

*Montgomery County Public Schools*

DRAMA AND THEATER  
SAFETY HANDBOOK



Rockville, Maryland

March 2007

## Introduction

The Drama and Theater Safety guidelines were developed to promote safe, accident-free theatrical productions in the Montgomery County Public Schools (MCPS). They are based upon proper theatrical safety techniques and should be referred to frequently as a checklist for production safety. Applicable MCPS safety regulations and county fire and safety codes shall be followed. All theater sponsors and media services technicians are required to be familiar with the contents of this handbook and to follow all safety guidelines and regulations. Throughout the handbook, the term *sponsor* refers jointly to all adult theater staff responsible for a production, including, but not limited to, the drama director, technical director, choreographer, and stage director. A media services technician may be designated as a technical director.

Each year, prior to production work, the theater sponsor shall conduct appropriate safety training sessions for students who plan to participate in set design, construction, lighting design, and other related technical theater activities. Students shall obtain parental permission to participate in safety training prior to any production work.

For questions regarding safety, contact Ms. Pamela Montgomery, safety supervisor, Department of Facilities Management, at 240-314-1070. Contact Ms. Helen Smith, coordinator of secondary art, theater, and dance, Department of Curriculum and Instruction, at 301-279-3834, or Ms. Gail Bailey, director, School Library Media Programs, at 301-279-3215, for help with all other related drama/theater questions.

By using these guidelines and being familiar with the MCPS safety regulations and county fire and safety codes, theater sponsors and students will be encouraged to present drama productions that are artistic, enjoyable, and as safe as possible for everyone involved. All theater sponsors and media services technicians shall review this document at the beginning of each school year and prior to any theatrical production.

We give special thanks to Fairfax County Public Schools for the use of their student licensure components (tests) within this handbook.



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# MCPS Drama and Theater Safety Handbook

## I. General Safety Responsibilities

- A. Students working on technical crews and those rehearsing or performing in the auditorium shall be under the direct supervision of a theater sponsor.
- B. General stage safety rules shall be posted backstage in prominent locations.
- C. Theater sponsors shall monitor student health and safety, and have health considerations (i.e., allergies, diabetic conditions, etc.) on record in the theater office.
- D. The theater sponsor or media services technician (MST) shall notify the Montgomery County fire marshal's office for approval of set and performance conditions at least 10 days in advance of the first performance. The Montgomery County fire marshall can be reached at 240-777-2457.
- E. Theater sponsors shall ensure that crewmembers are familiar with the location and operation of each type of fire extinguisher, fire curtain, and/or smoke doors. IN THE EVENT OF A FIRE, SECURE AN OUTSIDE LINE, CALL 911, AND EVACUATE THE BUILDING IMMEDIATELY.
- F. Work gloves, individual sanitized safety goggles, and hard hats shall be available when required for theater sponsors, students, and MSTs and shall be used in accordance with applicable safety regulations and guidelines.
- G. Theater sponsors shall promptly report all accidents to the administration. Emergency numbers must be posted and a phone must be accessible *at all times*.
- H. Smoking is prohibited on school property or in any school facility, regardless of the age or status of the individual.
- I. In compliance with the SEIU Local 500 contract, Article 22, page 59 (item B), an adult observer must be present when MSTs are required to perform duties in high places. The observer shall wear a hard hat and watch from the auditorium floor in close proximity to the MST. The observer shall call 911 (secure an outside line) in case of an emergency and notify a school administrator.
- J. An adult observer must be present when the technical director and trained students are on the catwalk.

## II. Student Training

- A. Sponsors shall select crewmembers based on their demonstrated dependability and responsibility.

- B. Only students and staff associated with the production shall be permitted backstage during rehearsals and performances.
- C. Students shall obtain parental permission to train for backstage work (see Appendix A). All students interested in working on set construction, lighting, sound, or special effects shall successfully complete a safety-training program conducted by the drama director. The areas of safety training will include, but are not limited to, the following:
  - 1. General stage safety required of any crewmember
  - 2. The use and care of lighting and audio equipment
  - 3. Safe operation of all permanently installed theatrical equipment
  - 4. Set construction safety, scaffolds, ladders, and winches/battens
  - 5. Power tool safety
  - 6. The fly system
  - 7. Catwalks
- D. Upon completion of the appropriate training, students will be issued a Technical Crew Authorization Card (see Appendix B), which will qualify them to work on those crews for which they have been trained—while under the direct supervision of the theater sponsor. A copy of this card will be on file with the theater sponsor.
- E. Students are not permitted on catwalks unless the technical director is present on the catwalk with the student, and an adult observer is present on the floor in close proximity to the catwalk.

### **III. Stage Storage and General Housekeeping**

- A. Stage space behind the proscenium shall not be used for the storage of any equipment other than that necessary for stage utilization. Unobstructed access to fire extinguishers, emergency exits, and the fire curtain must be maintained (see Montgomery County Fire Code Chapter 22).
- B. Backstage spaces shall be kept cleaned and organized at all times. Dispose of all trash and lumber scraps after each work session.
- C. Crewmembers are required to sweep the stage after construction work has taken place and before students are permitted to use it for rehearsal or performance.
- D. Proper ventilation and frequent damp mopping of the stage and construction areas are required in order to reduce dust accumulations.
- E. Sponsors will store and lock all stage equipment, scaffolding, ladders, and tools used by crews *immediately after use*.

- F. The theater sponsor or MST must secure the projection booth, catwalks, and all storage areas prior to leaving the auditorium.
- G. A first aid kit shall be located within easy access of work areas.
- H. Sponsors shall perform a safety inspection of all tools and equipment before use.
- I. Costumes shall be hung in a well-ventilated, cool, dry area that is cleaned regularly. Costumes, wigs, hats, etc., should be cleaned before reuse.
- J. Costumes shall be made from fire-retardant materials whenever possible. Untreated paper products are not permitted to be used for costumes or for accessories (refer to MCPS Regulation EBA-RA, *Fire Safety*).
- K. Temporary dressing rooms and makeup areas shall be large enough to accommodate cast members safely and comfortably and shall have sufficient light and exits.
- L. Any area in which scene construction takes place shall be sufficiently lighted, particularly those areas where power tools are used.

#### **IV. Catwalks and Fly Systems**

- A. Access to the catwalks shall be secured at all times.
- B. Access to the catwalks shall be limited to the MST, technical director, and trained students under the direct supervision of the technical director. The technical director must be present on the catwalk when students are on the catwalk at all times (an adult observer must also be present on the auditorium floor in close proximity to the catwalk). MSTs must have an adult observer present when MSTs are on the catwalks at all times.
- C. Technical director, MSTs, and students working on the catwalks shall wear non-slip shoes and avoid wearing loose clothing. Tools or other objects shall be secured to their persons with tag lines. All items shall be removed from these areas and properly stored when the work is completed. At no time shall a student be on a catwalk without a technical director on the catwalk and an adult observer present.
- D. At no time shall body weight be permitted on the ceiling panels.
- E. All catwalks shall be protected with guardrails, midrails, and standard toe boards (29CFR 1910.28 OSHA— refer to Appendix C).
- F. If catwalks are not available, the technical director, MSTs, and trained students under direct supervision of the technical director may only use approved scaffolding with braces and brakes (see Appendix C). An adult observer must be present when using scaffolding.



- G. Fly systems shall be regularly inspected (prior to use) and repaired as required. Use the maintenance work order system process.
- H. When flying scenery:
  - 1. Always clear the stage area below of people before loading weights.
  - 2. Load weight on the upper loading deck first (when one exists). When only bottom loading is possible, load half the required weights, raise them, and then hang the scenery. Next, raise the scenery and load the other half of the weights. Following this procedure will ensure that no line is ever more than half out of weight while loading.
  - 3. Secure scenery to the battens with trim chains or wire cable tested for adequate strength.
  - 4. Attach scenery to the batten first, then counterbalance with weights; remove weights before removing scenery.
  - 5. Check strength and distribution of cables carefully to avoid undue weight on any single cable.
  - 6. Assure that retaining bars are securely fastened on top of weights.
  - 7. Be alert to any indication of fouled rigging.

## **V. Electrical Systems and Booth**

- A. Students and sponsors are prohibited from making any alterations or repairs to permanent electrical systems. If alterations or repairs are necessary, the Division of Maintenance should be contacted. Students should not attempt to repair broken electrical, mechanical, or pneumatic instruments without prior adult approval. Lock-out and tag-out procedures must be followed in accordance with OSHA/MOSH safety regulations.
- B. Sponsors shall inspect all electric cords, cables, and power tools prior to use for frayed or damaged wiring and for needed repair or replacement. All lighting cables shall be made of 12-gauge wire, and all other cables shall be made of 14-gauge or heavier stranded wire; zip cord is not acceptable (see attached).
- C. All electrical equipment and all microphone cables must be properly grounded and double-insulated UL approved. No metal junction boxes on extension cords will be permitted. Metal junction boxes must be permanently affixed to a wall.
- D. Cables shall be stored, coiled, and racked in a safe place.

- E. Electrical cables shall be secured to floors or walls with gaffers tape.
- F. In traffic areas, cables shall be taped securely to the floor and covered with pieces of carpet. Power cords shall not be run under fixed carpet or under closed doors.
- G. All work lights shall be covered with wire shields.
- H. All lighting instruments shall be secured with safety chains, cables, or approved clamps.
- I. All lighting gels shall be approved for theatrical lighting and shall be securely installed.
- J. Auditorium house lights shall be maintained and replaced by building services staff.
- K. Technical directors, MSTs and students shall wear appropriate gloves when changing lamps. Instruments must be unplugged and allowed to cool before the lamp is changed.
- L. Technical directors and MSTs will inspect lighting rigs on a regular basis and report deficiencies to the school administration for appropriate action.
- M. New plugs, receptacles, or equipment should be UL approved and the proper type, size, and rating for theatrical use.
- N. Flammable materials, such as cardboard, tape, string, cloth, paper, rope, cellophane or plastic, shall not be used on or near any lighting instruments.
- O. Power tools, appliances, audio-visual equipment, or other inductive loads, shall not be plugged into a circuit controlled by a dimmer.
- P. Food and/or drinks are not permitted near or on the lighting or sound consoles.
- Q. Technical directors and/or MSTs must promptly report all hazards involving circuits, fusing, electrical cables, or equipment to school administrators, and close access to the area.
- R. Before leaving the auditorium after any rehearsal, performance, or crew work session, crew and sponsors shall turn off or disconnect all electrical circuits.

## **VI. Scenery and Construction**

- A. All set pieces, flats, floor coverings, and other scenic devices, including fabrics, must be flame proofed prior to production. Use either professional theatrical flame-proofing compound or the following method in a well-ventilated area:

1. Saturate material with a solution of 4 oz. boric acid, 9 oz. borax, and 1 oz. liquid detergent (wetting agent) to each gallon of water. Allow material to dry thoroughly.
  2. Iron or stretch material as needed.
  3. Note the date of flame proofing, materials used, and the person responsible. File the information with the school administration, the Division of Maintenance, and the theater sponsor.
  4. Test a small portion of the flame-proofed material outside the school building to be certain it is sufficiently safe.
- B. Flammable materials, such as paper streamers, corn shucks, or leaves, shall not be used for scenery. Refer to MCPS Regulation EBA-RA for a listing of prohibited materials.
- C. Open flame devices such as candles and torches are not permitted to be used at anytime (Montgomery County Fire Code).
- D. All platforms, stairs, or ramps must be constructed out of rigid and sound materials, firmly bolted together, and meet safety standards CFR 1910.28 (Appendix C).
- E. All scenery, flats, and large set pieces shall be rigidly anchored and braced.
- F. Sponsors shall supervise all student use of stepladders and shall use approved ladders and scaffolding, rather than crates, tables, or chairs (see Appendix C). Students shall be cautioned not to go higher than the second step from the top of any ladder, or against improvising any means of reaching greater height. Students are not permitted to carry unwieldy or loose objects up a ladder or scaffolding.
- G. When extension ladders are used, the sponsor shall make certain that the top rests against a solid wall and that the bottom of the ladder is sturdily set away from the wall at a distance of at least  $\frac{1}{4}$  the length of the ladder (1:4 ratio).
- H. Whenever a crewmember is working on a ladder, another student wearing a hard hat shall remain at the foot of the ladder to steady it and to direct traffic away from it.
- I. The use of glass is not permitted in set construction.
- J. Nails from loose lumber shall be promptly removed when striking the set.
- K. All crewmembers using power tools shall receive training in their safe operation.

## **VII. Pit Covers**

Pit Covers must be approved prior to their purchase and inspected after each installation and re-installation by the Division of Construction, Department of Facilities Management, 240-314-1000.

## **VIII. Performance and House Safety**

- A. All theater aisles shall be lighted and kept clear to a width of three feet. Inform the audience before the opening curtain either in writing, by announcement, or by display of the following:

“For your own safety, LOOK for your nearest EXIT.  
In case of emergency, WALK, do not run, to the nearest EXIT.”

And, “No smoking is allowed on school property”

Do not exceed posted capacity of the auditorium.

- B. In case of fire of any kind, the building shall be evacuated immediately, the pull station activated, and the fire department contacted (9-911). The building may not be reoccupied without the permission of the fire officer of the local fire department. Exit doors must not be chained and exit passageways must not be blocked at any time.
- C. Before any performance, the technical director shall inspect all scenery, fly systems, and lighting for safety and security. The technical director shall ensure that students handle all technical elements and equipment as planned and rehearsed. Any innovations or changes only shall be undertaken with the direct approval and supervision of the technical director.
- D. All backstage movement of cast and crew during a performance shall be planned carefully and rehearsed. The use of glow-in-the-dark tape to direct movement during blackouts is recommended.
- E. The safety of cast, crew, and audience shall be the major consideration in planning and executing any special effects on stage.
- F. The use of dry ice requires adequate ventilation, the use of heavy rubber gloves, and appropriate instruction in its safe and proper handling is required.
- G. Fireworks or firearms are prohibited. Blank or sealed-wired starter pistols can be used only with written permission from the school administration and shall be stored in a locked area before and after use. (See Regulation EBA-RA, *Fire Safety*)
- H. Only dulled, flexible, or tipped swords or knives should be used as props. They shall be stored in a locked cabinet or area before and after actual use.

