

Montgomery County Public Schools Facilities Guide
DIVISION 15 – MECHANICAL

SECTION 15000 MECHANICAL SYSTEMS GENERAL

PART 1 – GENERAL

1.1 SCOPE:

- A. The fundamental objective of these guidelines is to document standards for the design of mechanical systems for Montgomery County Public Schools (MCPS) educational facilities.
- B. These design guidelines are intended to provide the basis for the mechanical system conceptual design and are not intended to relieve the engineer of the responsibility to ensure that the equipment or systems design meets all applicable codes and accepted practices or engineering principles.
- C. This document reflects general design guidelines and product specifications for mechanical sub-systems included in recently completed facilities. The design guidelines reflect the recommended conditions or approach by MCPS for consistency and ease of maintenance. The specifications following each set of design guidelines provide general characteristics of major components and preferred products by brand name or vendor.
- D. Designers are requested to provide feedback comments to MCPS concerning the applicability of these guidelines. Address comments or questions to Division of Construction, Montgomery County Public Schools, 2096 Gaither Road, Suite 200, Rockville, Maryland 20850, Phone 240-314-1000.

1.2 PERMITS, CODES & STANDARDS:

- A. All work and material must incorporate applicable sections and conform to the most recent edition of the following partial list of standards, in addition to all other applicable local State and National codes:

AABC	Associated Air Balance Council
AGA	American Gas Associates
AMCA	Air Movement & Control Association
ANSI	American National Standards Institute
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating Refrigerating and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASTM	American Society for Testing and Materials
ICC	International Code Council
MSDE	MD, State Department of Education, Facilities Design Guide
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NFPA	National Fire Protection Association
NIST	National Institute of Standards & Technology
SMACNA	Sheet Metal & Air Conditioning Contractors National Associates
U.L.	Underwriters Laboratory
WSSC	Washington Suburban Sanitary Commission

- B. Applicable energy conservation forms, submittals, codes, and standards; latest editions or most recent standard:
 - 1. Procedures for Energy Conservation MCPS, Department of Facilities Management, provided on the MCPS Green Building homepage.
 - 2. ANSI Standard S12.60 American National Standard Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools.
 - 3. ASHRAE 52.2 Filter Media Rating
 - 4. ASHRAE 55 Thermal Environmental Conditions for Human Occupancy

5. ASHRAE 62.1 Ventilation for Acceptable Indoor Air Quality
6. ASHRAE's standard 90.1 - Energy Efficient Design of New Building, HVAC System Criteria, Energy Efficiency and Controls, the mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4) without amendments and the prescriptive requirements (Sections 5.5, 6.5, 7.5 and 9.5) or performance requirements (Section 11) without amendments.
7. ASHRAE's Advanced Energy Design Guide for K-12 Schools.
8. International Mechanical Code
9. Maryland State Department of Education, Public School Construction Program, Energy Use Performance Indices and DGS Energy Conservation Guidelines.
10. U.S. Green Building Council LEED for Schools
11. Schematic phase submittals of proposed energy conservation strategies must be made for specific requirements. (See SECTION 15001).
12. Design Development submittals shall include the energy analysis report and energy conservation summary form in accordance with SECTION 15001.
13. A copy of the Energy Budget Certification of Compliance (See SECTION 15001) must be signed and sealed by a professional engineer as part of the final submittals. If calculated energy use exceeds the energy budget, a waiver shall be filed.

PART 2 - PRODUCTS (not used)

PART 3 – EXECUTION

3.1 USE OF THIS DOCUMENT

- A. These guidelines are provided to architects/engineers at the beginning of a project to be used as standards for preferred systems, to enhance the quality of the facilities design and to establish standard design criteria for mechanical systems, equipment and methods
- B. The guidelines are to provide design guidance to architects and engineers on the technical aspect of the project development and design efforts.
- C. These standards are not intended as a project specification or to preclude the application of sound engineering judgment and practices in integrating the various aspects of the project. Also this publication is not intended as a substitute to meet codes, and standards, or other requirements applicable in Montgomery County and the State of Maryland.

