatory referral process, which is a distinct component of the larger school capital project process described in Article IV.

Roles

During the mandatory referral process Planning is the Lead Agency in the mandatory referral review and in the production of all deliverables to the Planning Board. Planning will have final approval of all engagement, communications, and deliverables (as described below) pertaining to the mandatory referral process.

MCPS will provide support and collaborate in the engagement, development, quality assurance, and production of applicable deliverables through various phases of the mandatory referral process.

Responsibilities

Planning maintains ultimate responsibility for navigating the mandatory referral process through Planning Board review. Planning will engage MCPS in the review process, providing opportunities for MCPS to revise plans as applicable, and as allowed within the mandatory referral rules and requirements. Planning will prepare timely comments on the development application for Planning Board review and transmit the Planning Board's comments to MCPS. Planning will participate in the MCPS presentation of the Planning Board's comments to the Board of Education.

MCPS will provide timely responses to Planning comments. MCPS will provide written responses to Planning Board comments and address issues raised in Planning Board comments, as practical. When not practical, MCPS's written responses will explain why solutions are not practical. MCPS will present the comments of the Planning Board to the Board of Education and invite Planning staff to participate in that presentation.

B. Process Phases, Expectations, and Desired Outcome

MCPS roles and responsibilities within the Planning mandatory referral process. MCPS commits to fulfilling these roles and Planning commits to engaging MCPS staff accordingly. Planning and Parks will prioritize and expeditiously process all submissions at the highest priority and work in partnership with MCPS to provide prompt reviews and approvals.

The phases outlined below are based on the collaborative planning process produced by the School Design Work Group (see Attachment A), which aims to implement earlier and more frequent coordination in a manner that preemptively resolves conflicting needs for school sites, leading to a smoother and more efficient Mandatory Referral review and an endorsement of school projects by the Planning Board. Each phase identifies several milestones in the earlier stages leading up to the Mandatory Referral review that provide opportunities for agencies to collaboratively explore the feasibility of various aspects of school projects, examine related countywide initiatives and Capital Improvements Program planning, review conceptual options, and resolve potential issues. It does not alter the legal requirements of the Mandatory Referral review and/or the Forest Conservation Plan review itself.

Mandatory Referral Stage	MCPS Roles and Responsibilities	Desired Outcomes
Pre-Planning & Feasibility	• Arrange joint meetings with Planning, Parks and other agencies to understand master plans and county initiatives relevant to potential school projects. • If considering a new school, evaluate potential sites per Montgomery County Board of Education Policy FAA, Educational Facilities Planning.	• Better understanding of each agency's goals and initiatives. • Funding is secured - potential joint agency funding efforts are explored, and support for additional Council funding is established if needed.
Schematic Design	• Coordinate meetings and collaborate with Planning and other relevant agencies as needed for each of the following steps: – NRI/FSD Submission for Planning Approval; – Schematic Design (Community Outreach); – DPS Consultation; – Concept Plan Submittal for DRC Review; – Preliminary Plan Presentation to BOE.	• Board of Education approval to move project forward.

Post Concept Plan	• Coordinate with Planning and other relevant agencies for preparation and submittal of requirements for the following steps: – Draft Forest Conservation Plan (FCP) + Concept Storm Water Management Plan Submittal; – Revisions and Detailed Plan Development.	• Comments from Concept Plan are incorporated into design development stages as applicable.
Mandatory Referral (MR)	• Collaborate with Planning and other relevant agencies as needed for a streamlined process during each of the following steps: – Mandatory Referral + Forest Conservation Plan Public Notice; – Mandatory Referral + Forest Conservation Plan Application; – Agency Recommendation Letters; – Pre-Staff Report; – Staff Report Posting + Planning Board Hearing; – Post-Approval Documentation.	• Project receives Planning Board approval. Any feedback received is included in design or coordinated further with Planning staff. • All necessary post-approval documents are processed and provided in a timely manner.

[Signatures Follow on the Next Page]

IN WITNESS WHEREOF, the Parties have executed this MOU as of the day and year first above-written.

WITNESS:

MONTGOMERY COUNTY PUBLIC SCHOOLS

By: _____
Monifa B. McKnight, Ed.D.
Superintendent of Schools

Date: 11/30/2023

WITNESS:

_____
Gavin Cohen
Secretary-Treasurer

MARYLAND-NATIONAL CAPITAL PARK AND PLANNING COMMISSION

By: Asuntha ChiangSmith
Asuntha Chiang-Smith
Executive Director

Date: 12/08/2023

MCPS and M-NCPPC Planning Processes MOU Attachment "A"

Collaborative Planning Process by School Design Workgroup

A collaborative planning approach for Montgomery County Public Schools' Projects

This proposed collaborative planning process is produced by the School Design Work Group (Work Group), an interagency partnership between Montgomery County Public Schools (MCPS), Montgomery Planning, Montgomery Parks, Montgomery County Department of Transportation (MCDOT), and Montgomery County Department of Permitting Services (MCDPS). Following discussions between the Planning Board and the Board of Education, staff from both agencies were encouraged to work more collaboratively. The Work Group has developed this framework of best practices for school design to advance shared goals for safety, Vision Zero, civic and sustainable design, efficient circulation, equitable access to school sites, fiscally smart infrastructure and timely, streamlined regulatory review. The Work Group met monthly for over a year to produce this proposal. This is a working document and should be revisited and updated as needed to better meet evolving needs and priorities.

This proposed process does not alter the legal requirements of the Mandatory Referral (MR) review. Instead, it identifies several milestones in the earlier stages leading up to the MR review that provide opportunities for various agencies to collaboratively explore the feasibility of various school projects, examine related countywide initiatives and CIP planning, review conceptual options, and resolve potential issues. An overarching goal is to utilize earlier and frequent coordination in a manner that preemptively resolves conflicting needs for school sites, leading to a smoother and more efficient MR review and a strong endorsement of school projects by the Planning Board.

Stage	Description	Desired Outcomes
PRE-PLANNING & FEASIBILITY STAGE		
Initial CIP planning	**Coordinate trends in MCPS as well as potential policy impacts.** **(May-June)** **Review M-NCPPC masterplans and initiatives and explore strategy to implement recommendations related to potential future school projects.** **Review MCDPS and MCDOT plans that will impact future work.** **If considering a new school, MCPS to evaluate potential new school sites per Montgomery County Board of Education Policy FAA, Educational Facilities Planning.**	**Combined staff to coordinate and gain an understanding of each agency's goals.** **Representatives from internal stakeholders to be present to provide input.** **Stakeholders to be aware of potential projects and effects on each agency's policy.** **Engagement and feedback to identify a site for a new school.**

Planning for Project and Initiative Funding Requests	**Review countywide initiatives and related infrastructure projects that require funding.**	**Each agency to define work that may be incorporated into planning and explore potential joint agency funding efforts.**
Pre-Planning for Feasibility Studies	**Create a working draft NRI/FSD and Site Survey for each project being reviewed for feasibility study.**	**Establish existing conditions.** • Establish buildable areas and identify physical and environmental constraints.
Feasibility Study (Planning Stage)	**Once a school facility project is added to the Capital Improvement Program MCPS to engage the services of an architect.** • Joint meeting with MCPS, MCPS consultants, M-NCPPC, MCDPS, MCDOT, and Parks. ○ MCPS Union representation to attend and share project specific needs • Review facility parameters, including enrollment, size, site access, physical constraints, parking and transit requirements, recreation requirements, applicable Master Plan and Functional Plan recommendations, (e.g. Pedestrian and Bicycle Master Plans). • Review transportation impacts and determine the appropriate documents that will be needed such as a traffic study, traffic statement etc. • Review Climate Action Plan • Assessment of the site per MCPS requirements.	**Meeting with MCPS and M-NCPPC to establish potential design goals.** **Meeting to establish and understand restrictions and implementation of related infrastructure improvements.** • M-NCPPC to provide MCPS with an overview of applicable Master Plan and Functional Plan recommendations, Vision Zero considerations, Parks, Recreation and Open Space Plan (PROS), urban design priorities, known environmental features and recreation needs, especially athletic fields. • MCPS to share constraints and proposed programmatic elements. • Establish potential concepts with a general idea of building footprints, vehicle and non-motorized circulation, stormwater management strategy and open space design.
Feasibility Study (Community Outreach)	**Meeting(s) with community to review Feasibility level diagrams of concepts.** • MCPS to begin the community engagement process. • M-NCPPC to attend meetings to hear community comments.	**MCPS to gather input from school community as well as broader civic community.** • Share general ideas of building footprints, pedestrian, bike and vehicle circulation, stormwater management strategy and open space design. • MCPS to gain an understanding of community concerns. • Determine a cost estimate for the base MCPS project and provide costs associated with related county initiatives as line items.

Board Briefing	**Joint annual presentation to Boards to review coordination efforts and outcome of the feasibility studies for all projects.** **Share cost estimates for base project and additional items.**	**Provide Board members an update on joint efforts and gain support to establish need of additional County Council funding, if required.**
CIP Planning / Request	**Project specific budgets that incorporate each agency's goals and objectives.**	**Review and update the Feasibility Study report.** **Secure funding.**
SCHEMATIC DESIGN STAGE		
Submit NRI/FSD for planning approval	**MCPS to submit NRI/FSD for M-NCPPC approval for projects that receive funding in the CIP and are moving forward beyond the feasibility study.**	**Gain approval of NRI/FSD to commence schematic design.**
Schematic Design (Community Outreach)	**Meetings with community to review Schematic designs.** • MCPS to continue the community engagement process. • M-NCPPC to attend meetings to hear community comments.	**MCPS to gather input from school community as well as broader civic community.** • Share ideas of building footprints, massing, pedestrian, bike and vehicle circulation, stormwater management strategy and open space design. • MCPS to refine each concept. • Determine a preferred concept to develop and present to BOE for approval. • Update cost estimates.
DPS consultation	**Meet with all departments of DPS to review plans.**	**Identify areas of concern related to Building, Fire Access, Infrastructure, and Land Development.**
MCPS to submit Concept Plan for review by DRC	**Interagency DRC to review the current plan with MCPS design team.** • MCPS, MCPS consultants, M-NCPPC, MCDPS, MCDOT, and Parks joint meeting. • PEPCO, WSSC and SHA to review and comment if applicable, including scope of traffic analysis. • Verify previous goals and modify as necessary. • Review proposed concepts from design team.	**To revisit the previous plan(s) and confirm the previous goals.** **Agencies to provide input on the submitted Concept.** • Verify the proposed plan, identify the criteria of MCPS while being mindful of M-NCPPC, MCDPS, MCDOT and Parks. • Review and address concerns that may still need to be addressed.