- I. The use of stage combat requires thorough instruction and rehearsal. Securing parental permission is advised.

## **Basic Theater/Auditorium Safety Rules**

(Post prominently and distribute to all users.)

- **NO ADULT = NO ACTIVITY**
- **TECH LICENSE REQUIRED** for access to control booth, catwalk, or lofts. Use of ladders, scaffolds, and powered personnel lifts is also restricted.
- **TECH LICENSE REQUIRED** to operate lights, sound, or rigging equipment. Use of set construction tools also is restricted.
- **NO LIQUIDS NEAR SOUND, LIGHT, OR ELECTRICAL EQUIPMENT.** No food or drink in the booth, carpeted areas, or near floor outlets.
- **KEEP ALL EXIT ROUTES CLEAR. FIRE?** Sound Alarm. EXIT. Then, report it (9-911). **DO NOT FIGHT THE FIRE!** Keep curtains a safe distance from lighting instruments.
- **REPORT** lost, broken, or malfunctioning items to adult supervisor/administrator. Do not use items that do not work properly. Tag with description.
- **STAY ALERT** to problems with curtains, cables, and equipment nearby.
- **NO “HORSEPLAY.”** Do not run, walk on house seats or go barefoot. Never throw anything from the booth or catwalk. Use tools properly.
- **LEAVING? LOCK UP!** Clean up after yourself. Check lost and found. Find a building service worker to assist locking up, if necessary. Leave things tidy and safe.
- **LEARN THE RULES.** Become familiar with the *MCPS Drama and Theater Safety Handbook*.



**THEATER SAFETY  
12-POINT WALK-THROUGH INSPECTION**

School: \_\_\_\_\_

Date: \_\_\_\_\_ Time: \_\_\_\_\_

Drama Director: \_\_\_\_\_

- | YES | NO  |   |
|-----|-----|---|
| ___ | ___ | 1. Auditorium doors are properly secured (if unoccupied).                       |
| ___ | ___ | 2. Control booth is properly secured.   |
| ___ | ___ | 3. Access to catwalk is properly secured.                                       |
| ___ | ___ | 4. Aisles are clear of obstructions and trip hazards.                           |
| ___ | ___ | 5. Exits are accessible; signs are illuminated.                                 |
| ___ | ___ | 6. Panic bars for all doors function properly.                                  |
| ___ | ___ | 7. Panic buttons for houselights function properly.                             |
| ___ | ___ | 8. Fire extinguishers are accessible and in working order.                      |
| ___ | ___ | 9. Work lights on stage function properly.                                      |
| ___ | ___ | 10. Stage equipment is properly stored.   |
| ___ | ___ | 11. Trash cans are properly used and emptied when necessary.                    |
| ___ | ___ | 12. Dressing rooms are clean and orderly.                                       |
| ___ | ___ | 13. The Division of Construction has inspected Pit covers prior to each set up. |

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

The information contained in this *Drama and Theater Safety Handbook* was obtained from sources believed to be reliable. It cannot be assumed that every acceptable fixed safety procedure is contained herein. Further, abnormal or unusual circumstances may warrant or require further or additional procedures.





**Appendix A**  
**Sample Letter for Securing Parental Permission**  
**For Student Stage Crew Training**

Dear Parents/Guardians:

Many students have an interest in technical theater and are members of backstage technical crews during rehearsals, performances, and strikes. This backstage work is an enjoyable and exciting part of the theatrical experience. Students have an opportunity to use complicated and expensive equipment that requires careful and responsible operation to create pleasing and safe theatrical effects.

Students who elect to work on technical crews are trained in the safe operation of all equipment and facilities to be used. They are guided by student crew heads that have had prior experience and are supervised by faculty members with expertise in these areas.

Your son/daughter has expressed an interest in technical theater work and has applied to be a member of a crew for this year. In order for him/her to be trained for participation, parental permission must be obtained. Please discuss with him/her the sense of responsibility that goes with such work in terms of commitment, safety, and keeping up with schoolwork. If you approve of your child's participation, please fill out and return the permission form below.

Please feel free to contact any of us if you wish further information or if you have questions or concerns.

Sincerely,

Drama Director

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\_\_\_\_\_ has my permission to participate in the training program to become an active member of a backstage technical crew. I understand that he/she will be trained in the operation of all equipment and will be responsibly guided by an adult at all times. I further understand that logical and prescribed safety regulations will be responsibly met. He/she may at times work with lighting instruments in the catwalk areas above the stage or house (with the technical director present at all times) and may operate power tools for scenery construction under proper supervision and after proper training.

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Parent or Guardian Signature

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(Date)

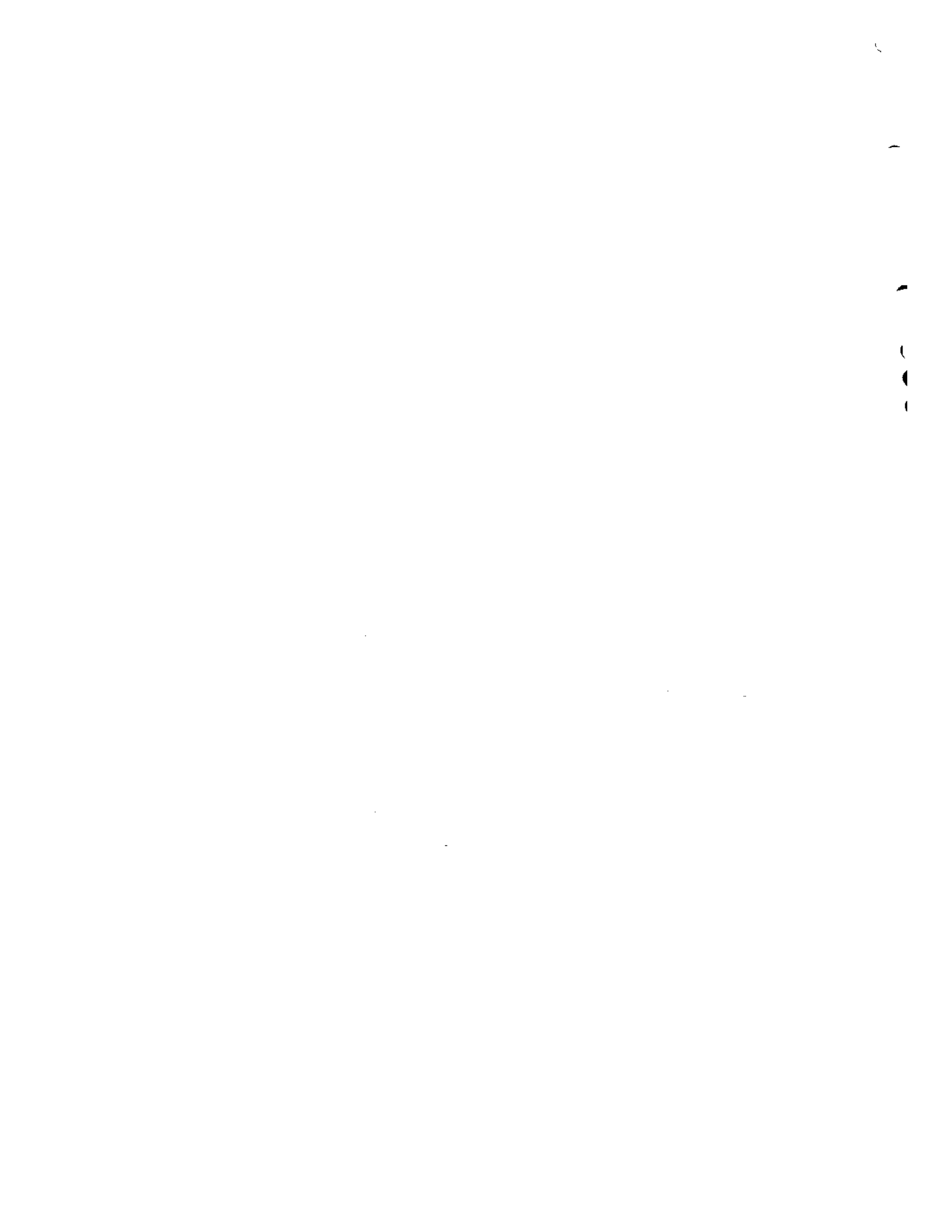


## Appendix B

<b>Technical Crew Training Authorization Card</b>	
<b>Licensure Level _____</b>	
_____ has undergone safety training and is authorized to participate in backstage technical work. He/she has completed specialized training in:	
<input type="checkbox"/> Lighting Equipment	
<input type="checkbox"/> Audio Equipment	
<input type="checkbox"/> Catwalks	
<b>Set Construction:</b>	
<input type="checkbox"/> Scaffolds	
<input type="checkbox"/> Ladders	
<input type="checkbox"/> Power Tools	
<input type="checkbox"/> Winch/Batten/Fly System	
_____	_____
Drama Director's Signature	(Date)
_____	_____
Technical Director's Signature	(Date)
<b>This card must be carried at all times.</b>	




**Appendix C**  
**OSHA Scaffolding Standard**



Regulations (Standards - 29 CFR)  
**Safety requirements for scaffolding. - 1910.28**

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 [Regulations \(Standards - 29 CFR\) - Table of Contents](#)

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● <b>Part Number:</b>	1910
● <b>Part Title:</b>	Occupational Safety and Health Standards
● <b>Subpart:</b>	D
● <b>Subpart Title:</b>	Walking-Working Surfaces
● <b>Standard Number:</b>	1910.28
● <b>Title:</b>	Safety requirements for scaffolding.

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1910.28(a)

"General requirements for all scaffolds."

1910.28(a)(1)

Scaffolds shall be furnished and erected in accordance with this standard for persons engaged in work that cannot be done safely from the ground or from solid construction, except that ladders used for such work shall conform to 1910.25 and 1910.26.

1910.28(a)(2)

The footing or anchorage for scaffolds shall be sound, rigid, and capable of carrying the maximum intended load without settling or displacement. Unstable objects such as barrels, boxes, loose brick, or concrete blocks shall not be used to support scaffolds or planks.

1910.28(a)(3)

[Reserved]

1910.28(a)(4)

Scaffolds and their components shall be capable of supporting without failure at least four times the maximum intended load.

1910.28(a)(5)

Scaffolds and other devices mentioned or described in this section shall be maintained in safe condition. Scaffolds shall not be altered or moved horizontally while they are in use or occupied.

..1910.28(a)(6)

1910.28(a)(6)

Any scaffold damaged or weakened from any cause shall be immediately repaired and shall not be used until repairs have been completed.

1910.28(a)(7)



Scaffolds shall not be loaded in excess of the working load for which they are intended.

**1910.28(a)(8)**

All load-carrying timber members of scaffold framing shall be a minimum of 1,500 f. (Stress Grade) construction grade lumber. All dimensions are nominal sizes as provided in the American Lumber Standards, except that where rough sizes are noted, only rough and undressed lumber or the size specified will satisfy minimum requirements. (Note: Where nominal sizes of lumber are used in place of rough sizes, the nominal size lumber shall be such as to provide equivalent strength to that specified in tables D-7 through D-12 and D-16.

**1910.28(a)(9)**

All planking shall be Scaffold Grade as recognized by grading rules for the species of wood used. The maximum permissible spans for 2- X 9-inch or wider planks are shown in the following table:

	Material				
	Full thickness undressed lumber			Nominal thickness lumber	
Working load (p.s.f.).....	25	50	75	25	50
Permissible span (ft.).....	10	8	6	8	9

The maximum permissible span for 1 1/4 x 9-inch or wider plank of full thickness is 4 feet with medium loading of 50 p.s.f.

**1910.28(a)(10)**

Nails or bolts used in the construction of scaffolds shall be of adequate size and in sufficient numbers at each connection to develop the designed strength of the scaffold. Nails shall not be subjected to a straight pull and shall be driven full length.

**1910.28(a)(11)**

**1910.28(a)(11)**

All planking or platforms shall be overlapped (minimum 12 inches) or secured from movement.

**1910.28(a)(12)**

An access ladder or equivalent safe access shall be provided.

**1910.28(a)(13)**

Scaffold planks shall extend over their end supports not less than 6 inches nor more than 18

inches.

**1910.28(a)(14)**

The poles, legs, or uprights of scaffolds shall be plumb, and securely and rigidly braced to prevent swaying and displacement.

**1910.28(a)(15)**

Materials being hoisted onto a scaffold shall have a tag line.

**1910.28(a)(16)**

Overhead protection shall be provided for men on a scaffold exposed to overhead hazards.

**1910.28(a)(17)**

Scaffolds shall be provided with a screen between the toeboard and the guardrail, extending along the entire opening, consisting of No. 18-gauge U.S. Standard Wire one-half-inch mesh or the equivalent, where persons are required to work or pass under the scaffolds.

**1910.28(a)(18)**

Employees shall not work on scaffolds during storms or high winds.

**1910.28(a)(19)**

**1910.28(a)(19)**

Employees shall not work on scaffolds that are covered with ice or snow, unless all ice or snow is removed and planking sanded to prevent slipping.

**1910.28(a)(20)**

Tools, materials, and debris shall not be allowed to accumulate in quantities to cause a hazard.

**1910.28(a)(21)**

Only treated or protected fiber rope shall be used for or near any work involving the use of corrosive substances or chemicals.

**1910.28(a)(22)**

Wire or fiber rope used for scaffold suspension shall be capable of supporting at least six times the intended load.

**1910.28(a)(23)**

When acid solutions are used for cleaning buildings over 50 feet in height, wire rope supported scaffolds shall be used.

**1910.28(a)(24)**

The use of shore scaffolds or lean-to scaffolds is prohibited.

**1910.28(a)(25)**

Lumber sizes, when used in this section, refer to nominal sizes except where otherwise stated.

**1910.28(a)(26)**

Scaffolds shall be secured to permanent structures, through use of anchor bolts, reveal bolts, or other equivalent means. Window cleaners' anchor bolts shall not be used.