3.2 LIFE CYCLE COST ANALYSIS (LCCA)

- A. Objectives:
 1. The purpose of an LCCA is to estimate the overall costs of project alternatives and to select the design that ensures the school facility will provide the lowest overall cost of ownership consistent with its quality and function. The greatest emphasis will be placed on this evaluation in lieu of MCPS preferred systems. The LCCA should be performed during the schematic phase and presented at the Pre-Design Development meeting to enable adequate time for refining the design and subsequently ensuring a reduction in life-cycle costs (LCC).
- B. Input Parameters:
 1. Each analysis should be based on three to four system scenarios. Depending on the application these scenarios may include: geexchange, four-pipe distribution, conventional water-source, AHU single zone and VAV, air-cooled split and packaged equipment, etc.
 2. Present-Value economic parameters and energy costs shall be provided by MCPS at the time the study.
 3. Acceptable LCCA-related programs include: BLCC (NIST); ECONPACK; Energy-10; SuccessEstimator.

3.3 ENERGY CONSERVATION

A. Objectives:

1. To comply with all applicable codes and standards for energy efficiency in design of school buildings, as mandated by Montgomery County, Montgomery County Board of Education Energy Policy, BOE Policy On Energy Conservation, MCPS Electricity Guidelines, MCPS Heating Guidelines, MCPS Food Preparation Guidelines and MCPS Water Use Guidelines and the State of Maryland Guidelines. The MCPS Policies and Guidelines are posted on the schools systems website at www.mcps.k12.md.us.
2. To design and construct school facilities that meet or exceed defined performance levels for energy efficiency and optimal life cycle costs.
3. To encourage the project architect and engineers to use of high efficiency equipment.

B. Energy Use Performance Indices: The Energy Use Performance Indices (Energy budget) for MCPS elementary and secondary schools are as follows

1. New Construction/Addition (Totaling 10,000 sq. ft. or more)
 - a. The energy use performance index for a typical new project is 45,000 Btu/gsf/yr. Achieving this goal after completion of this project is a key design objective. In general, the hours of school operation are assumed to be 200 days at 10 hours/day or 2000 hours/year. School operation includes board of education use and non-board of education use.
 - b. If the hours of operation differ from above, the Project Manager (with Energy Management) will provide estimated hours of operation and the assigned energy use performance index for the school.
2. Major Renovation: The Project Manager (with Energy Management) will provide the average energy consumed by School in the last three years, the energy use budget, and the estimated hours of school operation for school and community use. The energy use goal is to reduce energy consumption by minimum of 30%. Achieving this goal after completion of the project is a key design objective.

C. General Energy Conservation Guidelines:

1. The design engineer shall specify high efficient equipment, i.e. chillers, boilers, motors, controls, etc. per latest edition of ASHRAE 90.1, efficiency levels section.
2. Architecturally
 - a. The use of skylights, tall storefront windows, and high ceiling areas are discouraged. Installation of high fixed windows or light monitors in gymnasiums are to be considered for source of lighting.
 - b. Building envelope shall comply with latest edition of ASHRAE 90.1 and/or IECC Code requirements, which ever is more stringent.
 - c. All exterior glass shall be of low-E double glazing, National Fenestration Rating Council (NFRC) certified U-Value of 0.38 according to Montgomery County Energy Design Guidelines.