MCPS Board Presentation of Preliminary Plans	**MCPS presentation to the BOE to review outcome and coordination.** • Attendance of M-NCPPC planning staff as a joint coordination. • Identify any additional infrastructure needs uncovered during Concept Plan review.	**Approval of BOE to move project forward.**
POST CONCEPT PLAN STAGE		
Submit Draft Forest Conservation Plan (FCP) + Concept Stormwater Management Plan (SWM) Plan	• MCPS submits initial FCP, including preliminary locations of SWM facilities. Include any variance requests and justification if specimen trees are impacted. • MCPS submits Concept SWM plan to DPS. (DEP, DOT P&P) • Est. 6 to 8 weeks	• MCDPS to review the Concept SWM Plan and provide comments to MCPS. • Planning staff to review the Preliminary FCP and provide comments to MCPS. • Establish preliminary limits of disturbance (LOD) and start drafting process for easement documents.
Revise + Develop Detailed Plans	• MCPS consultants to prepare architectural, engineering and landscape drawings for the Mandatory Referral application. • MCPS consultants to submit traffic impact study or traffic statement. (30-day review by M-NCPPC, MCDOT and SHA)	• MCPS to incorporate comments as applicable from Concept Plan and update designs. • MCPS consultants to develop detailed drawings through design development stages based on comments from Concept Plan, FCP review and SWM review. • Finalize the limits of disturbance (LOD).
MANDATORY REFERRAL (MR) STAGE		
Mandatory Referral + Forest Conservation Plan Public Notice	• M-NCPPC to publicly notice the FCP application and the Mandatory Referral hearing. • MCPS to publicly notice the FCP and post the signs. • FCP sign posting must occur before the application is accepted. Written notice must be sent no more than five days after the application is accepted.	• Notify the public of the submittal of the MR and FCP. • MCPS consultants to finalize drawings. • Finalize the MR package.
Mandatory Referral + Forest Conservation Plan Application	• MCPS to submit the MR and FCP for review, including storm drain analysis where applicable. • 60-day MR review period including DRC and Planning Board Hearing.	• Provide complete information for review by various agencies. • Agencies to provide any remaining detailed comments to MCPS during the review period. • MCPS to incorporate applicable comments and resubmit within the 60-day MR window.
Agency Recommendation Letters	• MCDPS and MCDOT to provide recommendation letters for the Mandatory Referral.	• MCDOT and MCDPS provide Planning staff with necessary recommendation letters to complete the MR review. • Planning Department prepares staff report.

Pre-Staff Report	• Prior to posting staff report, MCPS and M-NCPPC to meet regularly to review recommendations and comments. • Planning Staff to share with MCPS final recommendations included in the staff report prior to posting.	• MCPS and M-NCPPC to confirm there are no outstanding items. • MCPS and M-NCPPC to coordinate on items that will require additional efforts in a collaborative manner.
Staff Report Posted + Planning Board Hearing	• Planning staff posts staff report two weeks prior to Planning Board hearing (or one week prior if no FCP review is required). • All agencies to attend the Planning Board hearing.	• Gain Planning Board approval. • MCPS to coordinate feedback from the Planning Board and include in design documents or coordinate further with staff as necessary.
Post-Approval Documentation	**Within two weeks of Planning Board hearing, Planning Board letter of recommendation and FCP resolution to be sent to MCPS.** • MCPS to record easements or pay a fee-in-lieu within 6 weeks of signed FCP through the following Forest Conservation Easement Approval Process: • MCPS sends a draft for review to Planning once the easement area is determined. (Note: This step may be initiated by MCPS while the MR review is ongoing to expedite the process.) • Planning reviews the draft and approves it. MCPS obtains signatures while waiting for the Final FCP to be certified. • MCPS submits final signed document to Planning electronically for approval. The Final FCP must be certified and attached to the easement before electronic approval is given. • MCPS receives electronic approval and records the easement. • Once MCPS submits the easement for recordation or pays a fee-in-lieu, construction work may begin with a pre-construction meeting, staking of the LOD, and tree and easement protection. As soon as the document is officially recorded in the Land Records, MCPS sends an electronic copy of the recorded document to Planning for their records.	**Ensure all necessary post-approval documents are processed and provided to MCPS and M-NCPPC in a timely manner.**

MOU Between M-NCPPC and MCPS

Final Audit Report 2023-12-08

Created:	2023-12-08
By:	Catherine Coello (Catherine.Coello@mncppc-mc.org)
Status:	Signed
Transaction ID:	CBJCHBCAABAAZ61JOYxcqmKCIYiY7swV7ZE06g7Sc5hp

"MOU Between M-NCPPC and MCPS" History

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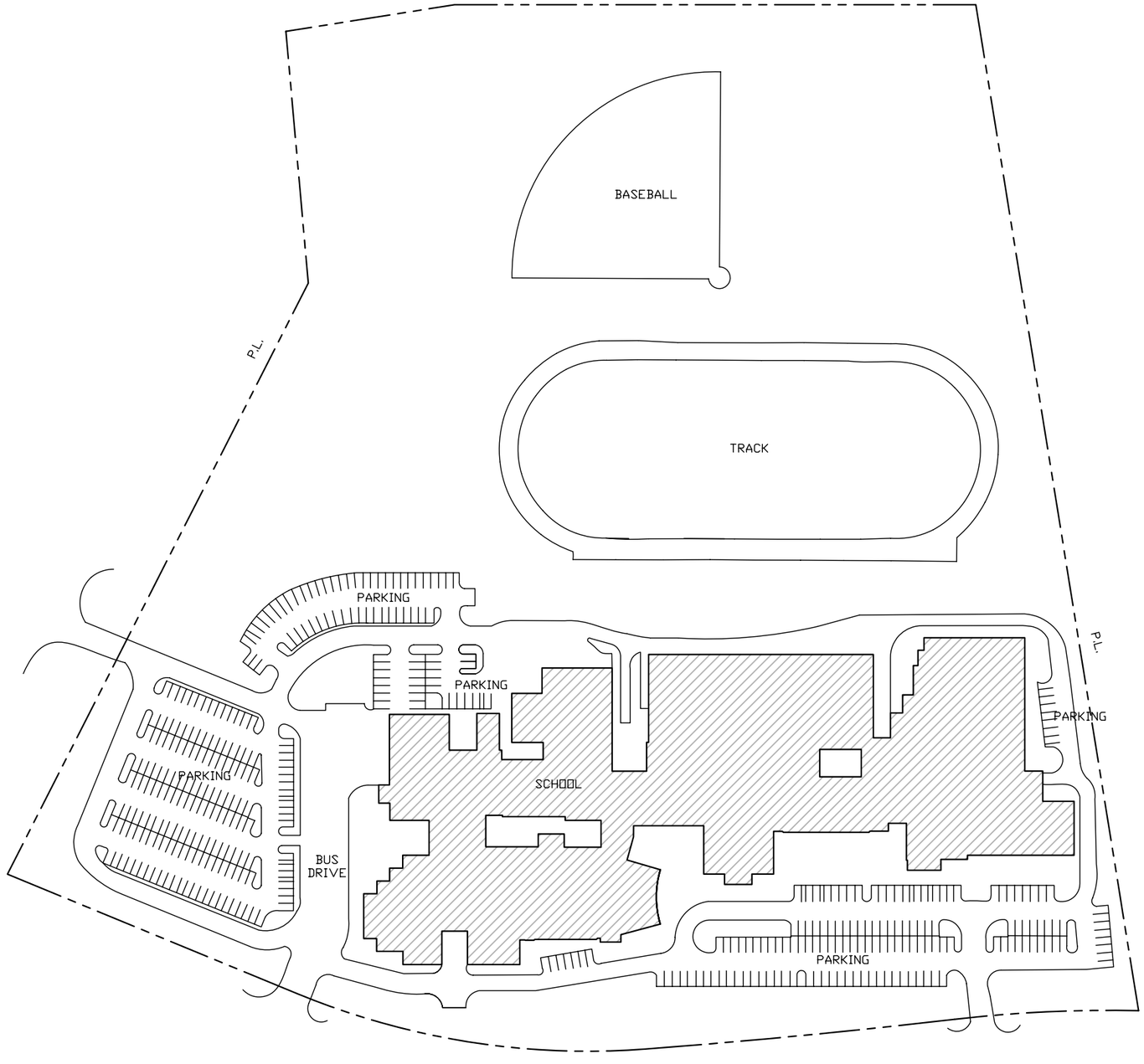
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Agreement completed.
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Attachment G –