**..1910.28(a)(27)**

**1910.28(a)(27)**

Special precautions shall be taken to protect scaffold members, including any wire or fiber ropes, when using a heat-producing process.

**1910.28(b)**

"General requirements for wood pole scaffolds."

**1910.28(b)(1)**

Scaffold poles shall bear on a foundation of sufficient size and strength to spread the load from the poles over a sufficient area to prevent settlement. All poles shall be set plumb.

**1910.28(b)(2)**

Where wood poles are spliced, the ends shall be squared and the upper section shall rest squarely on the lower section. Wood splice plates shall be provided on at least two adjacent sides and shall not be less than 4 feet 0 inches in length, overlapping the abutted ends equally and have the same width and not less than the cross-sectional area of the pole. Splice plates of other materials of equivalent strength may be used.

**1910.28(b)(3)**

Independent pole scaffolds shall be set as near to the wall of the building as practicable.

**1910.28(b)(4)**

All pole scaffolds shall be securely guyed or tied to the building or structure. Where the height or length exceeds 25 feet, the scaffold shall be secured at intervals not greater than 25 feet vertically and horizontally.

**..1910.28(b)(5)**

**1910.28(b)(5)**

Putlogs or bearers shall be set with their greater dimensions vertical, long enough to project over the ledgers of the inner and outer rows of poles at least 3 inches for proper support.

**1910.28(b)(6)**

Every wooden putlog on single pole scaffolds shall be reinforced with a 3/16 x 2-inch steel strip or equivalent secured to its lower edge throughout its entire length.

**1910.28(b)(7)**

Ledgers shall be long enough to extend over two pole spaces. Ledgers shall not be spliced between the poles. Ledgers shall be reinforced by bearing blocks securely nailed to the side of the pole to form a support for the ledger.

**1910.28(b)(8)**

Diagonal bracing shall be provided to prevent the poles from moving in a direction parallel with the wall of the building, or from buckling.

**1910.28(b)(9)**

Cross bracing shall be provided between the inner and outer sets of poles in independent pole scaffolds. The free ends of pole scaffolds shall be cross-braced.

**1910.28(b)(10)**

Full diagonal face bracing shall be erected across the entire face of pole scaffolds in both directions. The braces shall be spliced at the poles.

**..1910.28(b)(11)**

**1910.28(b)(11)**

Platform planks shall be laid with their edges close together so the platform will be tight with no spaces through which tools or fragments of material can fall.

**1910.28(b)(12)**

Where planking is lapped, each plank shall lap its end supports at least 12 inches. Where the ends of planks abut each other to form a flush floor, the butt joint shall be at the centerline of a pole. The abutted ends shall rest on separate bearers. Intermediate beams shall be provided where necessary to prevent dislodgment of planks due to deflection, and the ends shall be nailed or cleated to prevent their dislodgment.

**1910.28(b)(13)**

When a scaffold turns a corner, the platform planks shall be laid to prevent tipping. The planks that meet the corner putlog at an angle shall be laid first, extending over the diagonally placed putlog far enough to have a good safe bearing but not far enough to involve any danger from tipping. The planking running in the opposite direction at right angles shall be laid so as to extend over and rest on the first layer of planking.

**1910.28(b)(14)**

When moving platforms to the next level, the old platform shall be left undisturbed until the new putlogs or bearers have been set in place, ready to receive the platform planks.

**..1910.28(b)(15)**

**1910.28(b)(15)**

Guardrails not less than 2 x 4 inches or the equivalent and not less than 36 inches or more

than 42 inches high, with a mid-rail, when required, of 1 x 4-inch lumber or equivalent, and toeboards, shall be installed at all open sides on all scaffolds more than 10 feet above the ground or floor. Toeboards shall be a minimum of 4 inches in height. Wire mesh shall be installed in accordance with paragraph (a)(17) of this section.

**1910.28(b)(16)**

All wood pole scaffolds 60 feet or less in height shall be constructed and erected in accordance with tables D-7 through D-12 of this section. If they are over 60 feet in height, they shall be designed by a registered professional engineer and constructed and erected in accordance with such design. A copy of the typical drawings and specifications shall be made available to the employer and for inspection purposes.

**1910.28(b)(17)**

Wood-pole scaffolds shall not be erected beyond the reach of effective firefighting apparatus.

TABLE D-7 - MINIMUM NOMINAL SIZE AND MAXIMUM SPACING OF MEMBERS OF SINGLE POLE SCAFFOLDS - LIGHT DUTY

	Maximum height of scaffold	
	20 feet	60 feet
Uniformly distributed load.....	Not to exceed 25 pounds per square foot.	
Poles or uprights.....	2 by 4 in.....	4 by 4 in.
Pole spacing (longitudinal).....	6 ft. 0 in.....	10 ft. 0 in.
Maximum width of scaffold.....	5 ft. 0 in.....	5 ft. 0 in.
Bearers or putlogs to 3 ft. 0 in. width.....	2 by 4 in.....	2 by 4 in.
Bearers or putlogs to 5 ft. 0 in. width.....	2 by 6 in. or 3 by 4 in.	2 by 6 in. or 3 by 4 in. (rough).
Ledgers.....	1 by 4 in.....	1 1/4 by 9 in.
Planking.....	1 1/4 by 9 in. (rough).....	2 by 9 in.
Vertical spacing of horizontal members.....	7 ft. 0 in.....	7 ft. 0 in.
Bracing, horizontal and diagonal.....	1 by 4 in.....	1 by 4 in.
Tie-ins.....	1 by 4 in.....	1 by 4 in.
Toeboards.....	4 in. high (minimum).....	4 in. high (minimum)
Guardrail.....	2 by 4 in.....	2 by 4 in.

All members except planking are used on edge.

TABLE D-8 - MINIMUM NOMINAL SIZE AND MAXIMUM SPACING OF MEMBERS OF SINGLE POLE SCAFFOLDS - MEDIUM DUTY

Uniformly distributed load.....	Not to exceed 50 pounds
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	per square foot.
Maximum height of scaffold.....	60 ft.
Poles or uprights.....	4 by 4 in.
Pole spacing (longitudinal).....	8 ft. 0 in.
Maximum width of scaffold.....	5 ft. 0 in.
Bearers or putlogs.....	2 by 9 in. or 3 by 4 in.
Spacing of bearers or putlogs.....	8 ft. 0 in.
Ledgers.....	2 by 9 in.
Vertical spacing of horizontal members.	9 ft. 0 in.
Bracing, horizontal.....	1 by 6 in. or 1 1/4 by 4 in.
Bracing, diagonal.....	1 by 4 in.
Tie-ins.....	1 by 4 in.
Planking.....	2 by 9 in.
Toeboards.....	4 in. high (minimum).
Guardrail.....	2 by 4 in.

All members except planking are used on edge.

TABLE D-9 - MINIMUM NOMINAL SIZE AND MAXIMUM SPACING OF MEMBERS OF SINGLE POLE SCAFFOLDS - HEAVY DUTY

Uniformly distributed load.....	Not to exceed 75 pounds per square foot.	
Maximum height of scaffold.....	60 ft.	
Poles or uprights.....	4 by 4 in.	
Pole spacing (longitudinal).....	6 ft. 0 in.	
Maximum width of scaffold.....	5 ft. 0 in.	
Bearers or putlogs.....	2 by 9 in. or 3 by 5 in. (rough)	
Spacing of bearers or putlogs.....	6 ft. 0 in.	
Ledgers.....	2 by 9 in.	
Vertical spacing of horizontal members. .	6 ft. 6 in.	
Bracing, horizontal and diagonal.....	2 by 4 in.	
Tie-ins.....	1 by 4 in.	
Planking.....	2 by 9 in.	
Toeboards.....	4 in. high (minimum)	
Guardrail.....	2 by 4 in.	

All members except planking are used on edge.

TABLE D-10 - MINIMUM NOMINAL SIZE AND MAXIMUM SPACING OF MEMBERS OF INDEPENDENT POLE SCAFFOLDS - LIGHT DUTY

	Maximum height of scaffold	
	20 feet	60 feet
Uniformly distributed load.....	Not to exceed 25 pounds per square foot	
Poles or uprights.....	2 by 4 in.....	4 by 4 in.
Pole spacing (longitudinal).....	6 ft. 0 in..	10 ft. 0 in.
Pole spacing (transverse).....	6 ft. 0 in.....	10 ft. 0 in.

Ledgers.....	1 1/4 by 4 in....	1 1/4 by 9 in.
Bearers to 3 ft. 0 in. span.....	2 by 4 in.....	2 by 4 in.
Bearers to 10 ft. 0 in. span.....	2 by 6 in. or 3 by 4 in...	2 by 9 in. (rough) or 3 by 8 in.
Planking.....	1 1/4 by 9 in....	2 by 9 in.
Vertical spacing of horizontal members.....	7 ft. 0 in.....	7 ft. 0 in.
Bracing, horizontal and diagonal.	1 by 4 in.....	1 by 4 in.
Tie-ins.....	1 by 4 in.....	1 by 4 in.
Toeboards .....	4 in. high.....	4 in. high (minimum)
Guardrail.....	2 by 4 in.....	2 by 4 in.

All members except planking are used on edge.

TABLE D-11 - MINIMUM NOMINAL SIZE AND MAXIMUM SPACING OF MEMBERS OF INDEPENDENT POLE SCAFFOLDS - MEDIUM DUTY

Uniformly distributed load.....	Not to exceed 50 pounds per square foot.
Maximum height of scaffold.....	60 ft.
Poles or uprights.....	4 by 4 in.
Pole spacing (longitudinal).....	8 ft. 0 in.
Pole spacing (transverse).....	8 ft. 0 in.
Ledgers.....	2 by 9 in.
Vertical spacing of horizontal members....	6 ft. 0 in.
Spacing of bearers.....	8 ft. 0 in.
Bearers.....	2 by 9 in. (rough) or 2 by 10 in.
Bracing, horizontal.....	1 by 6 in. or 1 1/4 by 4 in.
Bracing, diagonal.....	1 by 4 in.
Tie-ins.....	1 by 4 in.
Planking.....	2 by 9 in.
Toeboards.....	4 in. high (minimum).
Guardrail.....	2 by 4 in.

All members except planking are used on edge.

TABLE D-12 - MINIMUM NOMINAL SIZE AND MAXIMUM SPACING OF MEMBERS OF INDEPENDENT POLE SCAFFOLDS - HEAVY DUTY

Uniformly distributed load.....	Not to exceed 75 pounds per square foot.
Maximum height of scaffold.....	60 ft.
Poles or uprights.....	4 by 4 in.
Pole spacing (longitudinal).....	6 ft. 0 in.
Pole spacing (transverse).....	8 ft. 0 in.
Ledgers.....	2 by 9 in.
Vertical spacing of horizontal members.	4 ft. 6 in.
Bearers.....	2 by 9 in. (rough)
Bracing, horizontal and diagonal.....	2 by 4 in.
Tie-ins.....	1 by 4 in.
Planking.....	2 by 9 in.
Toeboards.....	4 in. high (minimum).

Guardrail..... | 2 by 4 in.

All members except planking are used on edge.

TABLE D-13 - TUBE AND COUPLER SCAFFOLDS - LIGHT DUTY

Uniformly distributed load.....	Not to exceed 25 p.s.f.
Post spacing (longitudinal).....	10 ft. 0 in.
Post spacing (transverse).....	6 ft. 0 in.

Working levels	Additional planked levels	Maximum height
1	8	125 ft.
2	4	125 ft.
3	0	91 ft. 0 in.

TABLE D-14 - TUBE AND COUPLER SCAFFOLDS - MEDIUM DUTY

Uniformly distributed load.....	Not to exceed 50 p.s.f.
Post spacing (longitudinal).....	8 ft. 0 in.
Post spacing (transverse).....	6 ft. 0 in.

Working levels	Additional planked levels	Maximum height
1	6	125 ft.
2	0	78 ft. 0 in.

TABLE D-15 - TUBE AND COUPLER SCAFFOLDS - HEAVY DUTY

Uniformly distributed load.....	Not to exceed 75 p.s.f.
Post spacing (longitudinal).....	6 ft. 6 in.
Post spacing (transverse).....	6 ft. 0 in.

Working levels	Additional planked levels	Maximum height
1	6	125 ft.



**1910.28(c)**

"Tube and coupler scaffolds."

**1910.28(c)(1)**

A light-duty tube and coupler scaffold shall have all posts, bearers, runners, and bracing of nominal 2-inch O.D. steel tubing. The posts shall be spaced no more than 6 feet apart by 10 feet along the length of the scaffold. Other structural metals when used must be designed to carry an equivalent load.

**..1910.28(c)(2)**

**1910.28(c)(2)**

A medium-duty tube and coupler scaffold shall have all posts, runners, and bracing of nominal 2-inch O.D. steel tubing. Posts spaced not more than 6 feet apart by 8 feet along the length of the scaffold shall have bearers of nominal 2 1/2-inch O.D. steel tubing. Posts spaced not more than 5 feet apart by 8 feet along the length of the scaffold shall have bearers of nominal 2-inch O.D. steel tubing. Other structural metals when used must be designed to carry an equivalent load.

**1910.28(c)(3)**

A heavy-duty tube and coupler scaffold shall have all posts, runners, and bracing of nominal 2-inch O.D. steel tubing, with the posts spaced not more than 6 feet apart by 6 feet 6 inches along the length of the scaffold. Other structural metals when used must be designed to carry an equivalent load.

**1910.28(c)(4)**

Tube and coupler scaffolds shall be limited in heights and working levels to those permitted in tables D-13, 14, and 15, of this section. Drawings and specification of all tube and coupler scaffolds above the limitations in tables D-13, 14, and 15 of this section shall be designed by a registered professional engineer and copies made available to the employer and for inspection purposes.

**1910.28(c)(5)**

All tube and coupler scaffolds shall be constructed and erected to support four times the maximum intended loads as set forth in tables D-13, 14, and 15 of this section, or as set forth in the specifications by a registered professional engineer, copies which shall be made available to the employer and for inspection purposes.

**1910.28(c)(6)**

All tube and coupler scaffolds shall be erected by competent and experienced personnel.