3.4 GENERAL HVAC DESIGN PARAMETERS

A. Occupancies:

1. Classrooms: Consultants are directed to utilize Montgomery County Board of Education guidelines for assigning number of occupants to each design space. The program function of each designed classroom is subject to change throughout the life of the school, therefore consultants are directed to design to the largest number of occupants that could potentially utilize the space. Example: Secondary English is capped at 28, while all other Secondary classes are capped at 32; therefore the design consultant would design all Secondary classrooms to accommodate 32 students plus one teacher. The below table indicates the number of students capped by the Board of Education and the number of students and teacher utilized by consultants for corresponding grade levels:

Grade	No. of Students BOE Cap	Design Occupancy
Kindergarten	25	27
1-3	26	31
4-5	28	31
Secondary English	28	33
Secondary Others	32	33

2. Multi-Use Assembly / Auditorium: Occupancy for assembly areas are based on actual seating capacity indicated by Architect.
 3. Gymnasium: Occupancy for gymnasium areas is based on typical athletic events at a density of 30 ppl per 1,000 sq ft of floor area or as indicated by Architect.
 3. Unknown Occupancy: For spaces with unknown occupancies, utilize the default occupancy density listed in Table 6-1 of ASHRAE Standard 62.1-2004 (or latest edition) and/or estimate based on averaging approach described in Section 6.2.6.2 of this same standard.
- B. Occupancy Schedules: Typical occupancy occurrence relative to the percentage of annual hours of operation (Energy use Indices) for analysis of energy conservation and annual building energy simulations shall be as follows:

Percent of Total Occupancy	Annual hours of operation	Operating Hours	Time of Year
100	1,600	7 am to 3 pm	08/25 thru 06/15
50	630	6 am to 7 am - 3 pm to 5 pm	08/18 thru 06/22
25	420	5 am to 6 am - 5 pm to 6 pm	08/25 thru 06/15
25	400	8 am to 5 pm	06/22 thru 08/18

C. Ventilation Rates:

1. Unless further guidance is given, engineers are directed to design each ventilation system utilizing the ASHRAE Standard 62.1 Ventilation Rate Procedure. Occupancy densities are indicated in Section 15000-3.3.A of this Guideline.
2. Toilet rooms shall be exhausted at the rate of 125 CFM per water closet, urinal.
3. Single-zone assembly areas and gymnasiums shall utilize demand control ventilation (DCV) practices with the use of CO₂ for proportional control.
4. Non-air conditioned Gyms shall be provided with 6 air changes per hour through H&V units and 12 air changes per hour through supplemental ventilators for summer ventilation.
5. Short-Term Conditions: If it is known that peak occupancy will be of a short duration and/or ventilation will be varied or interrupted for a short time the designer shall comply with ASHRAE Standard 62.1 Section 6.2.6.2.

D. Design conditions:

1. Summer:
 - Outdoor: 95°Fdb, 78°Fwb and 80°Fwb for evaporating equipment.
 - Indoor: 76°Fdb, 50% RH.
2. Winter:

Outdoor: 10°Fdb

Indoor: 70°Fdb

Annual heating degree days: 5,000

- E. Seasonal Equipment Operations: MCPS facilities seasonal heating and cooling operating schedule for central plant equipment are as follows:
1. Boilers:
 - a. Larger boilers (e.g. fire tube): October through April
 - b. Small boilers dedicated to summer reheat: April through October
 - c. Modular, condensing boiler systems: Year round availability
 2. Chillers:
 - a. Water Cooled: May through September
 - b. Air Cooled:
 - 1) 2-pipe systems: May through September
 - 2) 4-pipe systems: Year round availability
 3. Cooling Towers:
 - a. Associated with chillers: May through September
 - b. Associated with water source heat pumps: Year round availability