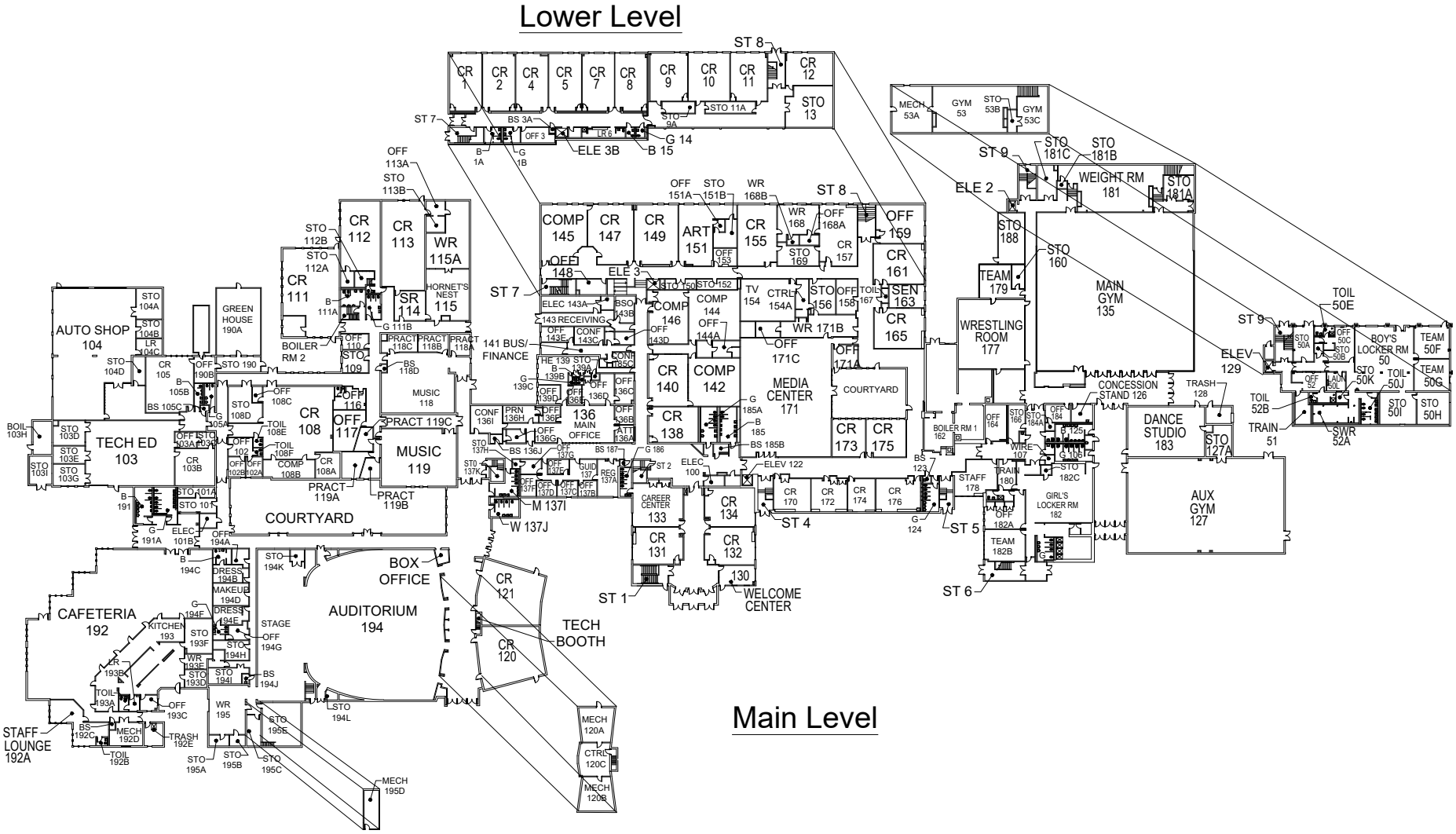
Building Location, Site Plan, and Floor Plan (existing site plan, for information only)



SITE PLAN N

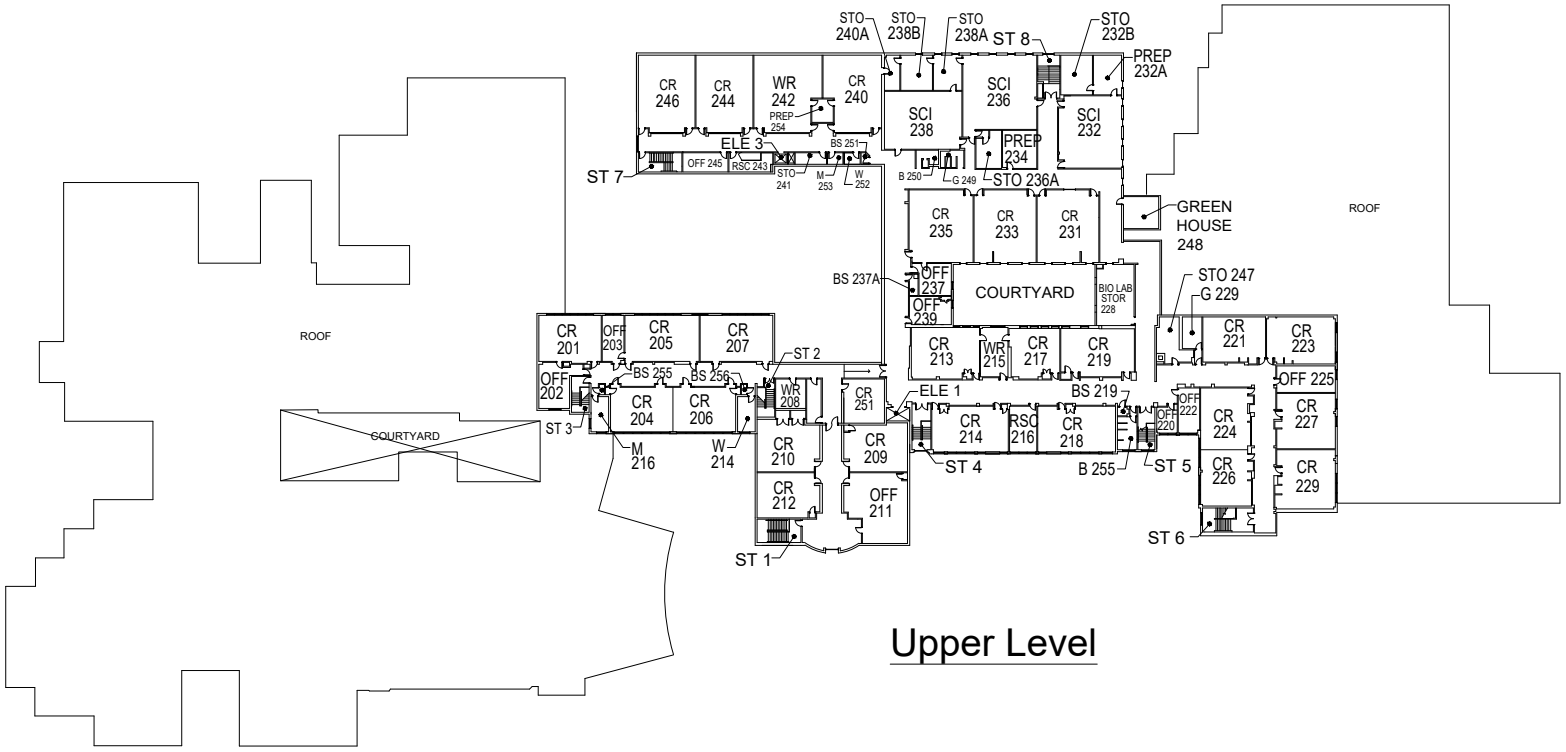
DAMASCUS HIGH SCHOOL

SCALE= N.T.S.



DAMASCUS HIGH SCHOOL

UPDATED: 10/13/20



Upper Level

DAMASCUS HIGH SCHOOL

UPDATED: 10/13/20

Attachment H –

AIA Document B101 Standard Form of Agreement Between Owner and Architect with MCPS Modifications (DRAFT)

AIA® Document B101® – 2017

Standard Form of Agreement Between Owner and Architect

AGREEMENT made as of the day of in the year
(In words, indicate day, month and year.)

BETWEEN the Architect's client identified as the Owner:
(Name, legal status, address and other information)

and the Architect:
(Name, legal status, address and other information)

for the following Project:
(Name, location and detailed description)

The Owner and Architect agree as follows.

ADDITIONS AND DELETIONS:
The author of this document may have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

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ARTICLE 1 INITIAL INFORMATION

§ 1.1 This Agreement is based on the Initial Information set forth in this Section 1.1.
(For each item in this section, insert the information or a statement such as "not applicable" or "unknown at time of execution.")

§ 1.1.1 The Owner's program for the Project:
(Insert the Owner's program, identify documentation that establishes the Owner's program, or state the manner in which the program will be developed.)

§ 1.1.2 The Project's physical characteristics:
(Identify or describe pertinent information about the Project's physical characteristics, such as size; location; dimensions; geotechnical reports; site boundaries; topographic surveys; traffic and utility studies; availability of public and private utilities and services; legal description of the site, etc.)

§ 1.1.3 The Owner's budget for the Cost of the Work, as defined in Section 6.1:
(Provide total and, if known, a line item breakdown.)

§ 1.1.4 The Owner's anticipated design and construction milestone dates:

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.1 Design phase milestone dates, if any:

.2 Construction commencement date:

.3 Substantial Completion date or dates:

.4 Other milestone dates:

§ 1.1.5 The Owner intends the following procurement and delivery method for the Project:
(Identify method such as competitive bid or negotiated contract, as well as any requirements for accelerated or fast-track design and construction, multiple bid packages, or phased construction.)

§ 1.1.6 The Owner's anticipated Sustainable Objective for the Project:
(Identify and describe the Owner's Sustainable Objective for the Project, if any.)

§ 1.1.6.1 If the Owner identifies a Sustainable Objective, the Owner and Architect shall complete and incorporate AIA Document E204™–2017, Sustainable Projects Exhibit, into this Agreement to define the terms, conditions and services related to the Owner's Sustainable Objective. If E204–2017 is incorporated into this agreement, the Owner and Architect shall incorporate the completed E204–2017 into the agreements with the consultants and contractors performing services or Work in any way associated with the Sustainable Objective.

§ 1.1.7 The Owner identifies the following representative in accordance with Section 5.3:
(List name, address, and other contact information.)

§ 1.1.8 The persons or entities, in addition to the Owner's representative, who are required to review the Architect's submittals to the Owner are as follows:
(List name, address, and other contact information.)

§ 1.1.9 The Owner shall retain the following consultants and contractors:
(List name, legal status, address, and other contact information.)

.1 Geotechnical Engineer:

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.2 Civil Engineer:

.3 Other, if any:
(List any other consultants and contractors retained by the Owner.)

§ 1.1.10 The Architect identifies the following representative in accordance with Section 2.3:
(List name, address, and other contact information.)

§ 1.1.11 The Architect shall retain the consultants identified in Sections 1.1.11.1 and 1.1.11.2:
(List name, legal status, address, and other contact information.)

§ 1.1.11.1 Consultants retained under Basic Services:

.1 Structural Engineer:

.2 Mechanical Engineer:

.3 Electrical Engineer:

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§ 1.1.11.2 Consultants retained under Supplemental Services:

§ 1.1.12 Other Initial Information on which the Agreement is based:

§ 1.2 The Owner and Architect may rely on the Initial Information. Both parties, however, recognize that the Initial Information may materially change and, in that event, the Owner and the Architect shall appropriately adjust the Architect's services, schedule for the Architect's services, and the Architect's compensation. The Owner shall adjust the Owner's budget for the Cost of the Work and the Owner's anticipated design and construction milestones, as necessary, to accommodate material changes in the Initial Information.

§ 1.3 The parties shall agree upon written protocols governing the transmission and use of, and reliance on, Instruments of Service or any other information or documentation in digital form.

§ 1.3.1 Any use of, or reliance on, all or a portion of a building information model without agreement to written protocols governing the use of, and reliance on, the information contained in the model shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 ARCHITECT'S RESPONSIBILITIES

§ 2.1 The Architect shall provide professional services as set forth in this Agreement. The Architect represents that it is properly licensed in the jurisdiction where the Project is located to provide the services required by this Agreement, or shall cause such services to be performed by appropriately licensed design professionals.