**..1910.28(c)(7)**

**1910.28(c)(7)**

Posts shall be accurately spaced, erected on suitable bases, and maintained plumb.

**1910.28(c)(8)**

Runners shall be erected along the length of the scaffold located on both the inside and the outside posts at even height. Runners shall be interlocked to form continuous lengths and coupled to each post. The bottom runners shall be located as close to the base as possible. Runners shall be placed not more than 6 feet 6 inches on centers.

**1910.28(c)(9)**

Bearers shall be installed transversely between posts and shall be securely coupled to the posts bearing on the runner coupler. When coupled directly to the runners, the coupler must be kept as close to the posts as possible.

**1910.28(c)(10)**

Bearers shall be at least 4 inches but not more than 12 inches longer than the post spacing or runner spacing. Bearers may be cantilevered for use as brackets to carry not more than two planks.

**1910.28(c)(11)**

Cross bracing shall be installed across the width of the scaffold at least every third set of posts horizontally and every fourth runner vertically. Such bracing shall extend diagonally from the inner and outer runners upward to the next outer and inner runners.

**..1910.28(c)(12)**

**1910.28(c)(12)**

Longitudinal diagonal bracing shall be installed at approximately a 45-degree angle from near the base of the first outer post upward to the extreme top of the scaffold. Where the longitudinal length of the scaffold permits, such bracing shall be duplicated beginning at every fifth post. In a similar manner, longitudinal diagonal bracing shall also be installed from the last post extending back and upward toward the first post. Where conditions preclude the attachment of this bracing to the posts, it may be attached to the runners.

**1910.28(c)(13)**

The entire scaffold shall be tied to and securely braced against the building at intervals not to exceed 30 feet horizontally and 26 feet vertically.

**1910.28(c)(14)**

Guardrails not less than 2 x 4 inches or the equivalent and not less than 36 inches or more than 42 inches high, with a mid-rail, when required, of 1 x 4-inch lumber or equivalent, and toeboards, shall be installed at all open sides on all scaffolds more than 10 feet above the ground or floor. Toeboards shall be a minimum of 4 inches in height. Wire mesh shall be installed in accordance with paragraph (a)(17) of this section.

**1910.28(d)**

"Tubular welded frame scaffolds."

**1910.28(d)(1)**

Metal tubular frame scaffolds, including accessories such as braces, brackets, trusses, screw legs, ladders, etc., shall be designed and proved to safely support four times the maximum intended load.

**1910.28(d)(2)**

Spacing of panels or frames shall be consistent with the loads imposed.

**..1910.28(d)(3)**

**1910.28(d)(3)**

Scaffolds shall be properly braced by cross bracing or diagonal braces, or both, for securing vertical members together laterally, and the cross braces shall be of such length as will automatically square and align vertical members so that the erected scaffold is always plumb, square, and rigid. All brace connections shall be made secure.

**1910.28(d)(4)**

Scaffold legs shall be set on adjustable bases or plain bases placed on mud sills or other foundations adequate to support the maximum intended load.

**1910.28(d)(5)**

The frames shall be placed one on top of the other with coupling or stacking pins to provide proper vertical alignment of the legs.

**1910.28(d)(6)**

Where uplift may occur, panels shall be locked together vertically by pins or other equivalent suitable means.

**1910.28(d)(7)**

Guardrails not less than 2 x 4 inches or the equivalent and not less than 36 inches or more than 42 inches high, with a mid-rail, when required, of 1- x 4-inch lumber or equivalent, and toeboards, shall be installed at all open sides on all scaffolds more than 10 feet above the ground or floor. Toeboards shall be a minimum of 4 inches in height. Wire mesh shall be installed in accordance with paragraph (a)(17) of this section.

**1910.28(d)(8)**

All tubular metal scaffolds shall be constructed and erected to support four times the maximum intended loads.

**..1910.28(d)(9)**

**1910.28(d)(9)**

To prevent movement, the scaffold shall be secured to the building or structure at intervals not to exceed 30 feet horizontally and 26 feet vertically.

**1910.28(d)(10)**

Maximum permissible spans of planking shall be in conformity with paragraph (a)(9) of this section.

**1910.28(d)(11)**

Drawings and specifications for all frame scaffolds over 125 feet in height above the base plates shall be designed by a registered professional engineer and copies made available to the employer and for inspection purposes.

**1910.28(d)(12)**

All tubular welded frame scaffolds shall be erected by competent and experienced personnel.

**1910.28(d)(13)**

Frames and accessories for scaffolds shall be maintained in good repair and every defect, unsafe condition, or noncompliance with this section shall be immediately corrected before further use of the scaffold. Any broken, bent, excessively rusted, altered, or otherwise structurally damaged frames or accessories shall not be used.

**1910.28(d)(14)**

Periodic inspections shall be made of all welded frames and accessories, and any maintenance, including painting, or minor corrections authorized by the manufacturer, shall be made before further use.

**..1910.28(e)**

**1910.28(e)**

"Outrigger scaffold."

**1910.28(e)(1)**

Outrigger beams shall extend not more than 6 feet beyond the face of the building. The inboard end of outrigger beams, measured from the fulcrum point to the extreme point of support, shall be not less than one and one-half times the outboard end in length. The beams shall rest on edge, the sides shall be plumb, and the edges shall be horizontal. The fulcrum point of the beam shall rest on a secure bearing at least 6 inches in each horizontal dimension. The beam shall be secured in place against movement and shall be securely braced at the fulcrum point against tipping.

**1910.28(e)(2)**

The inboard ends of outrigger beams shall be securely supported either by means of struts bearing against sills in contact with the overhead beams or ceiling, or by means of tension members secured to the floor joists underfoot, or by both if necessary. The inboard ends of outrigger beams shall be secured against tipping, and the entire supporting structure shall be securely braced in both directions to prevent any horizontal movement.

**1910.28(e)(3)**

Unless outrigger scaffolds are designed by a licensed professional engineer, they shall be constructed and erected in accordance with table D-16. Outrigger scaffolds designed by a registered professional engineer shall be constructed and erected in accordance with such design. A copy of the detailed drawings and specifications showing the sizes and spacing of members shall be kept on the job.

**1910.28(e)(4)**

Planking shall be laid tight and shall extend to within 3 inches of the building wall. Planking shall be nailed or bolted to outriggers.

**1910.28(e)(5)**

Where there is danger of material falling from the scaffold, a wire mesh or other enclosure shall be provided between the guardrail and the toeboard.

**..1910.28(e)(6)**

**1910.28(e)(6)**

Where additional working levels are required to be supported by the outrigger method, the plans and specifications of the outrigger and scaffolding structure shall be designed by a registered professional engineer.

**1910.28(f)**

"Masons' adjustable multiple-point suspension scaffolds."

**1910.28(f)(1)**

The scaffold shall be capable of sustaining a working load of 50 pounds per square foot and shall not be loaded in excess of that figure.

**1910.28(f)(2)**

The scaffold shall be provided with hoisting machines that meet the requirements of a nationally recognized testing laboratory. Refer to 1910.7 for definition of nationally recognized testing laboratory.

TABLE D-16 - MINIMUM NOMINAL SIZE AND MAXIMUM SPACING OF MEMBERS OF OUTRIGGER SCAFFOLDS

	Light duty	Medium duty
Maximum scaffold load.....	25 p.s.f.....	50 p.s.f.
Outrigger size.....	2 x 10 in.....	3 x 10 in.
Maximum outrigger spacing...	10 ft. 0 in....	6 ft. 0 in.
Planking.....	2 x 9 in.....	2 x 9 in.
Guardrail.....	2 x 4 in.....	2 x 4 in.
Guardrail uprights.....	2 x 4 in.....	2 x 4 in.
Toeboards (minimum).....	4 in.....	4 in.

**1910.28(f)(3)**

The platform shall be supported by wire ropes in conformity with paragraph (a)(22) of this section, suspended from overhead outrigger beams.

**1910.28(f)(4)**

The scaffold outrigger beams shall consist of structural metal securely fastened or anchored to the frame or floor system of the building or structure.

**1910.28(f)(5)**

Each outrigger beam shall be equivalent in strength to at least a standard 7-inch, 15.3-pound steel I-beam, be at least 15 feet long, and shall not project more than 6 feet 6 inches beyond the bearing point.

**..1910.28(f)(6)**

**1910.28(f)(6)**

Where the overhang exceeds 6 feet 6 inches, outrigger beams shall be composed of stronger beams or multiple beams and be installed in accordance with approved designs and instructions.

**1910.28(f)(7)**

If channel iron outrigger beams are used in place of I-beams, they shall be securely fastened together with the flanges turned out.

**1910.28(f)(8)**

All outrigger beams shall be set and maintained with their webs into vertical position.

**1910.28(f)(9)**

A stop bolt shall be placed at each end of every outrigger beam.

**1910.28(f)(10)**

The outrigger beam shall rest on suitable wood-bearing blocks.

**1910.28(f)(11)**

All parts of the scaffold such as bolts, nuts, fittings, clamps, wire rope, and outrigger beams and their fastenings, shall be maintained in sound and good working condition and shall be inspected before each installation and periodically thereafter.

**1910.28(f)(12)**

The free end of the suspension wire ropes shall be equipped with proper size thimbles and be secured by splicing or other equivalent means. The running ends shall be attached securely to the hoisting drum and at least four turns of rope shall at all times remain on the drum.

**..1910.28(f)(13)**

**1910.28(f)(13)**

Where a single outrigger beam is used, the steel shackles or clevises with which the wire ropes are attached to the outrigger beams shall be placed directly over the hoisting drums.

**1910.28(f)(14)**

The scaffold platform shall be equivalent in strength to at least 2-inch planking. (For maximum planking spans see paragraph (a)(9) of this section).

**1910.28(f)(15)**

Guardrails not less than 2 x 4 inches or the equivalent and not less than 36 inches or more than 42 inches high, with a mid-rail, when required, of 1 x 4-inch lumber or equivalent, and toeboards, shall be installed at all open sides on all scaffolds more than 10 feet above the ground or floor. Toeboards shall be a minimum of 4 inches in height. Wire mesh shall be installed in accordance with paragraph (a)(17) of this section.

**1910.28(f)(16)**

Overhead protection shall be provided on the scaffold, not more than 9 feet above the platform, consisting of 2-inch planking or material of equivalent strength laid tight, when men are at work on the scaffold and an overhead hazard exists.

**1910.28(f)(17)**

Each scaffold shall be installed or relocated in accordance with designs and instructions, of a registered professional engineer, and supervised by a competent, designated person.

**..1910.28(g)**

**1910.28(g)**

"Two-point suspension scaffolds (swinging scaffolds)."

**1910.28(g)(1)**

Two-point suspension scaffold platforms shall be not less than 20 inches no more than 36 inches wide overall. The platform shall be securely fastened to the hangers by U-bolts or by other equivalent means.

**1910.28(g)(2)**

The hangers of two-point suspension scaffolds shall be made of wrought iron, mild steel, or other equivalent material having a cross-sectional area capable of sustaining four times the maximum intended load, and shall be designed with a support for guardrail, intermediate rail, and toeboard.

**1910.28(g)(3)**

When hoisting machines are used on two-point suspension scaffolds, such machines shall be of a design tested and approved by a nationally recognized testing laboratory. Refer to 1910.7 for definition of nationally recognized testing laboratory.

**1910.28(g)(4)**

The roof irons or hooks shall be of wrought iron, mild steel, or other equivalent material of proper size and design, securely installed and anchored. Tie-backs of three-fourth inch manila rope or the equivalent shall serve as a secondary means of anchorage, installed at right angles to the face of the building whenever possible and secured to a structurally sound portion of the building.

**..1910.28(g)(5)**

**1910.28(g)(5)**

Guardrails not less than 2 x 4 inches or the equivalent and not less than 36 inches or more than 42 inches high, with a mid-rail, when required, of 1- x 4-inch lumber or equivalent, and toeboards, shall be installed at all open sides on all scaffolds more than 10 feet above the ground or floor. Toeboards shall be a minimum of 4 inches in height. Wire mesh shall be installed in accordance with paragraph (a)(17) of this section.

**1910.28(g)(6)**

Two-point suspension scaffolds shall be suspended by wire or fiber ropes. Wire and fiber ropes shall conform to paragraph (a)(22) of this section.

**1910.28(g)(7)**

The blocks for fiber ropes shall be of standard 6-inch size, consisting of at least one double and one single block. The sheaves of all blocks shall fit the size of rope used.

**1910.28(g)(8)**

All wire ropes, fiber ropes, slings, hangers, platforms, and other supporting parts shall be inspected before every installation. Periodic inspections shall be made while the scaffold is in use.

**1910.28(g)(9)**

On suspension scaffolds designed for a working load of 500 pounds, no more than two men shall be permitted to work at one time. On suspension scaffolds with a working load of 750 pounds, no more than three men shall be permitted to work at one time. Each workman shall be protected by a safety lifebelt attached to a lifeline. The lifeline shall be securely attached to substantial members of the structure (not scaffold) or to securely rigged lines, which will safely suspend the workman in case of a fall.

**1910.28(g)(10)**

Where acid solutions are used, fiber ropes are not permitted unless acid-proof.

**..1910.28(g)(11)**

**1910.28(g)(11)**

Two-point suspension scaffolds shall be securely lashed to the building or structure to prevent them from swaying. Window cleaners' anchors shall not be used for this purpose.



1910.28(g)(12)

The platform of every two-point suspension scaffold shall be one of the following types:

1910.28(g)(12)(i)

The side stringer of ladder-type platforms shall be clear straight-grained spruce or materials of equivalent strength and durability. The rungs shall be of straight-grained oak, ash, or hickory, at least 1-1/8 inch in diameter, with seven-eighth inch tenons mortised into the side stringers at least seven-eighth inch. The stringers shall be tied together with the tie rods not less than one-quarter inch in diameter, passing through the stringers and riveted up tight against washers on both ends. The flooring strips shall be spaced not more than five-eighth inch apart except at the side rails where the space may be 1 inch. Ladder-type platforms shall be constructed in accordance with table D-17.