3.5 GENERAL HVAC SYSTEMS DESCRIPTIONS

- A. The preferred HVAC system design is dedicated outdoor air systems for providing ventilation air (decoupled from comfort control equipment) and water source heat pumps for spatial temperature control.
- B. Water Source Heat pump systems can be geothermal systems or conventional cooling tower and boiler systems as guided by energy analyses, life cycle costs, and other considerations.
- C. Heat pumps shall be predominantly vertical ducted units located in mechanical rooms/closets; console units may be employed for offices and similar, small non-educational spaces.
- D. Dedicated Outdoor Air Systems (DOAS) solely providing ventilation air shall be 100% outdoor air units controlled to maintain constant discharge air conditions.
- E. Water-cooled heat pump rooftop units (RTU) or water-cooled energy recovery units (ERU) shall be employed for comfort control and ventilation for spaces subject to high occupancy variances (i.e. Gyms, Multi-Purpose Rooms, Cafeteria, Auditorium, etc.). The use of demand control ventilation and/or energy recovery shall be utilized to meet energy conservation requirements; the primary control shall maintain space temperature.
- F. General building exhaust air shall predominantly be thru DOAS supplemented by task specific exhaust fans.
- G. Systems control is predominantly via direct digital controls with the building automation system providing energy management routines. Local electric controls are employed for such systems as unit heaters, thermostatically controlled exhaust fans, split system air conditioning units.
- H. Chilled/heating water systems, 2 and 4 pipe, may be required as extensions of existing systems for building additions as determined during design development analysis.
- I. More specific system, equipment, and control descriptions are provided in subsequent sections of this Guideline.

3.6 GENERAL PLUMBING SYSTEMS DESCRIPTIONS: Systems design shall provide:

- A. Waste, vent and sanitary sewer system, domestic cold and hot water supply system and all fixtures, equipment, accessories and appurtenances.

- B. Gas service, where sufficient gas service is available from the local utility.
 - C. Coordinated connections to and installation of appliances, fixtures, fittings, etc. provided by other professional disciplines such as laboratory furnishings and food service equipment.
- 3.7 GENERAL FIRE PROTECTION SYSTEMS DESCRIPTIONS
- A. Automatic sprinkler system is to be provided in all new, modernization, and large additions to school buildings according to the latest edition of NFPA-13 and all applicable local fire codes, zoning, and fire alarm systems.
 - B. The fully automatic sprinkler shall be of wet pipe type in the inside of the building and dry type where exposed to the outside.
 - C. The fire protection engineer shall specify and design the components of the sprinkler system, pumps, back-flow preventer etc.; however, the final design and sizes of the pipes, pumps, and location of the sprinkler heads shall be done by the sprinkler contractor and approved by the fire marshal of the Montgomery County following MCPS review.
 - D. The plumbing contractor is responsible for installation of back-flow preventer; sprinkler contractor is responsible for the sprinkler system starting at the outlet end of back-flow preventer.
- 3.8 GREEN BUILDING: Systems designs shall be responsive to prerequisites and credits sought for projects pursuing certification by the US Green Building Council LEED Green Building Rating System for Schools. Projects not pursuing certification shall be designed with energy goals and sustainability sympathetic to LEED requirements. In addition to satisfying all LEED Prerequisites for projects pursuing certification, the following Point Credits are to be assessed:
- A. Water Efficiency Credit 3: Water Use Reduction. Use of low flow plumbing fixtures, dual flush valves and waterless urinals.
 - B. Energy & Atmosphere Credit 1: Optimize Energy Performance. Minimum of 30% Energy Reduction for New Construction and Modernizations. Use Energy Star Target Finder for minimum project score of 75.
 - C. Energy & Atmosphere Credit 3: Enhanced Commissioning
 - D. Energy & Atmosphere Credit 4: Enhanced Refrigerant Management
 - E. Energy & Atmosphere Credit 6: Green Power.
 - F. Indoor Environmental Quality Credit 3.1: Construction IAQ Management Plan During Construction
 - G. Indoor Environmental Quality Credit 3.2: Construction IAQ Management Plan Before Occupancy.
 - H. Indoor Environmental Quality Credit 4: Low-Emitting Materials Paints. Adhesives, insulation and sealant of all mechanical equipment and ductwork need to meet VOC and formaldehyde standards.
 - I. Indoor Environmental Quality Credit 6.2: Thermal Comfort Controllability
 - J. Indoor Environmental Quality Credit 7.1: Thermal Comfort-Design
 - K. Indoor Environmental Quality Credit 7.2: Thermal Comfort-Verification

END OF SECTION