§ 2.2 The Architect shall perform its services consistent with the professional skill and care ordinarily provided by architects practicing in the same or similar locality under the same or similar circumstances. The Architect shall perform its services as expeditiously as is consistent with such professional skill and care and the orderly progress of the Project.

§ 2.3 The Architect shall identify a representative authorized to act on behalf of the Architect with respect to the Project.

§ 2.4 Except with the Owner's knowledge and consent, the Architect shall not engage in any activity, or accept any employment, interest or contribution that would reasonably appear to compromise the Architect's professional judgment with respect to this Project.

§ 2.5 The Architect shall maintain the following insurance until termination of this Agreement. If any of the requirements set forth below are in addition to the types and limits the Architect normally maintains, the Owner shall pay the Architect as set forth in Section 11.9.

§ 2.5.1 Commercial General Liability with policy limits of not less than ($) for each occurrence and ($) in the aggregate for bodily injury and property damage.

§ 2.5.2 Automobile Liability covering vehicles owned, and non-owned vehicles used, by the Architect with policy limits of not less than ($) per accident for bodily injury, death of any person, and property damage arising out of the ownership, maintenance and use of those motor vehicles, along with any other statutorily required automobile coverage.

§ 2.5.3 The Architect may achieve the required limits and coverage for Commercial General Liability and Automobile

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Liability through a combination of primary and excess or umbrella liability insurance, provided such primary and excess or umbrella liability insurance policies result in the same or greater coverage as the coverages required under Sections 2.5.1 and 2.5.2, and in no event shall any excess or umbrella liability insurance provide narrower coverage than the primary policy. The excess policy shall not require the exhaustion of the underlying limits only through the actual payment by the underlying insurers.

§ 2.5.4 Workers' Compensation at statutory limits.

§ 2.5.5 Employers' Liability with policy limits not less than ($) each accident, ($) each employee, and ($) policy limit.

§ 2.5.6 Professional Liability covering negligent acts, errors and omissions in the performance of professional services with policy limits of not less than ($) per claim and ($) in the aggregate.

§ 2.5.7 Additional Insured Obligations. To the fullest extent permitted by law, the Architect shall cause the primary and excess or umbrella policies for Commercial General Liability and Automobile Liability to include the Owner as an additional insured for claims caused in whole or in part by the Architect's negligent acts or omissions. The additional insured coverage shall be primary and non-contributory to any of the Owner's insurance policies and shall apply to both ongoing and completed operations.

§ 2.5.8 The Architect shall provide certificates of insurance to the Owner that evidence compliance with the requirements in this Section 2.5.

ARTICLE 3 SCOPE OF ARCHITECT'S BASIC SERVICES

§ 3.1 The Architect's Basic Services consist of those described in this Article 3 and include usual and customary structural, mechanical, and electrical engineering services. Services not set forth in this Article 3 are Supplemental or Additional Services.

§ 3.1.1 The Architect shall manage the Architect's services, research applicable design criteria, attend Project meetings, communicate with members of the Project team, and report progress to the Owner.

§ 3.1.2 The Architect shall coordinate its services with those services provided by the Owner and the Owner's consultants. The Architect shall be entitled to rely on, and shall not be responsible for, the accuracy, completeness, and timeliness of, services and information furnished by the Owner and the Owner's consultants. The Architect shall provide prompt written notice to the Owner if the Architect becomes aware of any error, omission, or inconsistency in such services or information.

§ 3.1.3 As soon as practicable after the date of this Agreement, the Architect shall submit for the Owner's approval a schedule for the performance of the Architect's services. The schedule initially shall include anticipated dates for the commencement of construction and for Substantial Completion of the Work as set forth in the Initial Information. The schedule shall include allowances for periods of time required for the Owner's review, for the performance of the Owner's consultants, and for approval of submissions by authorities having jurisdiction over the Project. Once approved by the Owner, time limits established by the schedule shall not, except for reasonable cause, be exceeded by the Architect or Owner. With the Owner's approval, the Architect shall adjust the schedule, if necessary, as the Project proceeds until the commencement of construction.

§ 3.1.4 The Architect shall not be responsible for an Owner's directive or substitution, or for the Owner's acceptance of non-conforming Work, made or given without the Architect's written approval.

§ 3.1.5 The Architect shall contact governmental authorities required to approve the Construction Documents and entities providing utility services to the Project. The Architect shall respond to applicable design requirements imposed by those authorities and entities.

§ 3.1.6 The Architect shall assist the Owner in connection with the Owner's responsibility for filing documents required for the approval of governmental authorities having jurisdiction over the Project.

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§ 3.2 Schematic Design Phase Services

§ 3.2.1 The Architect shall review the program and other information furnished by the Owner, and shall review laws, codes, and regulations applicable to the Architect's services.

§ 3.2.2 The Architect shall prepare a preliminary evaluation of the Owner's program, schedule, budget for the Cost of the Work, Project site, the proposed procurement and delivery method, and other Initial Information, each in terms of the other, to ascertain the requirements of the Project. The Architect shall notify the Owner of (1) any inconsistencies discovered in the information, and (2) other information or consulting services that may be reasonably needed for the Project.

§ 3.2.3 The Architect shall present its preliminary evaluation to the Owner and shall discuss with the Owner alternative approaches to design and construction of the Project. The Architect shall reach an understanding with the Owner regarding the requirements of the Project.

§ 3.2.4 Based on the Project requirements agreed upon with the Owner, the Architect shall prepare and present, for the Owner's approval, a preliminary design illustrating the scale and relationship of the Project components.

§ 3.2.5 Based on the Owner's approval of the preliminary design, the Architect shall prepare Schematic Design Documents for the Owner's approval. The Schematic Design Documents shall consist of drawings and other documents including a site plan, if appropriate, and preliminary building plans, sections and elevations; and may include some combination of study models, perspective sketches, or digital representations. Preliminary selections of major building systems and construction materials shall be noted on the drawings or described in writing.

§ 3.2.5.1 The Architect shall consider sustainable design alternatives, such as material choices and building orientation, together with other considerations based on program and aesthetics, in developing a design that is consistent with the Owner's program, schedule and budget for the Cost of the Work. The Owner may obtain more advanced sustainable design services as a Supplemental Service under Section 4.1.1.

§ 3.2.5.2 The Architect shall consider the value of alternative materials, building systems and equipment, together with other considerations based on program and aesthetics, in developing a design for the Project that is consistent with the Owner's program, schedule, and budget for the Cost of the Work.

§ 3.2.6 The Architect shall submit to the Owner an estimate of the Cost of the Work prepared in accordance with Section 6.3.

§ 3.2.7 The Architect shall submit the Schematic Design Documents to the Owner, and request the Owner's approval.

§ 3.3 Design Development Phase Services

§ 3.3.1 Based on the Owner's approval of the Schematic Design Documents, and on the Owner's authorization of any adjustments in the Project requirements and the budget for the Cost of the Work, the Architect shall prepare Design Development Documents for the Owner's approval. The Design Development Documents shall illustrate and describe the development of the approved Schematic Design Documents and shall consist of drawings and other documents including plans, sections, elevations, typical construction details, and diagrammatic layouts of building systems to fix and describe the size and character of the Project as to architectural, structural, mechanical and electrical systems, and other appropriate elements. The Design Development Documents shall also include outline specifications that identify major materials and systems and establish, in general, their quality levels.

§ 3.3.2 The Architect shall update the estimate of the Cost of the Work prepared in accordance with Section 6.3.

§ 3.3.3 The Architect shall submit the Design Development Documents to the Owner, advise the Owner of any adjustments to the estimate of the Cost of the Work, and request the Owner's approval.

§ 3.4 Construction Documents Phase Services

§ 3.4.1 Based on the Owner's approval of the Design Development Documents, and on the Owner's authorization of any adjustments in the Project requirements and the budget for the Cost of the Work, the Architect shall prepare Construction Documents for the Owner's approval. The Construction Documents shall illustrate and describe the further development of the approved Design Development Documents and shall consist of Drawings and Specifications setting forth in detail the

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quality levels and performance criteria of materials and systems and other requirements for the construction of the Work. The Owner and Architect acknowledge that, in order to perform the Work, the Contractor will provide additional information, including Shop Drawings, Product Data, Samples and other similar submittals, which the Architect shall review in accordance with Section 3.6.4.

§ 3.4.2 The Architect shall incorporate the design requirements of governmental authorities having jurisdiction over the Project into the Construction Documents.

§ 3.4.3 During the development of the Construction Documents, the Architect shall assist the Owner in the development and preparation of (1) procurement information that describes the time, place, and conditions of bidding, including bidding or proposal forms; (2) the form of agreement between the Owner and Contractor; and (3) the Conditions of the Contract for Construction (General, Supplementary and other Conditions). The Architect shall also compile a project manual that includes the Conditions of the Contract for Construction and Specifications, and may include bidding requirements and sample forms.

§ 3.4.4 The Architect shall update the estimate for the Cost of the Work prepared in accordance with Section 6.3.

§ 3.4.5 The Architect shall submit the Construction Documents to the Owner, advise the Owner of any adjustments to the estimate of the Cost of the Work, take any action required under Section 6.5, and request the Owner's approval.

§ 3.5 Procurement Phase Services

§ 3.5.1 General

The Architect shall assist the Owner in establishing a list of prospective contractors. Following the Owner's approval of the Construction Documents, the Architect shall assist the Owner in (1) obtaining either competitive bids or negotiated proposals; (2) confirming responsiveness of bids or proposals; (3) determining the successful bid or proposal, if any; and, (4) awarding and preparing contracts for construction.

§ 3.5.2 Competitive Bidding

§ 3.5.2.1 Bidding Documents shall consist of bidding requirements and proposed Contract Documents.

§ 3.5.2.2 The Architect shall assist the Owner in bidding the Project by:

- **.1** facilitating the distribution of Bidding Documents to prospective bidders;
- **.2** organizing and conducting a pre-bid conference for prospective bidders;
- **.3** preparing responses to questions from prospective bidders and providing clarifications and interpretations of the Bidding Documents to the prospective bidders in the form of addenda; and,
- **.4** organizing and conducting the opening of the bids, and subsequently documenting and distributing the bidding results, as directed by the Owner.

§ 3.5.2.3 If the Bidding Documents permit substitutions, upon the Owner's written authorization, the Architect shall, as an Additional Service, consider requests for substitutions and prepare and distribute addenda identifying approved substitutions to all prospective bidders.