1910.28(g)(12)(ii)

Plank-type platforms shall be composed of not less than nominal 2 x 8-inch unspliced planks, properly cleated together on the underside starting 6 inches from each end; intervals in between shall not exceed 4 feet. The plank-type platform shall not extend beyond the hangers more than 18 inches. A bar or other effective means shall be securely fastened to the platform at each end to prevent its slipping off the hanger. The span between hangers for plank-type platforms shall not exceed 10 feet.

..1910.28(g)(12)(iii)

1910.28(g)(12)(iii)

Beam platforms shall have side stringers of lumber not less than 2 x 6 inches set on edge. The span between hangers shall not exceed 12 feet when beam platforms are used. The flooring shall be supported on 2- and 6-inch crossbeams, laid flat and set into the upper edge of the stringers with a snug fit, at intervals of not more than 4 feet, securely nailed in place. The flooring shall be of 1- x 6-inch material properly nailed. Floorboards shall not be spaced more than one-half inch apart.

TABLE D-17 - SCHEDULE FOR LADDER-TYPE PLATFORMS

	Length of platform (feet)		
	12	14 & 16	18 & 20
Side stringers, minimum cross section (finished sizes):			
At ends (in.).....	1 3/4 x 2 3/4	1 3/4 x 2 3/4	1 3/4 x 3
At middle (in.)....	1 3/4 x 3 3/4	1 3/4 x 3 3/4	1 1/4 x 4
Reinforcing strip (minimum) (1).....	.....	.....	.....
Rungs (2).....	.....	.....	.....

Tie rods:			
Number (minimum)...	3	4	4
Diameter (minimum).	1/4 in	1/4 in	1/4 in
Flooring, minimum			
finished size (in.)..	1/2 x 2 3/4	1/2 x 2 3/4	1/2 x 2 3/4

TABLE D-17 - SCHEDULE FOR LADDER-TYPE PLATFORMS

[CONTINUED]

	Length of platform (feet)	
	22 & 24	28 & 30
Side stringers, minimum cross section (finished sizes):		
At ends (in.).....	1 3/4 x 3	1 3/4 x 3 1/2
At middle (in.)....	1 3/4 x 4 1/4	1 3/4 x 5
Reinforcing strip (minimum) (1).....		
Rungs (2).....		
Tie rods:		
Number (minimum)...	5	6
Diameter (minimum).	1/4 in	1/4 in
Flooring, minimum		
finished size (in.)..	1/2 x 3/4	1/2 x 2 3/4

Footnote(1) A 1/8 x 7/8-in, steel reinforcing strip or its equivalent shall be attached to the side or underside full length.

Footnote(2) Rungs shall be 1 1/8-in. minimum, diameter with at least 7/8-in. diameter tenons, and the maximum spacing shall be 12 in. center to center.

**1910.28(h)**

"Stone setters' adjustable multiple-point suspension scaffolds."

**1910.28(h)(1)**

The scaffold shall be capable of sustaining a working load of 25 pounds per square foot and shall not be overloaded. Scaffolds shall not be used for storage of stone or other heavy materials.

**1910.28(h)(2)**

The hoisting machine and its supports shall be of a type tested and listed by a nationally

recognized testing laboratory (refer to 1910.399(a)(77) for definition of listed, and 1910.7 for a nationally recognized testing laboratory).

**1910.28(h)(3)**

The platform shall be securely fastened to the hangers by U-bolts or other equivalent means.

**1910.28(h)(4)**

The scaffold unit shall be suspended from metal outriggers, iron brackets, wire rope slings, or iron hooks which will safely support the maximum intended load.

**1910.28(h)(5)**

Outriggers when used shall be set with their webs in a vertical position, securely anchored to the building or structure and provided with stop bolts at each end.

**..1910.28(h)(6)**

**1910.28(h)(6)**

The scaffold shall be supported by wire rope conforming with paragraph (a)(22) of this section, suspended from overhead supports.

**1910.28(h)(7)**

The free ends of the suspension wire ropes shall be equipped with proper size thimbles, secured by splicing or other equivalent means. The running ends shall be securely attached to the hoisting drum and at least four turns of rope shall remain on the drum at all times.

**1910.28(h)(8)**

Guardrails not less than 2 by 4 inches or the equivalent and not less than 36 inches or more than 42 inches high, with a mid-rail, when required, of 1- by 4-inch lumber or equivalent, and toeboards, shall be installed at all open sides on all scaffolds more than 10 feet above the ground or floor. Toeboards shall be a minimum of 4 inches in height. Wire mesh shall be installed in accordance with paragraph (a)(17) of this section.

**1910.28(h)(9)**

When two or more scaffolds are used on a building or structure, they shall not be bridged one to the other but shall be maintained at even height with platforms butting closely.

**1910.28(h)(10)**

Each scaffold shall be installed or relocated in accordance with designs and instructions of a registered professional engineer, and such installation or relocation shall be supervised by a competent designated person.

**..1910.28(i)**

**1910.28(i)**

"Single-point adjustable suspension scaffolds."

**1910.28(i)(1)**

The scaffolding, including power units or manually operated winches, shall be a type tested and listed by a nationally recognized testing laboratory (refer to 1910.399(a)(77) for definition of listed, and 1910.7 for a nationally recognized testing laboratory).

**1910.28(i)(2)**

[Reserved]

**1910.28(i)(3)**

All power-operated gears and brakes shall be enclosed.

**1910.28(i)(4)**

In addition to the normal operating brake, all power-driven units must have an emergency brake that engages automatically when the normal speed of descent is exceeded.

**1910.28(i)(5)**

Guards, mid-rails, and toeboards shall completely enclose the cage or basket. Guardrails shall be no less than 2 by 4 inches or the equivalent installed no less than 36 inches nor more than 42 inches above the platform. Mid-rails shall be 1 by 6 inches or the equivalent; installed equidistant between the guardrail and the platform. Toeboards shall be a minimum of 4 inches in height.

**1910.28(i)(6)**

The hoisting machines, cables, and equipment shall be regularly serviced and inspected after each installation and every 30 days thereafter.

**1910.28(i)(7)**

The units may be combined to form a two-point suspension scaffold. Such scaffold shall comply with paragraph (g) of this section.

**..1910.28(i)(8)**

**1910.28(i)(8)**

The supporting cable shall be straight for its entire length, and the operator shall not sway the basket and fix the cable to any intermediate points to change his original path of travel.

**1910.28(i)(9)**

Equipment shall be maintained and used in accordance with the manufacturers' instructions.

**1910.28(i)(10)**

Suspension methods shall conform to applicable provisions of paragraphs (f) and (g) of this section.

**1910.28(j)**

"Boatswain's chairs."

**1910.28(j)(1)**

The chair seat shall be not less than 12 by 24 inches, and of 1-inch thickness. The seat shall be reinforced on the underside to prevent the board from splitting.

**1910.28(j)(2)**

The two fiber rope seat slings shall be of 5/8-inch diameter, reeved through the four seat holes so as to cross each other on the underside of the seat.

**1910.28(j)(3)**

Seat slings shall be of at least 3/8-inch wire rope when a workman is conducting a heat-producing process such as gas or arc welding.

**1910.28(j)(4)**

The workman shall be protected by a safety life belt attached to a lifeline. The lifeline shall be attached securely to substantial members of the structure (not scaffold) or to securely rigged lines, which will safely suspend the worker in case of a fall.

**..1910.28(j)(5)**

**1910.28(j)(5)**

The tackle shall consist of correct size ball bearing or bushed blocks and properly spliced 5/8-inch diameter first-grade manila rope.

**1910.28(j)(6)**

The roof irons, hooks, or the object to which the tackle is anchored shall be installed securely. Tiebacks when used shall be installed at right angles to the face of the building and securely fastened to a chimney

**1910.28(k)**

"Carpenters' bracket scaffolds."

**1910.28(k)(1)**

The brackets shall consist of a triangular wood frame not less than 2 by 3 inches in cross section or of metal of equivalent strength. Each member shall be properly fitted and securely joined.

**1910.28(k)(2)**

Each bracket shall be attached to the structure by means of one of the following:

**1910.28(k)(2)(i)**

A bolt no less than five-eighths inch in diameter that shall extend through the inside of the building wall.

**1910.28(k)(2)(ii)**

A metal stud attachment device.

**1910.28(k)(2)(iii)**

Welding to steel tanks.

**1910.28(k)(2)(iv)**

Hooking over a well-secured and adequately strong supporting member.

The brackets shall be spaced no more than 10 feet apart.

**..1910.28(k)(3)**

**1910.28(k)(3)**

No more than two persons shall occupy any given 10 feet of a bracket scaffold at any one time. Tools and materials shall not exceed 75 pounds in addition to the occupancy.

**1910.28(k)(4)**

The platform shall consist of not less than two 2- by 9-inch nominal size planks extending not more than 18 inches or less than 6 inches beyond each end support.

**1910.28(k)(5)**

Guardrails not less than 2 by 4 inches or the equivalent and not less than 36 inches or more than 42 inches high, with a mid-rail, when required, of 1- by 4-inch lumber or equivalent, and toeboards, shall be installed at all open sides on all scaffolds more than 10 feet above the ground or floor. Toeboards shall be a minimum of 4 inches in height. Wire mesh shall be installed in accordance with paragraph (a)(17) of this section.

**1910.28(l)**

"Bricklayers' square scaffolds."

**1910.28(l)(1)**

The squares shall not exceed 5 feet in width and 5 feet in height.

**1910.28(l)(2)**

Members shall be not less than those specified in Table D-18.

**1910.28(l)(3)**

The squares shall be reinforced on both sides of each corner with 1- by 6-inch gusset pieces. They shall also have braces 1 by 8 inches on both sides running from center to center of each member, or other means to secure equivalent strength and rigidity.

**..1910.28(l)(4)**

**1910.28(l)(4)**

The squares shall be set not more than 5 feet apart for medium duty scaffolds and not more than 8 feet apart for light duty scaffolds. Bracing 1 x 8 inches, extending from the bottom of each square to the top of the next square, shall be provided on both front and rear sides of the scaffold.

TABLE D-18 - MINIMUM DIMENSIONS FOR BRICKLAYERS' SQUARE SCAFFOLD MEMBERS

Members	Dimensions (Inches)
Bearers or horizontal members.....	2 by 6
Legs.....	2 by 6
Braces at corners.....	1 by 6
Braces diagonally from center frame..	1 by 8

**1910.28(1)(5)**

Platform Planks shall be at least 2- by 9-inch nominal size. The ends of the planks shall overlap the bearers of the squares and each plank shall be supported by not less than three squares.

**1910.28(1)(5)**

Bricklayers' square scaffolds shall not exceed three tiers in height and shall be so constructed and arranged that one square shall rest directly above the other. The upper tiers shall stand on a continuous row of planks laid across the next lower tier and be nailed down or otherwise secured to prevent displacement.

**1910.28(1)(7)**

Scaffolds shall be level and set upon a firm foundation.

**1910.28(m)**

"Horse scaffolds."

**1910.28(m)(1)**

Horse scaffolds shall not be constructed or arranged more than two tiers or 10 feet in height.

**1910.28(m)(2)**

The members of the horses shall be not less than those specified in Table D-19.

**1910.28(m)(3)**

Horses shall be spaced not more than 5 feet for medium duty and not more than 8 feet for light duty.

**..1910.28(m)(4)**

**1910.28(m)(4)**

When arranged in tiers, each horse shall be placed directly over the horse in the tier below.

**1910.28(m)(5)**

On all scaffolds arranged in tiers the legs shall be nailed down to the planks to prevent displacement or thrust and each tier shall be substantially cross-braced.

TABLE D-19 - MINIMUM DIMENSIONS FOR HORSE SCAFFOLD MEMBERS

Members	Dimensions (Inches)
Horizontal members or bearers .....	3 by 4
Legs .....	1 1/4 by 4 1/2
Longitudinal brace between legs .....	1 by 6
Gusset brace at top of legs .....	1 by 8
Half diagonal braces .....	1 1/4 by 4 1/2

**1910.28(m)(6)**

Horses or parts that have become weak or defective shall not be used.

**1910.28(m)(7)**

Guardrails not less than 2 by 4 inches or the equivalent and not less than 36 inches or more than 42 inches high with a mid-rail, when required, of 1- by 4-inch lumber or equivalent and toeboards, shall be installed at all open sides on all scaffolds more than 10 feet above the ground or floor. Toeboards shall be a minimum of 4 inches in height. Wire mesh shall be installed in accordance with paragraph (a)(17) of this section.

**1910.28(n)**

"Needle beam scaffold."

**1910.28(n)(1)**

Wood needle beams shall be in accordance with paragraph (a)(5) and (9) of this section and shall be not less than 4 by 6 inches in size, with the greater dimension placed in a vertical direction. Metal beams or the equivalent conforming to paragraph (a)(4) and (8) of this section may be used.

**..1910.28(n)(2)**

**1910.28(n)(2)**

Ropes or hangers shall be provided for supports. The span between supports on the needle beam shall not exceed 10 feet for 4- by 6-inch timbers. Rope supports shall be equivalent in strength to 1-inch diameter first-grade manila rope.

**1910.28(n)(3)**



The ropes shall be attached to the needle beams by a scaffold hitch or a properly made eye splice. The loose end of the rope shall be tied by a bowline knot or by a round turn and one-half hitch.

**1910.28(n)(4)**

The platform span between the needle beams shall not exceed 8 feet when using 2-inch scaffold plank. For spans greater than 8 feet, platforms shall be designed based on design requirements for the special span. The overhang of each end of the platform planks shall be not less than 1 foot and not more than 18 inches.

**1910.28(n)(5)**

When one needle beam is higher than the other or when the platform is not level, the platform shall be secured against slipping.

**1910.28(n)(6)**

All unattached tools, bolts, and nuts used on needle beam scaffolds shall be kept in suitable containers.

**1910.28(n)(7)**

One end of a needle beam scaffold may be supported by a permanent structural member conforming to paragraphs (a)(4) and (8) of this section.

**..1910.28(n)(8)**

**1910.28(n)(8)**

Each man working on a needle beam scaffold 20 feet or more above the ground or floor and working with both hands, shall be protected by a safety life belt attached to a lifeline. The lifeline shall be securely attached to substantial members of the structure (not scaffold), or to securely rigged lines, which will safely suspend the workman in case of a fall.

**1910.28(o)**

"Plasterers', decorators', and large area scaffolds."

**1910.28(o)(1)**

Plasterers', decorators', lathers', and ceiling workers' inside scaffolds shall be constructed in accordance with the general requirements set forth for independent wood pole scaffolds.

**1910.28(o)(2)**

Guardrails not less than 2 by 4 inches or the equivalent and not less than 36 inches or more than 42 inches high, with a mid-rail, when required, of 1- by 4-inch lumber or equivalent, and toeboards, shall be installed at all open sides on all scaffolds more than 10 feet above the ground or floor. Toeboards shall be a minimum of 4 inches in height. Wire mesh shall be installed in accordance with paragraph (a)(17) of this section.

**1910.28(o)(3)**

All platform planks shall be laid with the edges close together.

**1910.28(o)(4)**

When independent pole scaffold platforms are erected in sections, such sections shall be provided with connecting runways equipped with substantial guardrails.

**1910.28(p)**

"Interior hung scaffolds."

**..1910.28(p)(1)**

**1910.28(p)(1)**

[Reserved]

**1910.28(p)(2)**

The suspended steel wire rope shall conform to paragraph (a)(22) of this section. Wire may be used providing the strength requirements of paragraph (a)(22) of this section are met.

**1910.28(p)(3)**

For hanging wood scaffolds, the following minimum nominal size material is recommended:

**1910.28(p)(3)(i)**

Supporting bearers 2 by 9 inches on edge.

**1910.28(p)(3)(ii)**

Planking 2 by 9 inches or 2 by 10 inches, with maximum span 7 feet for heavy duty and 10 feet for light duty or medium duty.

**1910.28(p)(4)**

Steel tube and coupler members may be used for hanging scaffolds with both types of scaffold designed to sustain a uniform distributed working load up to heavy duty scaffold loads with a safety factor of four.

**1910.28(p)(5)**

When a hanging scaffold is supported by means of wire rope, such wire rope shall be wrapped at least twice around the supporting members and twice around the bearers of the scaffold, with each end of the wire rope secured by at least three standard wire-rope clips.

**..1910.28(p)(6)**

**1910.28(p)(6)**

All overhead supporting members shall be inspected and checked for strength before the scaffold is erected.

**1910.28(p)(7)**

Guardrails not less than 2 by 4 inches or the equivalent and not less than 36 inches or more than 42 inches high, with a mid-rail, when required, of 1- by 4-inch lumber or equivalent, and toeboards, shall be installed at all open sides on all scaffolds more than 10 feet above the ground or floor. Toeboards shall be a minimum of 4 inches in height. Wire mesh shall be installed in accordance with paragraph (a)(17) of this section.

**1910.28(q)**

"Ladder-jack scaffolds."

**1910.28(q)(1)**

All ladder-jack scaffolds shall be limited to light duty and shall not exceed a height of 20 feet above the floor or ground.

**1910.28(q)(2)**

All ladders used in connection with ladder-jack scaffolds shall be heavy-duty ladders and shall be designed and constructed in accordance with 1910.25 and 1910.26.

**1910.28(q)(3)**

The ladder jack shall be so designed and constructed that it will bear on the side rails in addition to the ladder rungs, or if bearing on rungs only, the bearing area shall be at least 10 inches on each rung.

**..1910.28(q)(4)**

**1910.28(q)(4)**

Ladders used in conjunction with ladder jacks shall be so placed, fastened, held, or equipped with devices so as to prevent slipping.

**1910.28(q)(5)**

The wood platform planks shall be not less than 2 inches nominal in thickness. Both metal and wood platform planks shall overlap the bearing surface not less than 12 inches. The span between supports for wood shall not exceed 8 feet. Platform width shall be not less than 18 inches.

**1910.28(q)(6)**

Not more than two persons shall occupy any given 8 feet of any ladder-jack scaffold at any one time.

**1910.28(r)**

"Window-jack scaffolds."

**1910.28(r)(1)**

Window-jack scaffolds shall be used only for the purpose of working at the window opening through which the jack is placed.

**1910.28(r)(2)**

Window jacks shall not be used to support planks placed between one window jack and another or for other elements of scaffolding.

**1910.28(r)(3)**

Window-jack scaffolds shall be provided with suitable guardrails unless safety belts with lifelines are attached and provided for the workman. Window-jack scaffolds shall be used by one man only.

**..1910.28(s)**

**1910.28(s)**

"Roofing brackets."

**1910.28(s)(1)**

Roofing brackets shall be constructed to fit the pitch of the roof.

**1910.28(s)(2)**

Brackets shall be secured in place by nailing in addition to the pointed metal projections. The nails shall be driven full length into the roof. When rope supports are used, they shall consist of first-grade manila of at least three-quarter-inch diameter, or equivalent.

**1910.28(s)(3)**

A substantial catch platform shall be installed below the working area of roofs more than 20 feet from the ground to eaves with a slope greater than 3 inches in 12 inches without a parapet. In width, the platform shall extend 2 feet beyond the projection of the eaves and shall be provided with a safety rail, mid-rail, and toeboard. This provision shall not apply where employees engaged in work upon such roofs are protected by a safety belt attached to a lifeline.

**1910.28(t)**

"Crawling board or chicken ladders."

**1910.28(t)(1)**

Crawling boards shall be not less than 10 inches wide and 1 inch thick, having cleats 1 x 1 1/2 inches. The cleats shall be equal in length to the width of the board and spaced at equal intervals not to exceed 24 inches. Nails shall be driven through and clinched on the underside. The crawling board shall extend from the ridge pole to the eaves when used in connection with roof construction, repair, or maintenance.

**..1910.28(t)(2)**

**1910.28(t)(2)**

A firmly fastened lifeline of at least three-quarter-inch rope shall be strung beside each crawling board for a handhold.

**1910.28(t)(3)**

Crawling boards shall be secured to the roof by means of adequate ridge hooks or equivalent effective means.

**1910.28(u)**

"Float or ship scaffolds."

**1910.28(u)(1)**

Float or ship scaffolds shall support not more than three men and a few light tools, such as those needed for riveting, bolting, and welding. They shall be constructed in accordance with paragraphs (u)(2) through (6) of this section, unless substitute designs and materials provide equivalent strength, stability, and safety.

**1910.28(u)(2)**

The platform shall be not less than 3 feet wide and 6 feet long, made of three-quarter-inch plywood, equivalent to American Plywood Association Grade B-B, Group I, Exterior.

**1910.28(u)(3)**

Under the platform, there shall be two supporting bearers made from 2- x 4-inch, or 1- x 10-inch rough, selected lumber, or better. They shall be free of knots or other flaws and project 6 inches beyond the platform on both sides. The ends of the platform shall extend about 6 inches beyond the outer edges of the bearers. Each bearer shall be securely fastened to the platform.

**..1910.28(u)(4)**

**1910.28(u)(4)**

An edging of wood not less than 3/4 x 1-1/2 inches, or equivalent, shall be placed around all sides of the platform to prevent tools from rolling off.

**1910.28(u)(5)**

Supporting ropes shall be 1-inch diameter manila rope or equivalent, free from deterioration, chemical damage, flaws, or other imperfections. Rope connections shall be such that the platform cannot shift or slip. If two ropes are used with each float, each of the two supporting ropes shall be hitched around one end of a bearer and pass under the platforms to the other end of the bearer where it is hitched again, leaving sufficient rope at each end for the supporting ties.

**1910.28(u)(6)**

Each workman shall be protected by a safety lifebelt attached to a lifeline. The lifeline shall be securely attached to substantial members of the structure (not scaffold) or to securely rigged lines, which will safely suspend the workman in case of a fall.

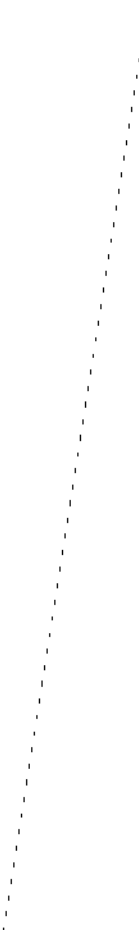
**1910.28(v)**

"Scope." This section establishes safety requirements for the construction, operation,

maintenance, and use of scaffolds used in the maintenance of buildings and structures.

[39 FR 23502, June 27, 1974, as amended at 43 FR 49746, Oct. 24, 1978; 49 FR 5321, Feb. 10, 1984; 53 FR 12121, Apr. 12, 1988]

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## **Appendix D**

### **Student Technical Crew Training Authorization Card Requirements, Additional Student Resources, Safety Tests, and Answer Keys**





## **Student Technician Authorization**

A licensed student technician is required for all events held under the direction of the Drama Department in any MCPS theater space. Licensed technicians are trained, tested, and selected by the drama director in order to help ensure the safety of audience members and performers. The following lists the criteria for three different levels of licensure for MCPS student technicians.

Prerequisites for all student technicians:

- Emergency care card on file with the theater sponsor.
- Annual parental permission form on file with the theater sponsor for sound/lights.
- Written safety tests passed annually with a score of 100% in audio, lighting, winches/battens, catwalks, ladders, scaffolding, curtains, fire safety, and power tools.
- Theater sponsor's approval.
- Presence of a school administration's approved adult at all times during all school-sponsored or outside activities.

### **Class "C" Technical Authorization Requirements**

The student must:

- Demonstrate respect for established safety and administrative procedures.
- Complete ten hours of supervised practical work in the areas of lighting, sound, and/or scenery, or have the theater sponsor's approval of equivalent experience.

Restrictions (The student is authorized to do only the following activities):

- May work only as an apprentice under the supervision of the sponsor or an "A" or "B" licensed technician on the light board and/or sound board.
- May assist hanging, aiming, and focusing activities from the ground—may not work in catwalks, scaffolding, or ladders unless separately certified.

### **Class "B" Technical Authorization Requirements**

The student must:

- Demonstrate respect for established safety and administrative procedures.
- Pass required written safety tests with perfect scores.
- Complete 20 hours of supervised practical work in the areas of lighting, sound, and/or scenery, or have the theater sponsor's approved equivalent experience.
- Complete a practical test demonstrating knowledge of lighting board and basic sound equipment, including basic set up of hand held microphones and operation of CD or other basic sound effect equipment.
- Demonstrate practical understanding of instrument hanging, aiming, and focusing.

Restrictions (The student is authorized to do only the following activities):

- May operate light board, sound board, follow spots and headset/communication systems independently, and may supervise “C” licensed technicians.
- May apprentice for catwalk work, under the supervision of “A” licensed technicians or the technical director. (No student shall be permitted on the catwalk unless the drama/technical director is present on the catwalk with the student.)

## Class “A” Technical Authorization Requirements

The student must:

- Demonstrate leadership through respect for established safety and administrative procedures.
- Pass all required written tests with perfect scores.
- Complete 30 hours of supervised practical work in the area of lighting and/or sound, or have Theater Sponsor approved experience equivalent.
- Complete a practical test demonstrating mastery of light board operation and basic sound equipment (including ability to patch and program).
- Demonstrate for the teacher practical understanding of all lighting fixtures, hanging, aiming, focusing, and maintenance.
- Must complete written and practical implementation of one or more:
  - lighting design—including plot, instrument schedule and cue sheet
  - sound design—including design, plot, and cue sheet

Restrictions:

- May operate a light and sound board and all authorized tools in the theater independently and may supervise “B” and “C” licensed technicians.
- May set up and operate advanced level microphones (e.g., body microphones).
- May hang, patch, focus, and otherwise tend to the needs of an event with approval and supervision by the technical director or MST.

## Audio Basics

### Types of microphones

**Uni-directional**—only picks up sound in front (great for soloists; lousy for people who move their face away from the front of the microphone—for example, inexperienced speakers at a podium).

**Omni-directional**—picks up sound all around, including the audience.

**Cardioid**—picks up sound mostly in front (a great compromise).

**Condenser microphone**—small microphones (needing power)—used for hanging from above, etc.

**PZM (or PCC)**—floor microphones (needing power) good for unobtrusive, general amplification (also great on a table or podium for broad pickup).

**Wireless “body” microphone**—a transmitter with a small microphone, plus a receiver that plugs into your sound system. Both halves need power and operate on a matching frequency. Delicate signals can be degraded by cell phone frequencies, sweat, obstacles, or use of similar frequencies at the same time. Microphone placement over the ear, in the hair, or attached to the face with Velcro assures consistent sound level, even when the head turns. Lapel or center of bra is easier but less effective. Wireless microphones can be hidden around a set or in props, if helpful. Wireless hand-held microphones are also available and can share a receiver (but not at the same time as their “body” microphone is being used).

**Brands:** Shure or Audio-Technica

### Cables

**XLR cable** (Low-Z) is the standard type of microphone cable. It has 3 pins at one end; and 3 socket holes at the other (male/female). This type of cable is used for long runs (FCPS will replace with new cable, if broken). PZMs and condenser microphones may use a mini-XLR cable.

**¼ inch PHONE jack cables** (Hi-Z) connect some microphones and many other components to mixer or to each other. Speakers sometimes use this type of connector, too. As a cable, this risks signal degradation over long runs.

**Mini-phone jack** is what you use for regular headphones, etc.

**RCA or phono jacks** are sometimes used to connect audio components together. They have a single pin surrounded by a cylinder separated into three curved sections.

### Sound system components

**Sound source:** speaker/singer microphone, CD player; computer; tape deck; and I-Pod; etc.

**Cable to microphone:** connects sound source to microphone/audio input.

**Mixer:** “board” that receives signals from various audio sources, permits adjustments, and combines sounds.

**Amplifier:** boosts signal strength (sometimes separate from mixer; sometimes not).

**Cable to speakers:** connects amplified final mix to speakers.

**Speakers:** sends your sound program to the audience.

**Monitors:** sends the program sound or a separate signal to an independent set of speakers—in dressing rooms, backstage, on stage, etc., (require their own amplifier).

### **Sound board elements**

**Inputs:** both XLR and phone jack inputs are typical for each microphone channel.

**Gain:** a “pot” (potentiometer) or dial to adjust for the sensitivity of that channel’s microphone; may have a “pad” button for further adjustment (experiment—a *peak* light indicates high volume).