§ 3.5.3 Negotiated Proposals

§ 3.5.3.1 Proposal Documents shall consist of proposal requirements and proposed Contract Documents.

§ 3.5.3.2 The Architect shall assist the Owner in obtaining proposals by:

- **.1** facilitating the distribution of Proposal Documents for distribution to prospective contractors and requesting their return upon completion of the negotiation process;
- **.2** organizing and participating in selection interviews with prospective contractors;
- **.3** preparing responses to questions from prospective contractors and providing clarifications and interpretations of the Proposal Documents to the prospective contractors in the form of addenda; and,
- **.4** participating in negotiations with prospective contractors, and subsequently preparing a summary report of the negotiation results, as directed by the Owner.

§ 3.5.3.3 If the Proposal Documents permit substitutions, upon the Owner's written authorization, the Architect shall, as an

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Additional Service, consider requests for substitutions and prepare and distribute addenda identifying approved substitutions to all prospective contractors.

§ 3.6 Construction Phase Services

§ 3.6.1 General

§ 3.6.1.1 The Architect shall provide administration of the Contract between the Owner and the Contractor as set forth below and in AIA Document A201™–2017, General Conditions of the Contract for Construction. If the Owner and Contractor modify AIA Document A201–2017, those modifications shall not affect the Architect's services under this Agreement unless the Owner and the Architect amend this Agreement.

§ 3.6.1.2 The Architect shall advise and consult with the Owner during the Construction Phase Services. The Architect shall have authority to act on behalf of the Owner only to the extent provided in this Agreement. The Architect shall not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the Work, nor shall the Architect be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect shall be responsible for the Architect's negligent acts or omissions, but shall not have control over or charge of, and shall not be responsible for, acts or omissions of the Contractor or of any other persons or entities performing portions of the Work.

§ 3.6.1.3 Subject to Section 4.2 and except as provided in Section 3.6.6.5, the Architect's responsibility to provide Construction Phase Services commences with the award of the Contract for Construction and terminates on the date the Architect issues the final Certificate for Payment.

§ 3.6.2 Evaluations of the Work

§ 3.6.2.1 The Architect shall visit the site at intervals appropriate to the stage of construction, or as otherwise required in Section 4.2.3, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine, in general, if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect shall not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. On the basis of the site visits, the Architect shall keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work.

§ 3.6.2.2 The Architect has the authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect shall have the authority to require inspection or testing of the Work in accordance with the provisions of the Contract Documents, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 3.6.2.3 The Architect shall interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests shall be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 3.6.2.4 Interpretations and decisions of the Architect shall be consistent with the intent of, and reasonably inferable from, the Contract Documents and shall be in writing or in the form of drawings. When making such interpretations and decisions, the Architect shall endeavor to secure faithful performance by both Owner and Contractor, shall not show partiality to either, and shall not be liable for results of interpretations or decisions rendered in good faith. The Architect's decisions on matters relating to aesthetic effect shall be final if consistent with the intent expressed in the Contract Documents.

§ 3.6.2.5 Unless the Owner and Contractor designate another person to serve as an Initial Decision Maker, as that term is defined in AIA Document A201–2017, the Architect shall render initial decisions on Claims between the Owner and Contractor as provided in the Contract Documents.

§ 3.6.3 Certificates for Payment to Contractor

§ 3.6.3.1 The Architect shall review and certify the amounts due the Contractor and shall issue certificates in such amounts.

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The Architect's certification for payment shall constitute a representation to the Owner, based on the Architect's evaluation of the Work as provided in Section 3.6.2 and on the data comprising the Contractor's Application for Payment, that, to the best of the Architect's knowledge, information and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to (1) an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, (2) results of subsequent tests and inspections, (3) correction of minor deviations from the Contract Documents prior to completion, and (4) specific qualifications expressed by the Architect.

§ 3.6.3.2 The issuance of a Certificate for Payment shall not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work, (2) reviewed construction means, methods, techniques, sequences or procedures, (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment, or (4) ascertained how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 3.6.3.3 The Architect shall maintain a record of the Applications and Certificates for Payment.

§ 3.6.4 Submittals

§ 3.6.4.1 The Architect shall review the Contractor's submittal schedule and shall not unreasonably delay or withhold approval of the schedule. The Architect's action in reviewing submittals shall be taken in accordance with the approved submittal schedule or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time, in the Architect's professional judgment, to permit adequate review.

§ 3.6.4.2 The Architect shall review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. Review of such submittals is not for the purpose of determining the accuracy and completeness of other information such as dimensions, quantities, and installation or performance of equipment or systems, which are the Contractor's responsibility. The Architect's review shall not constitute approval of safety precautions or construction means, methods, techniques, sequences or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 3.6.4.3 If the Contract Documents specifically require the Contractor to provide professional design services or certifications by a design professional related to systems, materials, or equipment, the Architect shall specify the appropriate performance and design criteria that such services must satisfy. The Architect shall review and take appropriate action on Shop Drawings and other submittals related to the Work designed or certified by the Contractor's design professional, provided the submittals bear such professional's seal and signature when submitted to the Architect. The Architect's review shall be for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect shall be entitled to rely upon, and shall not be responsible for, the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals.

§ 3.6.4.4 Subject to Section 4.2, the Architect shall review and respond to requests for information about the Contract Documents. The Architect shall set forth, in the Contract Documents, the requirements for requests for information. Requests for information shall include, at a minimum, a detailed written statement that indicates the specific Drawings or Specifications in need of clarification and the nature of the clarification requested. The Architect's response to such requests shall be made in writing within any time limits agreed upon, or otherwise with reasonable promptness. If appropriate, the Architect shall prepare and issue supplemental Drawings and Specifications in response to the requests for information.

§ 3.6.4.5 The Architect shall maintain a record of submittals and copies of submittals supplied by the Contractor in accordance with the requirements of the Contract Documents.

§ 3.6.5 Changes in the Work

§ 3.6.5.1 The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. Subject to Section 4.2, the Architect shall prepare Change Orders and Construction Change Directives for the Owner's approval and execution in accordance with the Contract Documents.

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§ 3.6.5.2 The Architect shall maintain records relative to changes in the Work.

§ 3.6.6 Project Completion

§ 3.6.6.1 The Architect shall:

.1 conduct inspections to determine the date or dates of Substantial Completion and the date of final completion;

.2 issue Certificates of Substantial Completion;

.3 forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract Documents and received from the Contractor; and,

.4 issue a final Certificate for Payment based upon a final inspection indicating that, to the best of the Architect's knowledge, information, and belief, the Work complies with the requirements of the Contract Documents.

§ 3.6.6.2 The Architect's inspections shall be conducted with the Owner to check conformance of the Work with the requirements of the Contract Documents and to verify the accuracy and completeness of the list submitted by the Contractor of Work to be completed or corrected.

§ 3.6.6.3 When Substantial Completion has been achieved, the Architect shall inform the Owner about the balance of the Contract Sum remaining to be paid the Contractor, including the amount to be retained from the Contract Sum, if any, for final completion or correction of the Work.

§ 3.6.6.4 The Architect shall forward to the Owner the following information received from the Contractor: (1) consent of surety or sureties, if any, to reduction in or partial release of retainage or the making of final payment; (2) affidavits, receipts, releases and waivers of liens, or bonds indemnifying the Owner against liens; and (3) any other documentation required of the Contractor under the Contract Documents.

§ 3.6.6.5 Upon request of the Owner, and prior to the expiration of one year from the date of Substantial Completion, the Architect shall, without additional compensation, conduct a meeting with the Owner to review the facility operations and performance.

ARTICLE 4 SUPPLEMENTAL AND ADDITIONAL SERVICES

§ 4.1 Supplemental Services

§ 4.1.1 The services listed below are not included in Basic Services but may be required for the Project. The Architect shall provide the listed Supplemental Services only if specifically designated in the table below as the Architect's responsibility, and the Owner shall compensate the Architect as provided in Section 11.2. Unless otherwise specifically addressed in this Agreement, if neither the Owner nor the Architect is designated, the parties agree that the listed Supplemental Service is not being provided for the Project.

(Designate the Architect's Supplemental Services and the Owner's Supplemental Services required for the Project by indicating whether the Architect or Owner shall be responsible for providing the identified Supplemental Service. Insert a description of the Supplemental Services in Section 4.1.2 below or attach the description of services as an exhibit to this Agreement.)

Supplemental Services	**Responsibility** *(Architect, Owner, or not provided)*
§ 4.1.1.1 Programming	
§ 4.1.1.2 Multiple preliminary designs	
§ 4.1.1.3 Measured drawings	
§ 4.1.1.4 Existing facilities surveys	
§ 4.1.1.5 Site evaluation and planning	
§ 4.1.1.6 Building Information Model management responsibilities	
§ 4.1.1.7 Development of Building Information Models for post construction use	
§ 4.1.1.8 Civil engineering	
§ 4.1.1.9 Landscape design	

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§ 4.1.1.10 Architectural interior design	
§ 4.1.1.11 Value analysis	
§ 4.1.1.12 Detailed cost estimating beyond that required in Section 6.3	
§ 4.1.1.13 On-site project representation	
§ 4.1.1.14 Conformed documents for construction	
§ 4.1.1.15 As-designed record drawings	
§ 4.1.1.16 As-constructed record drawings	
§ 4.1.1.17 Post-occupancy evaluation	
§ 4.1.1.18 Facility support services	
§ 4.1.1.19 Tenant-related services	
§ 4.1.1.20 Architect's coordination of the Owner's consultants	
§ 4.1.1.21 Telecommunications/data design	
§ 4.1.1.22 Security evaluation and planning	
§ 4.1.1.23 Commissioning	
§ 4.1.1.24 Sustainable Project Services pursuant to Section 4.1.3	
§ 4.1.1.25 Fast-track design services	
§ 4.1.1.26 Multiple bid packages	
§ 4.1.1.27 Historic preservation	
§ 4.1.1.28 Furniture, furnishings, and equipment design	
§ 4.1.1.29 Other services provided by specialty Consultants	
§ 4.1.1.30 Other Supplemental Services	

§ 4.1.2 Description of Supplemental Services

§ 4.1.2.1 A description of each Supplemental Service identified in Section 4.1.1 as the Architect's responsibility is provided below.

(Describe in detail the Architect's Supplemental Services identified in Section 4.1.1 or, if set forth in an exhibit, identify the exhibit. The AIA publishes a number of Standard Form of Architect's Services documents that can be included as an exhibit to describe the Architect's Supplemental Services.)

§ 4.1.2.2 A description of each Supplemental Service identified in Section 4.1.1 as the Owner's responsibility is provided below.

(Describe in detail the Owner's Supplemental Services identified in Section 4.1.1 or, if set forth in an exhibit, identify the exhibit.)

§ 4.1.3 If the Owner identified a Sustainable Objective in Article 1, the Architect shall provide, as a Supplemental Service, the Sustainability Services required in AIA Document E204™–2017, Sustainable Projects Exhibit, attached to this Agreement. The Owner shall compensate the Architect as provided in Section 11.2.

§ 4.2 Architect's Additional Services

The Architect may provide Additional Services after execution of this Agreement without invalidating the Agreement. Except for services required due to the fault of the Architect, any Additional Services provided in accordance with this Section 4.2

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shall entitle the Architect to compensation pursuant to Section 11.3 and an appropriate adjustment in the Architect's schedule.

§ 4.2.1 Upon recognizing the need to perform the following Additional Services, the Architect shall notify the Owner with reasonable promptness and explain the facts and circumstances giving rise to the need. The Architect shall not proceed to provide the following Additional Services until the Architect receives the Owner's written authorization:

.1 Services necessitated by a change in the Initial Information, previous instructions or approvals given by the Owner, or a material change in the Project including size, quality, complexity, the Owner's schedule or budget for Cost of the Work, or procurement or delivery method;

.2 Services necessitated by the enactment or revision of codes, laws, or regulations, including changing or editing previously prepared Instruments of Service;

.3 Changing or editing previously prepared Instruments of Service necessitated by official interpretations of applicable codes, laws or regulations that are either (a) contrary to specific interpretations by the applicable authorities having jurisdiction made prior to the issuance of the building permit, or (b) contrary to requirements of the Instruments of Service when those Instruments of Service were prepared in accordance with the applicable standard of care;

.4 Services necessitated by decisions of the Owner not rendered in a timely manner or any other failure of performance on the part of the Owner or the Owner's consultants or contractors;

.5 Preparing digital models or other design documentation for transmission to the Owner's consultants and contractors, or to other Owner-authorized recipients;

.6 Preparation of design and documentation for alternate bid or proposal requests proposed by the Owner;

.7 Preparation for, and attendance at, a public presentation, meeting or hearing;

.8 Preparation for, and attendance at, a dispute resolution proceeding or legal proceeding, except where the Architect is party thereto;

.9 Evaluation of the qualifications of entities providing bids or proposals;

.10 Consultation concerning replacement of Work resulting from fire or other cause during construction; or,

.11 Assistance to the Initial Decision Maker, if other than the Architect.

§ 4.2.2 To avoid delay in the Construction Phase, the Architect shall provide the following Additional Services, notify the Owner with reasonable promptness, and explain the facts and circumstances giving rise to the need. If, upon receipt of the Architect's notice, the Owner determines that all or parts of the services are not required, the Owner shall give prompt written notice to the Architect of the Owner's determination. The Owner shall compensate the Architect for the services provided prior to the Architect's receipt of the Owner's notice.

.1 Reviewing a Contractor's submittal out of sequence from the submittal schedule approved by the Architect;

.2 Responding to the Contractor's requests for information that are not prepared in accordance with the Contract Documents or where such information is available to the Contractor from a careful study and comparison of the Contract Documents, field conditions, other Owner-provided information, Contractor-prepared coordination drawings, or prior Project correspondence or documentation;

.3 Preparing Change Orders and Construction Change Directives that require evaluation of Contractor's proposals and supporting data, or the preparation or revision of Instruments of Service;

.4 Evaluating an extensive number of Claims as the Initial Decision Maker; or,

.5 Evaluating substitutions proposed by the Owner or Contractor and making subsequent revisions to Instruments of Service resulting therefrom.

§ 4.2.3 The Architect shall provide Construction Phase Services exceeding the limits set forth below as Additional Services. When the limits below are reached, the Architect shall notify the Owner:

.1 ( ) reviews of each Shop Drawing, Product Data item, sample and similar submittals of the Contractor

.2 ( ) visits to the site by the Architect during construction

.3 ( ) inspections for any portion of the Work to determine whether such portion of the Work is substantially complete in accordance with the requirements of the Contract Documents

.4 ( ) inspections for any portion of the Work to determine final completion.

§ 4.2.4 Except for services required under Section 3.6.6.5 and those services that do not exceed the limits set forth in Section 4.2.3, Construction Phase Services provided more than 60 days after (1) the date of Substantial Completion of the Work or (2) the initial date of Substantial Completion identified in the agreement between the Owner and Contractor, whichever is earlier,

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shall be compensated as Additional Services to the extent the Architect incurs additional cost in providing those Construction Phase Services.

§ 4.2.5 If the services covered by this Agreement have not been completed within ( ) months of the date of this Agreement, through no fault of the Architect, extension of the Architect's services beyond that time shall be compensated as Additional Services.

ARTICLE 5 OWNER'S RESPONSIBILITIES

§ 5.1 Unless otherwise provided for under this Agreement, the Owner shall provide information in a timely manner regarding requirements for and limitations on the Project, including a written program, which shall set forth the Owner's objectives; schedule; constraints and criteria, including space requirements and relationships; flexibility; expandability; special equipment; systems; and site requirements.

§ 5.2 The Owner shall establish the Owner's budget for the Project, including (1) the budget for the Cost of the Work as defined in Section 6.1; (2) the Owner's other costs; and, (3) reasonable contingencies related to all of these costs. The Owner shall update the Owner's budget for the Project as necessary throughout the duration of the Project until final completion. If the Owner significantly increases or decreases the Owner's budget for the Cost of the Work, the Owner shall notify the Architect. The Owner and the Architect shall thereafter agree to a corresponding change in the Project's scope and quality.

§ 5.3 The Owner shall identify a representative authorized to act on the Owner's behalf with respect to the Project. The Owner shall render decisions and approve the Architect's submittals in a timely manner in order to avoid unreasonable delay in the orderly and sequential progress of the Architect's services.

§ 5.4 The Owner shall furnish surveys to describe physical characteristics, legal limitations and utility locations for the site of the Project, and a written legal description of the site. The surveys and legal information shall include, as applicable, grades and lines of streets, alleys, pavements and adjoining property and structures; designated wetlands; adjacent drainage; rights-of-way, restrictions, easements, encroachments, zoning, deed restrictions, boundaries and contours of the site; locations, dimensions, and other necessary data with respect to existing buildings, other improvements and trees; and information concerning available utility services and lines, both public and private, above and below grade, including inverts and depths. All the information on the survey shall be referenced to a Project benchmark.

§ 5.5 The Owner shall furnish services of geotechnical engineers, which may include test borings, test pits, determinations of soil bearing values, percolation tests, evaluations of hazardous materials, seismic evaluation, ground corrosion tests and resistivity tests, including necessary operations for anticipating subsoil conditions, with written reports and appropriate recommendations.

§ 5.6 The Owner shall provide the Supplemental Services designated as the Owner's responsibility in Section 4.1.1.

§ 5.7 If the Owner identified a Sustainable Objective in Article 1, the Owner shall fulfill its responsibilities as required in AIA Document E204™–2017, Sustainable Projects Exhibit, attached to this Agreement.

§ 5.8 The Owner shall coordinate the services of its own consultants with those services provided by the Architect. Upon the Architect's request, the Owner shall furnish copies of the scope of services in the contracts between the Owner and the Owner's consultants. The Owner shall furnish the services of consultants other than those designated as the responsibility of the Architect in this Agreement, or authorize the Architect to furnish them as an Additional Service, when the Architect requests such services and demonstrates that they are reasonably required by the scope of the Project. The Owner shall require that its consultants and contractors maintain insurance, including professional liability insurance, as appropriate to the services or work provided.

§ 5.9 The Owner shall furnish tests, inspections and reports required by law or the Contract Documents, such as structural, mechanical, and chemical tests, tests for air and water pollution, and tests for hazardous materials.

§ 5.10 The Owner shall furnish all legal, insurance and accounting services, including auditing services, that may be reasonably necessary at any time for the Project to meet the Owner's needs and interests.

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§ 5.11 The Owner shall provide prompt written notice to the Architect if the Owner becomes aware of any fault or defect in the Project, including errors, omissions or inconsistencies in the Architect's Instruments of Service.

§ 5.12 The Owner shall include the Architect in all communications with the Contractor that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect.

§ 5.13 Before executing the Contract for Construction, the Owner shall coordinate the Architect's duties and responsibilities set forth in the Contract for Construction with the Architect's services set forth in this Agreement. The Owner shall provide the Architect a copy of the executed agreement between the Owner and Contractor, including the General Conditions of the Contract for Construction.

§ 5.14 The Owner shall provide the Architect access to the Project site prior to commencement of the Work and shall obligate the Contractor to provide the Architect access to the Work wherever it is in preparation or progress.

§ 5.15 Within 15 days after receipt of a written request from the Architect, the Owner shall furnish the requested information as necessary and relevant for the Architect to evaluate, give notice of, or enforce lien rights.

ARTICLE 6 COST OF THE WORK

§ 6.1 For purposes of this Agreement, the Cost of the Work shall be the total cost to the Owner to construct all elements of the Project designed or specified by the Architect and shall include contractors' general conditions costs, overhead and profit. The Cost of the Work also includes the reasonable value of labor, materials, and equipment, donated to, or otherwise furnished by, the Owner. The Cost of the Work does not include the compensation of the Architect; the costs of the land, rights-of-way, financing, or contingencies for changes in the Work; or other costs that are the responsibility of the Owner.

§ 6.2 The Owner's budget for the Cost of the Work is provided in Initial Information, and shall be adjusted throughout the Project as required under Sections 5.2, 6.4 and 6.5. Evaluations of the Owner's budget for the Cost of the Work, and the preliminary estimate of the Cost of the Work and updated estimates of the Cost of the Work, prepared by the Architect, represent the Architect's judgment as a design professional. It is recognized, however, that neither the Architect nor the Owner has control over the cost of labor, materials, or equipment; the Contractor's methods of determining bid prices; or competitive bidding, market, or negotiating conditions. Accordingly, the Architect cannot and does not warrant or represent that bids or negotiated prices will not vary from the Owner's budget for the Cost of the Work, or from any estimate of the Cost of the Work, or evaluation, prepared or agreed to by the Architect.