**Equalizers:** dials that divide the channel’s sound into four (may vary) frequencies from high to low that can be adjusted separately to achieve different tones and effects (experiment).

**Foldback (FB):** dial(s) that send the channel’s sound to a monitor system—like backstage, or your dressing rooms—if the equipment is set up to do so (requires a separate amplifier to be turned on).

**Echo:** adds that channel to whatever special effect setting is configured.

**Pan:** sends the channel’s signal to either the right or left speakers.

**Fader:** slider that determines the volume of the channel’s signal sent to the mix.

**Mute:** cuts off the signal for that channel.

**Program (various synonyms):** sends the mix of channels out to the house speakers.

**Line-in:** inputs for use with CD players, tape decks, etc.

**Auxiliary volume:** adjusts volume of CD, tape deck, items from Line-in inputs, etc.

### **Sound effects**

Digital effects from CDs or Internet download such as SoundDogs, SoundFX, etc., (Can be played from any sound source into your mixer/sound board—Digital sources, i.e., computer, I-Pod, etc., avoid the delay of the equipment getting up to speed. Software programs like Adobe Audition or (Mac) GarageBand help create custom sound clips. Programs like Sound FX help organize, identify, and play sound clips).

### **Basic microphone set-up**

1. Plug in the microphone. Note which microphone input number is being used (experiment if necessary, but then post a chart ID'ing which input number is where).
2. Turn on the soundboard and amplifier, if necessary.
3. Bring up the microphone fader that matches the input number
4. Bring up the fader for main program mix.
  - a. Adjust as necessary. Play with fader level and gain. Assure that the microphone is turned on.
  - b. Recognize that individuals speak differently, so further adjustment will be necessary unless the microphone is tested with the final user.

### **Show set-up for microphones**

Floor microphones at the edge of the stage, and several hanging microphones, should do a good job of general amplification. Placement is crucial, and each space is different. Microphones can even cancel each other out if placed badly (experiment). All cues should be designed, created, and tested before your technical rehearsal(s), even if it has to be in pantomime or with substitute equipment. This will buy valuable time for crucial adjustments during subsequent rehearsals.

For musicals, body microphones are recommended, and they are difficult to work with. Try using blocks of wood/string/paperclip to get actors used to fetching and returning them on cue and to help costume dressers determine where to add pockets for the transmitter. Making elastic body microphone belts can be helpful. If the microphones drop, they may never work reliably again. Use a fresh battery in each one for each performance. Beware of open microphones backstage. Plot out who wears which one (color code them on the transmitter, receiver, and sound board) when the microphones are to be worn, and who places and fetches them at the start or end of each rehearsal or performance. Write in cues for each microphone to come up and down as entrances and exits occur.

Placing your soundboard in the back of the house can increase accuracy of adjustment, since the board up hears what the audience hears. Be sure to gaff down cables to avoid tripping hazards.

You may need monitors on stage, or in the pit, so that the actors and conductor can hear what's going on.

**Suggested Safety Announcement:** "Welcome to the show! Please take a moment to note the nearest exit. In case of emergency, WALK, DO NOT RUN TO THE NEAREST EXIT. Please be reminded that the taking of flash pictures during the show is strictly forbidden, as it distracts the audience and can be dangerous to the actors. No food or drink is permitted in the theater. Please turn off cell phones because they disrupt the signals of our wireless microphones when they are in silent or vibrate mode. Thank you very much. Enjoy the show!"

## Sound Cue Sheet

### Create a spreadsheet that lists the following information in columns:

**Pg** = page of script on which audio effect occurs.

**Cue #** = sequential number of audio cues (consider even #'s only, to leave gaps for late additions).

**Cue** = action or line of dialogue that immediately precedes audio effect.

**Effect/Mic #** = microphone number (or color) to be adjusted, or description of sound effect, music, etc.

**Fade-up time** = number of seconds from silence to "full" volume ("Bump-up" = immediate).

**Vol** = loudest volume (on a scale of 1 – 10) that this cue will use.

**Fade-out time** = number of seconds from "full" volume to silence ("Bump-out" = immediate).

## Lighting Basics

### Specifications

#### **Certification**

Technicians working with the stage lighting system must be certified by the technical director and must have a current parental permission form on file (see Appendix B).

#### **Alterations and Repairs**

School personnel may not make any alterations to permanent electrical systems or lighting instruments. Requests for changes must be submitted to the building service manager.

#### **Permissible Adjustments**

- a. Re-hanging and refocusing of instruments
- b. Re-circuiting at the hanging position
- c. Changing color media or pattern templates
- d. Using extension cables
- e. Replacing burned-out lamps

#### **Extension Cables**

The only type of cable acceptable for use as an extension cord for a lighting instrument is 12-gauge (20 amp capacity), 3-conductor (grounded), protected with type *S*, *SO*, *SOO*, *SE*, *SEO*, *ST*, *STO* or *STOO* insulation. The cable type can be identified by the permanent inscription found on the external insulating jacket. The acceptable cable mark is "12/3 AWG" followed by one of the letter codes: S, SO, SOO, SE, SEO, ST, STO, STOO.

Note: Cable with the mark "SJ" is not acceptable for use with lighting equipment. The 12/2 SJ or 14/2 SJ cables can be used for audio speakers, provided they have the correct type of connectors.

## **Approved Equipment**

All lighting instruments must be listed by a recognized independent testing laboratory such as Underwriters Laboratories (UL) or Electrical Testing Laboratories (ETL), and bear the UL or ETL label.

## **Guidelines**

### **Inspection**

Inspect each instrument as it is being hung and focused to determine if the equipment is both mechanically and electrically safe to use. *Instrument* refers to any type of stage lighting device—*fresnel, ellipsoidal, PARcan, scoop, striplight, cyc light*, etc. Potential problems with extremely dangerous consequences include the following:

- a. Cracked C-clamps
- b. Stripped or missing bolts
- c. Cracked or broken lenses
- d. Missing safety cables
- e. Loose wires or fiberglass insulating sleeve
- f. Exposed electrical conductors
- g. Rattling parts—Remove from service equipment found to be faulty, and label it, "DANGEROUS, DO NOT USE,"—and provide a brief explanation of the problem. Request repair using the "Work Order " process.

### **Hanging**

When hanging instruments for use, clamp them tightly with a wrench. Mount a safety cable immediately after the instrument is clamped in place.

### **Attachment of Accessories**

Exercise great care when using a *color frame, pattern holder, barn door, or snoot* with an instrument. Check to ensure that these items are correctly installed and cannot accidentally slip out of the instrument. *Downlights*, or instruments that are nearly perpendicular to the stage, are particularly at risk. Keep *lens barrels* of ellipsoidals and *lens doors* of fresnels tightly secured. Location of safety cables can be ensured by always keeping a safety cable with each lighting instrument.



## Fire Prevention

Hang instruments with careful consideration given to fire hazards. Do not focus instruments directly into cables or other equipment. Place instruments so as not to create a hazard when a curtain is drawn at a later time. Instruments should be hung in such a manner that the lens end of the instrument has at least 48" of clearance and the sides and back have at least 18" of clearance. Under NO circumstances should stage lighting be left unattended!

## Electrical Capacity

Always be aware of the *amperage* of the different electrical components being used and the *wattages* of the instruments. Have a thorough understanding of Ohm's law as it applies to the power formula in order to prevent overloading electrical equipment (see explanation at the end of this section). Theatrical lighting receptacle in a Montgomery County Public School theater is 20. There is usually only one receptacle per circuit. On occasion, there will be two. This number may be increased by the use of *twofers*, bearing in mind the total amp capacity of the circuit. There always will be only one circuit per receptacle; this number cannot change.

## Plugging in Equipment

When plugging an instrument into a circuit, make sure that the power to that circuit is OFF. Never "*hot patch*" electrical equipment. (This requirement also applies to inserting a dimmer module into its rack.)

## Thermal Protection

Since lighting instruments operate at very high temperatures and can cause serious burns, wear leather gloves while focusing, and EXERCISE EXTREME CAUTION to protect other exposed skin from accidental burns.

## Lamp Replacement

When an instrument requires a lamp replacement, take the following steps in the order listed. The usual range of wattage for a typical theater lighting instrument is 500–1000 with the exception of cyclorama strip lights, which can be 300 watts.

- a. Turn off power.
- b. Unplug instrument.
- c. Allow lamp to cool.
- d. Remove old lamp using gloves, since the lamp may still be warm. The glass envelope might break, or the lamp might still be good—if malfunction is due to some other cause.
- e. Check lamp type to be sure that the replacement is of proper wattage, base type, and light center *length (LCL)*.
- f. Use clean cotton or plastic gloves to install new lamp. Do not touch glass envelope with bare hands, since natural skin oils will destroy the quartz glass. If the glass is touched accidentally, wash it off immediately with alcohol and allow it to air dry.

- g. Make sure the lamp is securely seated, and the *lamp housing* is properly closed.
- h. Replug the instrument into the circuit.
- i. Use *dimmer* to slowly energize the circuit.

### **Instrument Storage**

Store lighting instruments carefully, to prevent damage. Gently coil the electrical lead to prevent the plug from getting caught and pulled. Push lens barrels and shutters fully into the instrument and tighten *yoke bolts*. Store instruments clamped to a storage pipe, if possible. If space does not allow storage of instruments clamped to a storage pipe, place lens end down on a clean surface out of the way of other activity. Instruments stored on the catwalk must be secured with a safety cable to keep them from falling.

### **Securing Overhead Electrical Cables**

When cables are mounted above, secure them properly to keep them from falling. Cord, jute, cotton or tie lines, *gaffers tape*, or *duct tape* are acceptable means of attaching cable to *battens*. Do not use masking tape.

### **Securing Electrical Floor Cables**

In order to prevent a tripping hazard, avoid placing cables on the floor if at all possible. If it is absolutely necessary to do this, choose locations that have the least impact on foot traffic, such as the bases of walls, or under platforms and risers. When placing the cables, clean the floor of loose dust and debris first, then arrange cables flat on the floor in a smooth, neat manner and tape down securely with *gaffers* or *duct tape* to keep them in place. In areas where scenery pieces or numerous performers must cross, cover the cables with a *protective wood curb and gutter*, or with a commercially available rubber cable cover such as Flex-I-Duct.

### **Electrical Cable Storage**

Properly stored cables that are not being used should be coiled neatly and individually, tied or taped, and placed in a location that will protect them from physical abuse—such as being walked on, having scenery stored on them, or having any contact with moisture.

### **Dimmer Security**

Keep the dimmer rack doors closed and locked while the system is operating. For schools that have fewer dimmers than the total number of lighting circuits, the doors may be opened by an adult supervisor so that the dimmer modules may be re-plugged.

### **Protection of Control Board**

Do not allow smoking, eating, or drinking in the control booth. Accidental spills have ruined lighting control boards. When the control board is not in use, it must be turned OFF and its protective cover must be in place.

## Strobe Effects

If strobe lights are used for a performance, provide a clearly visible sign at all entrances to the auditorium that states: NOTICE: STROBE LIGHTS WILL BE USED.

## Power Formula

The power formula is used to determine the amount of electrical energy consumed in an electrical circuit. This formula is derived from Ohm's law and is also called the "West Virginia" or "Pie" formula.

### West Virginia formula:

W = power in watts

V = voltage in volts

A = current in amperes

W = VA Use this equation to determine watts.

A = W/V Use this equation to determine amps.

V = W/A Use this equation to determine volts.

### "Pie" formula:

P = power in watts

I = current in amperes

E = voltage in volts

P = IE Use this equation to determine watts.

E = P/I Use this equation to determine volts.

I = P/E Use this equation to determine amperes (amps).

## Example

To determine the amperage load of an electrical circuit, the only information needed is the total wattage of the instruments plugged into the circuit. The voltage for all Montgomery County Public Schools' theaters can be assumed to be 120 volts. If two 750-watt instruments are plugged into a circuit, the formula is set up as follows:

### Formula

A = W/V ("West Virginia" equation to determine amps)

W (watts) = 2 x 750 = 1500

V (volts) = 120

A = 1500 (watts)

120 (volts)

A (amperes) = 12.5

## Terminology

**Batten**—the pipe from which an instrument hangs.

**C-clamp**—the curved piece of metal on which an instrument hangs from its batten.

**Circuit**—the places where you can plug in an instrument, plus hidden wiring (Note their numbers!).

**Channel**—the sliders on the lighting board to bring up the intensity of a dimmer.

**Dimmer**—the electronics that control (as instructed by its channel) how much electricity goes to a circuit.

**Gel**—the colored plastic used to tint light (goes in a gel frame within the light's gel frame holder).

**Gobo**—a stencil of thin metal placed in a Leko to cast its pattern (there are LOTS) on the stage.

**Instrument**—the whole stage light.

**Lamp**—bulb (500, 750, and 1000 watts are typical); Identified by a 3-letter code (e.g. FEL).

**Pigtail**—the cord that is part of the instrument.

**Safety chain**—airplane cable with clasp, looped around yoke and batten.

**Stage pin plug**—the plug shaped like a rectangular box with three pins sticking out.

**Yoke**—the U-shaped metal from which the instrument hangs, to which the C-clamp attaches.

### Types of lights

**Cyc Light**—a strip of lights (3, 4 or 40) in large inflexible housing, for lighting a backdrop or cyclorama (identified by the multiple pigtails/plugs coming out of it).

**Ellipsoidal (*Leko*)**—long light with long name, best for a long throw of light (Identified by the four shutters sticking out of top/bottom/right/left. Can be sharply focused, used with gobos, etc. A "Source 4" is a popular example.)

**Follow Spot**—a huge ellipsoidal mounted on a rotating stand, moved by an operator to track actors' movement. (Size, sharpness and color of the beam are all adjustable by the operator.)

**Fresnel**—basic short throw light; boxy shaped with lens cut into concentric circles. (Best for short throw of light (black box or above stage.) Can be focused but not sharply—shutter with barn doors.

**Intelligent lights**—all the flexibility of a follow spot (and then some), but controlled by software instead of a person (very expensive and complicated—Techno-Beam; Mac 500; IntelliBeam are examples).