§ 6.3 In preparing estimates of the Cost of Work, the Architect shall be permitted to include contingencies for design, bidding, and price escalation; to determine what materials, equipment, component systems, and types of construction are to be included in the Contract Documents; to recommend reasonable adjustments in the program and scope of the Project; and to include design alternates as may be necessary to adjust the estimated Cost of the Work to meet the Owner's budget. The Architect's estimate of the Cost of the Work shall be based on current area, volume or similar conceptual estimating techniques. If the Owner requires a detailed estimate of the Cost of the Work, the Architect shall provide such an estimate, if identified as the Architect's responsibility in Section 4.1.1, as a Supplemental Service.

§ 6.4 If, through no fault of the Architect, the Procurement Phase has not commenced within 90 days after the Architect submits the Construction Documents to the Owner, the Owner's budget for the Cost of the Work shall be adjusted to reflect changes in the general level of prices in the applicable construction market.

§ 6.5 If at any time the Architect's estimate of the Cost of the Work exceeds the Owner's budget for the Cost of the Work, the Architect shall make appropriate recommendations to the Owner to adjust the Project's size, quality, or budget for the Cost of the Work, and the Owner shall cooperate with the Architect in making such adjustments.

§ 6.6 If the Owner's budget for the Cost of the Work at the conclusion of the Construction Documents Phase Services is exceeded by the lowest bona fide bid or negotiated proposal, the Owner shall

.1 give written approval of an increase in the budget for the Cost of the Work;

.2 authorize rebidding or renegotiating of the Project within a reasonable time;

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.3 terminate in accordance with Section 9.5;

.4 in consultation with the Architect, revise the Project program, scope, or quality as required to reduce the Cost of the Work; or,

.5 implement any other mutually acceptable alternative.

§ 6.7 If the Owner chooses to proceed under Section 6.6.4, the Architect shall modify the Construction Documents as necessary to comply with the Owner's budget for the Cost of the Work at the conclusion of the Construction Documents Phase Services, or the budget as adjusted under Section 6.6.1. If the Owner requires the Architect to modify the Construction Documents because the lowest bona fide bid or negotiated proposal exceeds the Owner's budget for the Cost of the Work due to market conditions the Architect could not reasonably anticipate, the Owner shall compensate the Architect for the modifications as an Additional Service pursuant to Section 11.3; otherwise the Architect's services for modifying the Construction Documents shall be without additional compensation. In any event, the Architect's modification of the Construction Documents shall be the limit of the Architect's responsibility under this Article 6.

ARTICLE 7 COPYRIGHTS AND LICENSES

§ 7.1 The Architect and the Owner warrant that in transmitting Instruments of Service, or any other information, the transmitting party is the copyright owner of such information or has permission from the copyright owner to transmit such information for its use on the Project.

§ 7.2 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and shall retain all common law, statutory and other reserved rights, including copyrights. Submission or distribution of Instruments of Service to meet official regulatory requirements or for similar purposes in connection with the Project is not to be construed as publication in derogation of the reserved rights of the Architect and the Architect's consultants.

§ 7.3 The Architect grants to the Owner a nonexclusive license to use the Architect's Instruments of Service solely and exclusively for purposes of constructing, using, maintaining, altering and adding to the Project, provided that the Owner substantially performs its obligations under this Agreement, including prompt payment of all sums due pursuant to Article 9 and Article 11. The Architect shall obtain similar nonexclusive licenses from the Architect's consultants consistent with this Agreement. The license granted under this section permits the Owner to authorize the Contractor, Subcontractors, Sub-subcontractors, and suppliers, as well as the Owner's consultants and separate contractors, to reproduce applicable portions of the Instruments of Service, subject to any protocols established pursuant to Section 1.3, solely and exclusively for use in performing services or construction for the Project. If the Architect rightfully terminates this Agreement for cause as provided in Section 9.4, the license granted in this Section 7.3 shall terminate.

§ 7.3.1 In the event the Owner uses the Instruments of Service without retaining the authors of the Instruments of Service, the Owner releases the Architect and Architect's consultant(s) from all claims and causes of action arising from such uses. The Owner, to the extent permitted by law, further agrees to indemnify and hold harmless the Architect and its consultants from all costs and expenses, including the cost of defense, related to claims and causes of action asserted by any third person or entity to the extent such costs and expenses arise from the Owner's use of the Instruments of Service under this Section 7.3.1. The terms of this Section 7.3.1 shall not apply if the Owner rightfully terminates this Agreement for cause under Section 9.4.

§ 7.4 Except for the licenses granted in this Article 7, no other license or right shall be deemed granted or implied under this Agreement. The Owner shall not assign, delegate, sublicense, pledge or otherwise transfer any license granted herein to another party without the prior written agreement of the Architect. Any unauthorized use of the Instruments of Service shall be at the Owner's sole risk and without liability to the Architect and the Architect's consultants.

§ 7.5 Except as otherwise stated in Section 7.3, the provisions of this Article 7 shall survive the termination of this Agreement.

ARTICLE 8 CLAIMS AND DISPUTES

§ 8.1 General

§ 8.1.1 The Owner and Architect shall commence all claims and causes of action against the other and arising out of or related to this Agreement, whether in contract, tort, or otherwise, in accordance with the requirements of the binding dispute resolution method selected in this Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Architect waive all claims and causes of action

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not commenced in accordance with this Section 8.1.1.

§ 8.1.2 To the extent damages are covered by property insurance, the Owner and Architect waive all rights against each other and against the contractors, consultants, agents, and employees of the other for damages, except such rights as they may have to the proceeds of such insurance as set forth in AIA Document A201–2017, General Conditions of the Contract for Construction. The Owner or the Architect, as appropriate, shall require of the contractors, consultants, agents, and employees of any of them, similar waivers in favor of the other parties enumerated herein.

§ 8.1.3 The Architect and Owner waive consequential damages for claims, disputes, or other matters in question, arising out of or relating to this Agreement. This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination of this Agreement, except as specifically provided in Section 9.7.

§ 8.2 Mediation

§ 8.2.1 Any claim, dispute or other matter in question arising out of or related to this Agreement shall be subject to mediation as a condition precedent to binding dispute resolution. If such matter relates to or is the subject of a lien arising out of the Architect's services, the Architect may proceed in accordance with applicable law to comply with the lien notice or filing deadlines prior to resolution of the matter by mediation or by binding dispute resolution.

§ 8.2.2 The Owner and Architect shall endeavor to resolve claims, disputes and other matters in question between them by mediation, which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of this Agreement. A request for mediation shall be made in writing, delivered to the other party to this Agreement, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of a complaint or other appropriate demand for binding dispute resolution but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration proceeding is stayed pursuant to this section, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 8.2.3 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 8.2.4 If the parties do not resolve a dispute through mediation pursuant to this Section 8.2, the method of binding dispute resolution shall be the following:
(Check the appropriate box.)

[ ] Arbitration pursuant to Section 8.3 of this Agreement

[ ] Litigation in a court of competent jurisdiction

[ ] Other: *(Specify)*

If the Owner and Architect do not select a method of binding dispute resolution, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, the dispute will be resolved in a court of competent jurisdiction.

§ 8.3 Arbitration

§ 8.3.1 If the parties have selected arbitration as the method for binding dispute resolution in this Agreement, any claim, dispute or other matter in question arising out of or related to this Agreement subject to, but not resolved by, mediation shall be subject to arbitration, which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of this Agreement. A demand for arbitration shall be made in writing, delivered to the other party to this Agreement, and filed with the person or entity administering the arbitration.

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§ 8.3.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the claim, dispute or other matter in question would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the claim, dispute or other matter in question.

§ 8.3.2 The foregoing agreement to arbitrate, and other agreements to arbitrate with an additional person or entity duly consented to by parties to this Agreement, shall be specifically enforceable in accordance with applicable law in any court having jurisdiction thereof.

§ 8.3.3 The award rendered by the arbitrator(s) shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 8.3.4 Consolidation or Joinder

§ 8.3.4.1 Either party, at its sole discretion, may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation; (2) the arbitrations to be consolidated substantially involve common questions of law or fact; and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 8.3.4.2 Either party, at its sole discretion, may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 8.3.4.3 The Owner and Architect grant to any person or entity made a party to an arbitration conducted under this Section 8.3, whether by joinder or consolidation, the same rights of joinder and consolidation as the Owner and Architect under this Agreement.

§ 8.4 The provisions of this Article 8 shall survive the termination of this Agreement.

ARTICLE 9 TERMINATION OR SUSPENSION

§ 9.1 If the Owner fails to make payments to the Architect in accordance with this Agreement, such failure shall be considered substantial nonperformance and cause for termination or, at the Architect's option, cause for suspension of performance of services under this Agreement. If the Architect elects to suspend services, the Architect shall give seven days' written notice to the Owner before suspending services. In the event of a suspension of services, the Architect shall have no liability to the Owner for delay or damage caused the Owner because of such suspension of services. Before resuming services, the Owner shall pay the Architect all sums due prior to suspension and any expenses incurred in the interruption and resumption of the Architect's services. The Architect's fees for the remaining services and the time schedules shall be equitably adjusted.

§ 9.2 If the Owner suspends the Project, the Architect shall be compensated for services performed prior to notice of such suspension. When the Project is resumed, the Architect shall be compensated for expenses incurred in the interruption and resumption of the Architect's services. The Architect's fees for the remaining services and the time schedules shall be equitably adjusted.

§ 9.3 If the Owner suspends the Project for more than 90 cumulative days for reasons other than the fault of the Architect, the Architect may terminate this Agreement by giving not less than seven days' written notice.

§ 9.4 Either party may terminate this Agreement upon not less than seven days' written notice should the other party fail substantially to perform in accordance with the terms of this Agreement through no fault of the party initiating the termination.

§ 9.5 The Owner may terminate this Agreement upon not less than seven days' written notice to the Architect for the Owner's convenience and without cause.

§ 9.6 If the Owner terminates this Agreement for its convenience pursuant to Section 9.5, or the Architect terminates this

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Agreement pursuant to Section 9.3, the Owner shall compensate the Architect for services performed prior to termination, Reimbursable Expenses incurred, and costs attributable to termination, including the costs attributable to the Architect's termination of consultant agreements.

§ 9.7 In addition to any amounts paid under Section 9.6, if the Owner terminates this Agreement for its convenience pursuant to Section 9.5, or the Architect terminates this Agreement pursuant to Section 9.3, the Owner shall pay to the Architect the following fees:
(Set forth below the amount of any termination or licensing fee, or the method for determining any termination or licensing fee.)

.1 Termination Fee:

.2 Licensing Fee if the Owner intends to continue using the Architect's Instruments of Service:

§ 9.8 Except as otherwise expressly provided herein, this Agreement shall terminate one year from the date of Substantial Completion.

§ 9.9 The Owner's rights to use the Architect's Instruments of Service in the event of a termination of this Agreement are set forth in Article 7 and Section 9.7.

ARTICLE 10 MISCELLANEOUS PROVISIONS

§ 10.1 This Agreement shall be governed by the law of the place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 8.3.

§ 10.2 Terms in this Agreement shall have the same meaning as those in AIA Document A201–2017, General Conditions of the Contract for Construction.

§ 10.3 The Owner and Architect, respectively, bind themselves, their agents, successors, assigns, and legal representatives to this Agreement. Neither the Owner nor the Architect shall assign this Agreement without the written consent of the other, except that the Owner may assign this Agreement to a lender providing financing for the Project if the lender agrees to assume the Owner's rights and obligations under this Agreement, including any payments due to the Architect by the Owner prior to the assignment.

§ 10.4 If the Owner requests the Architect to execute certificates, the proposed language of such certificates shall be submitted to the Architect for review at least 14 days prior to the requested dates of execution. If the Owner requests the Architect to execute consents reasonably required to facilitate assignment to a lender, the Architect shall execute all such consents that are consistent with this Agreement, provided the proposed consent is submitted to the Architect for review at least 14 days prior to execution. The Architect shall not be required to execute certificates or consents that would require knowledge, services, or responsibilities beyond the scope of this Agreement.

§ 10.5 Nothing contained in this Agreement shall create a contractual relationship with, or a cause of action in favor of, a third party against either the Owner or Architect.

§ 10.6 Unless otherwise required in this Agreement, the Architect shall have no responsibility for the discovery, presence, handling, removal or disposal of, or exposure of persons to, hazardous materials or toxic substances in any form at the Project site.

§ 10.7 The Architect shall have the right to include photographic or artistic representations of the design of the Project among the Architect's promotional and professional materials. The Architect shall be given reasonable access to the completed Project to make such representations. However, the Architect's materials shall not include the Owner's confidential or

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proprietary information if the Owner has previously advised the Architect in writing of the specific information considered by the Owner to be confidential or proprietary. The Owner shall provide professional credit for the Architect in the Owner's promotional materials for the Project. This Section 10.7 shall survive the termination of this Agreement unless the Owner terminates this Agreement for cause pursuant to Section 9.4.

§ 10.8 If the Architect or Owner receives information specifically designated as "confidential" or "business proprietary," the receiving party shall keep such information strictly confidential and shall not disclose it to any other person except as set forth in Section 10.8.1. This Section 10.8 shall survive the termination of this Agreement.

§ 10.8.1 The receiving party may disclose "confidential" or "business proprietary" information after 7 days' notice to the other party, when required by law, arbitrator's order, or court order, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or to the extent such information is reasonably necessary for the receiving party to defend itself in any dispute. The receiving party may also disclose such information to its employees, consultants, or contractors in order to perform services or work solely and exclusively for the Project, provided those employees, consultants and contractors are subject to the restrictions on the disclosure and use of such information as set forth in this Section 10.8.

§ 10.9 The invalidity of any provision of the Agreement shall not invalidate the Agreement or its remaining provisions. If it is determined that any provision of the Agreement violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Agreement shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Agreement.

ARTICLE 11 COMPENSATION

§ 11.1 For the Architect's Basic Services described under Article 3, the Owner shall compensate the Architect as follows:

.1 Stipulated Sum
(Insert amount)

.2 Percentage Basis
(Insert percentage value)

( ) % of the Owner's budget for the Cost of the Work, as calculated in accordance with Section 11.6.

.3 Other
(Describe the method of compensation)

§ 11.2 For the Architect's Supplemental Services designated in Section 4.1.1 and for any Sustainability Services required pursuant to Section 4.1.3, the Owner shall compensate the Architect as follows:
(Insert amount of, or basis for, compensation. If necessary, list specific services to which particular methods of compensation apply.)

§ 11.3 For Additional Services that may arise during the course of the Project, including those under Section 4.2, the Owner shall compensate the Architect as follows:
(Insert amount of, or basis for, compensation.)

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§ 11.4 Compensation for Supplemental and Additional Services of the Architect's consultants when not included in Section 11.2 or 11.3, shall be the amount invoiced to the Architect plus percent (%), or as follows:
(Insert amount of, or basis for computing, Architect's consultants' compensation for Supplemental or Additional Services.)

§ 11.5 When compensation for Basic Services is based on a stipulated sum or a percentage basis, the proportion of compensation for each phase of services shall be as follows:

Schematic Design Phase	percent (	%)
Design Development Phase	percent (	%)
Construction Documents Phase	percent (	%)
Procurement Phase	percent (	%)
Construction Phase	percent (	%)
Total Basic Compensation	one hundred percent	(100.00 %)

§ 11.6 When compensation identified in Section 11.1 is on a percentage basis, progress payments for each phase of Basic Services shall be calculated by multiplying the percentages identified in this Article by the Owner's most recent budget for the Cost of the Work. Compensation paid in previous progress payments shall not be adjusted based on subsequent updates to the Owner's budget for the Cost of the Work.

§ 11.6.1 When compensation is on a percentage basis and any portions of the Project are deleted or otherwise not constructed, compensation for those portions of the Project shall be payable to the extent services are performed on those portions. The Architect shall be entitled to compensation in accordance with this Agreement for all services performed whether or not the Construction Phase is commenced.

§ 11.7 The hourly billing rates for services of the Architect and the Architect's consultants are set forth below. The rates shall be adjusted in accordance with the Architect's and Architect's consultants' normal review practices.
(If applicable, attach an exhibit of hourly billing rates or insert them below.)

Employee or Category	Rate ($0.00)

§ 11.8 Compensation for Reimbursable Expenses
§ 11.8.1 Reimbursable Expenses are in addition to compensation for Basic, Supplemental, and Additional Services and include expenses incurred by the Architect and the Architect's consultants directly related to the Project, as follows:

.1 Transportation and authorized out-of-town travel and subsistence;
.2 Long distance services, dedicated data and communication services, teleconferences, Project web sites, and extranets;
.3 Permitting and other fees required by authorities having jurisdiction over the Project;
.4 Printing, reproductions, plots, and standard form documents;
.5 Postage, handling, and delivery;
.6 Expense of overtime work requiring higher than regular rates, if authorized in advance by the Owner;
.7 Renderings, physical models, mock-ups, professional photography, and presentation materials requested by the Owner or required for the Project;
.8 If required by the Owner, and with the Owner's prior written approval, the Architect's consultants' expenses of professional liability insurance dedicated exclusively to this Project, or the expense of additional insurance coverage or limits in excess of that normally maintained by the Architect's consultants;
.9 All taxes levied on professional services and on reimbursable expenses;
.10 Site office expenses;
.11 Registration fees and any other fees charged by the Certifying Authority or by other entities as necessary to

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achieve the Sustainable Objective; and,

.12 Other similar Project-related expenditures.

§ 11.8.2 For Reimbursable Expenses the compensation shall be the expenses incurred by the Architect and the Architect's consultants plus percent (%) of the expenses incurred.

§ 11.9 Architect's Insurance. If the types and limits of coverage required in Section 2.5 are in addition to the types and limits the Architect normally maintains, the Owner shall pay the Architect for the additional costs incurred by the Architect for the additional coverages as set forth below:

(Insert the additional coverages the Architect is required to obtain in order to satisfy the requirements set forth in Section 2.5, and for which the Owner shall reimburse the Architect.)

§ 11.10 Payments to the Architect

§ 11.10.1 Initial Payments

§ 11.10.1.1 An initial payment of ($) shall be made upon execution of this Agreement and is the minimum payment under this Agreement. It shall be credited to the Owner's account in the final invoice.

§ 11.10.1.2 If a Sustainability Certification is part of the Sustainable Objective, an initial payment to the Architect of ($) shall be made upon execution of this Agreement for registration fees and other fees payable to the Certifying Authority and necessary to achieve the Sustainability Certification. The Architect's payments to the Certifying Authority shall be credited to the Owner's account at the time the expense is incurred.

§ 11.10.2 Progress Payments

§ 11.10.2.1 Unless otherwise agreed, payments for services shall be made monthly in proportion to services performed. Payments are due and payable upon presentation of the Architect's invoice. Amounts unpaid ( ) days after the invoice date shall bear interest at the rate entered below, or in the absence thereof at the legal rate prevailing from time to time at the principal place of business of the Architect.

(Insert rate of monthly or annual interest agreed upon.)

%

§ 11.10.2.2 The Owner shall not withhold amounts from the Architect's compensation to impose a penalty or liquidated damages on the Architect, or to offset sums requested by or paid to contractors for the cost of changes in the Work, unless the Architect agrees or has been found liable for the amounts in a binding dispute resolution proceeding.

§ 11.10.2.3 Records of Reimbursable Expenses, expenses pertaining to Supplemental and Additional Services, and services performed on the basis of hourly rates shall be available to the Owner at mutually convenient times.

ARTICLE 12 SPECIAL TERMS AND CONDITIONS

Special terms and conditions that modify this Agreement are as follows:

(Include other terms and conditions applicable to this Agreement.)

ARTICLE 13 SCOPE OF THE AGREEMENT

§ 13.1 This Agreement represents the entire and integrated agreement between the Owner and the Architect and supersedes all prior negotiations, representations or agreements, either written or oral. This Agreement may be amended only by written instrument signed by both the Owner and Architect.

§ 13.2 This Agreement is comprised of the following documents identified below:

.1 AIA Document B101™–2017, Standard Form Agreement Between Owner and Architect

.2 Building Information Modeling Exhibit, if completed:

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.3 Exhibits:
(Check the appropriate box for any exhibits incorporated into this Agreement.)

[ ] AIA Document E204™–2017, Sustainable Projects Exhibit, dated as indicated below:
(Insert the date of the E204-2017 incorporated into this agreement.)

[ ] Other Exhibits incorporated into this Agreement:
(Clearly identify any other exhibits incorporated into this Agreement, including any exhibits and scopes of services identified as exhibits in Section 4.1.2.)

.4 Other documents:
(List other documents, if any, forming part of the Agreement.)

This Agreement entered into as of the day and year first written above.

OWNER *(Signature)*	**ARCHITECT** *(Signature)*
(Printed name and title)	*(Printed name, title, and license number, if required)*

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