**PAR can**—like a patio light in a metal tube (simple, tough, inflexible, and you can add color) .

**Scoop**—a huge bowl with a lamp in the middle. (Used for work lights or a wash of color on the stage.)

**(Suggestion:** Set up one of each type of instrument aimed from the same distance at the same spot. **Compare:** How large an area is lit by one light from what distance? Try focusing, adjusting, etc., each scoop (as possible) to see what difference it makes. How many areas would it take to cover your entire stage—if you overlap them?

## **Design**

### **The ADDIE system:**

#### **A—Analyze**

**What do you have?** Tally your inventory of working equipment (repair as necessary) and supplies.

**What do you need?** Go through the script to find scene breaks, mood changes, special effects, etc. Note large and small areas to be lit, practicals—(like on-stage lamps)

#### **D—Design**

Decide what you want things to look like. Take it one “look” at a time. What colors match the mood of the scene? What moments can be enhanced with dramatic lighting? What color will the lights be—behind the action of the play, at each moment? Number these cues as your first draft.

#### **D—Develop**

What must happen to bring your vision into the real world? (This is the experimentation phase.)

### **Sequence**

1. Draw a scale ground plan, overhead view of your stage.
2. Draw your set design on a copy of your stage “ground plan.”
3. Divide the set into areas to be lit. Label each one.
4. Pick one area and determine where to place appropriate instruments to light it. Place one instrument 45 degrees up and over to the left, and one to the right. Back light if you can. (You are likely to have to compromise on where (which circuit) you actually can place these instruments
  - a. Record the circuit #'s you select at this point.
  - b. Record the instrument type you select (templates for clear drawing are available).
  - c. Indicate hang versus plug location—if it varies.
  - d. Record gel number and color to use for each instrument (NC = no color). If you can, gel one front light with warm colors (rose, amber, etc); and, the other light with cool colors

(blue). You can create a great variety of moods by varying the balance between the gels during the show.

5. Repeat this process (a.–d.) for each area of your set. You will really depend on the resulting hang plot (you might want to enlarge and laminate the set areas, so you can easily spot and make changes).
6. Hang the instruments where you have planned.
7. Go slowly through the show cue by cue, setting intensity levels and timing for each “look” that you designed. If your lighting board permits programming, do this now. If you can set “submasters” for each area and/or each “look,” that will be very helpful, too.
8. Plan to make a million mid-course corrections and modifications as you rehearse. See what works or does not work; get inspired, etc.
9. If your light board can do so, record a copy of all cues each day (and secure a duplicate!). One power surge and all your cues are gone.

### **I—Implement**

Actually run the lighting as you planned it.

### **E—Evaluate**

Take the time to discuss and record what went right, what needs improvement, who to go to for help, what to do when, etc. If you set up a place on Blackboard, all future lighting people can build on the lessons learned from their predecessors.

The construction of stage scenery usually requires the use of hand and power tools. **Accidents involving tools are among the most common causes of injuries in theaters.** The manufacturers of tools are concerned with safety and make every effort to design their tools to provide the greatest possible protection for the user. However, the single most important factor in achieving safety is the user. Follow all manufacturer instructions and safety rules.

## **CATWALKS**

### **Specifications**

#### **Certification**

All students working on the catwalk must be certified for access by the drama director for the school. Certification requires parental permission, prior training, supervised experience in the theater, and passing a skills test.

#### **Supervision**

The technical director must be on the catwalk with student technicians at all times, and an adult observer must be located in proximity.

**Capacity**

No more than two student technicians and one adult supervisor (technical director) may be on the catwalk at any time.

**Guidelines****Security**

Keep the door(s) to the catwalk area closed and locked when the catwalk is not in use.

**“Drop Hazard” Prevention**

Empty pockets of all loose items prior to beginning work on the catwalk.

**Use of Tools**

Attach all tools to your body or the building structure with *safety tie lines* to prevent accidental dropping.

**Storage**

Carefully store supplies and materials pertaining to catwalk operations to prevent injury to technicians on the catwalk or to anyone below.

**Projectiles**

Do not throw or drop any items from the catwalk.

**Hoisting Equipment**

Use a sturdy rope to raise and lower lighting instruments to the catwalk. Smaller lightweight items should be carried up by the technician, or use a plastic bucket attached to the hoist rope. Do not allow anyone to stand beneath items being raised or lowered.

**Housekeeping**

Give special attention to housekeeping—do not allow food, drink, or tobacco products on the catwalk. Enforce “No Smoking” policy (no smoking in schools or on school property).

**Safety Cables**

Attach all lighting instruments, including those not in use, to the catwalk by safety cables. Safety cables are of critical importance for lighting instruments hung above the heads of members of the audience. Always check to make sure safety cables/safety chains are properly secured.

**Unauthorized Storage**

Do not store any items in the catwalk area that do not pertain to catwalk operations. Do not store any combustible items in the catwalk area.

**Unauthorized Access**

Do not leave the area of the catwalk to crawl along the roof trusses or to walk out on the ceiling for any reason.

### **Greatest Safety Risks**

- Falling
- Dropping something on someone below
- Going out onto the “ceiling” just beyond the catwalk, and crashing through onto the seats below

### **Troubleshooting**

- Don’t reach beyond your grasp.
- Use safety chains for every instrument hung. Attach safety chains before securing or adjusting the instrument.

### **Reminder**

Lock the door when the catwalk is not in use. Use both hands on ladders leading to the catwalk.

## **POWER TOOLS**

Following are specifications and guidelines for working with tools:

### **Specifications**

**Skills Test**—A student must achieve a perfect score on a written and practical skills test for each power tool he or she intends to use.

**Parental Permission**—Students using power tools must have a signed parental permission form on file at the school. An adult supervisor must be present when students are working with power tools.

**Authorized Tools**—The power tools that are approved for high school theater student use are: drills, power screwdrivers, saber saws, reciprocating saws, powered sanders, and powered miter box saws.

**Circular Saws**—Hand-held circular saws of any size are prohibited for student use.

### **Guidelines**

**Manufacturer's Instructions**—Understand the safe operation of any tool prior to using it. Read and follow the manufacturer's instructions completely.

**Clothing**—Be aware that proper attire is extremely important when working with tools. Remove loose jewelry and secure loose clothing to prevent entanglement with moving parts. Tie back long hair because it can be easily drawn into air vents of power tools or be caught in moving bits and blades. Do not wear gloves when working with power tools as they can get caught by a blade or bit. Gloves offer good protection from pinches and blows from hand tools.

**Eye Protection**—Wear ANSI Z87.1 approved safety glasses, goggles, or face shield when working with power tools.



**Attentiveness**—Stay alert at all times when working with tools, particularly powered ones. Many skilled workers have been injured because of simple mistakes that could have been easily prevented.

**Selection of Tool**—Select the proper tools for the job. Inexpensive hand tools often chip easily or break under stress. Do not use an undersized power tool to do heavy-duty work.

**Inspection**—Prior to using a tool, check for missing or damaged parts. Make sure all guards work properly. If a tool is dropped while work is in progress, recheck prior to continuing.

**Proper Adjustment**—Make sure that all bits, belts, and blades are tightly clamped. The speed at which power tools operate can cause parts to be thrown a considerable distance and at a high velocity.

**Removal of Adjusting Keys and Wrenches**—Remove all *adjusting keys and wrenches* prior to starting a tool.

**Extension Cords**—Whenever possible, plug power tools directly into an outlet, not through an extension cord. If an extension cord is necessary, make sure that the size of the wire is equal to or greater than the tool's cord and that the cord bears the "UL" label (Underwriters Laboratory listed). Never use an ungrounded *two-wire extension cord*.

**Care of Electrical Cord**—Do not abuse a tool's electrical cord. Never lower the tool to the floor by its cord.

**Securing Work**—Secure work with a vise or clamps whenever possible, so that both hands are free to control the tool.

**Proper Balance**—Do not overreach when working with tools. Maintain proper footing at all times.

**Work Speed**—Do not force tools. They will do the job better and safer at the rate for which they were designed.

**De-energizing**—Disconnect a power tool when it is not in use, and prior to making an adjustment.

**Battery Powered Tools**—Since battery-operated tools pose a special hazard in that they are always energized, remove the battery, if possible, prior to making any adjustments.

**Maintenance**—Maintain tools properly. Keep them clean to prevent loss of grip. Keep air vents free of sawdust and chips to prevent overheating. Keep bits and blades sharp so that tools are not overworked.

**Notification**—If a tool is found to be mechanically or electrically defective, tag the tool, "DANGEROUS: DO NOT USE" and remove it from service. A teacher or administrator must be alerted to the problem.

**Storage**—Store tools in their proper places when through working with them. Remove bits and blades, and carefully coil power cords to prevent damage. Make sure tools are clean prior to storage.

**WINCHES**—(for lowering and raising battens)

*Battens* that can be lowered or raised by means of *winches* can be great time savers. The hanging of lighting equipment is easily accomplished in a safe manner when the technician can stand on the floor and not have to use a ladder. Winches exert great force to lift the extremely heavy loads placed on battens. The safe operation of winches demands a thorough knowledge of and respect for the physical factors involved.

**Following are specifications and guidelines for the safe operation of winches:**

### **Specifications**

**Certification**—Technicians operating winches must be certified by the school's drama director.

**Supervision**—An adult staff member (drama director, theater director, or MST) must be on stage when any batten is being raised or lowered.

**Alterations**—No alterations or adjustments should be made to the permanently-installed components of a winch batten. Requests for repairs or changes must be directed to the building service manager or school administrator.

### **Guidelines**

**Identification**—Carefully identify the batten needed and locate the proper winch—before moving (or flying) a batten.

**Obstructions**—Check for possible obstructions that may foul the moving batten, such as microphone cables, curtains, scenery, lighting instruments, and lighting cables.

**Spotters**—Use as least one other technician as a *spotter* to watch the moving batten. If possible, use *two spotters*—one on each side of the stage.

**Protection of Personnel**—When a batten is being flown, ensure silence on stage, and warn other personnel. Do not allow anyone to walk or stand beneath a batten being flown.

**Unusual Sounds**—Listen for unusual sounds from the winch system or warnings from the spotter(s).

**Load Capacity**—Do not exceed the posted load limit for any batten.

**Fouled Battens**—Watch the travel of the batten and *wire-rope lift lines*. Stop if the batten should change angle, or if one or more of the lift lines are observed going slack.

**Operating the Winch**—Keep a hand on the winch handle at all times. Do not "slap" the handle to make it spin by itself because this action can cause a batten to descend rapidly out of control and become a "runaway."

**Runaways**—In the event of a runaway batten, Shout: "HEADS" as a warning and immediately clear all personnel away from the path of the batten, lift lines, and the winch. (When a runaway comes to an abrupt stop, the shock can cause breakage of lift lines and *loft blocks*, creating a secondary fall hazard.)

**Notification**—Immediately notify school administration and the Area Division of Maintenance Depot, Department of Facilities Management if there is a runaway or any other unusual situation with any winch system.

## LADDERS

Ladders are essential tools to theater operations because it is necessary to adjust stage lighting, assemble, and paint tall scenic units, and hang microphones. Their use and care must be monitored to protect the safety of the person using the ladder and the people working on the ground below the climber.

**Following are specifications and guidelines for the use and care of ladders:**

### Specifications

**OSHA Rating**—Ladders for stage use must have an *OSHA* rating of Type 1 (heavy duty, 250 pounds) or Type 1A (extra heavy duty, 300 pounds). Ladders having an OSHA rating are labeled accordingly.

**Electrical Shock Prevention**—Ladders used for lighting or other electrical work must be made of fiberglass or wood. Metal ladders may not be used.

**Ladder Types**—(Extension ladders or straight single ladders may not be used.) Self-supporting step-ladders, platform ladders, or A-frame ladders (without center extension) are acceptable.

### Guidelines

**Inspection**—Maintain ladders in good condition at all times. Prior to each day's use, inspect ladders to ensure that the joints between steps and side rails are tight, all hardware and fittings are securely attached, and moveable parts operate freely without binding or undue play.

**Damaged Ladders**—Do not use ladders with broken or missing steps or with broken side developed defects. Tag or mark DANGEROUS: DO NOT USE.

**Cleanliness**—Keep steps and side rails clean and free of all foreign material, including wet paint, mud, snow, grease, oil, or other such substances.

**Painted Ladders**—Do not paint wood ladders with opaque coatings because these disguise splits, cracks, and other defects.

**Work Area**—Use a ladder on a flat, firm base. Keep the surrounding area clean.

**Level Surface**—Do not climb a ladder on a sloped surface such as a ramp on a stage set or an aisle in the auditorium.

**Unstable Surfaces**—Do not place ladders on desks, boxes, barrels, or other unstable bases to obtain additional height.

**Use Near Doors**—Do not use a ladder in front of a door that opens toward the ladder, unless the door is blocked open or guarded.

**Proper Deployment**—Use only ladders that are fully opened, with the *spreaders* locked in place.

**Climbing**—When climbing a ladder, keep body centered between the side rails and do not overreach. A good work practice is to never allow your belt buckle to cross either side rail. Face the ladder when climbing up or down, and maintain a firm grip using both hands.

**Proper Climbing**—Climb only on the front side of the ladder (using the rungs or steps), not on the brace side. Only one person at a time may be on a ladder.

**Maximum Height**—Do not climb, stand, or sit above the second step from the top of the ladder.

**Securing Tools**—Secure tools and other objects against falling while work is being performed from a ladder. Use safety tie lines to attach tools to the body. Never leave tools or equipment on a ladder. Never drop or throw tools or equipment to another worker.

**Moving a Ladder**—Do not attempt to move a ladder while a person is on it.

**Storage**—Store ladders properly indoors in such a way that they are not subjected to physical abuse, such as storing or dropping heavy items on them.

**Substitutes**—Do not use a chair, table, or any other substitute in place of a ladder.

## SET CONSTRUCTION

The production of scenery for the theater is a specialized craft that combines artistic interpretation with basic practicality. Theater arts training emphasizes creativity and experimentation between the director and the design staff. It is impossible to establish standard guidelines that cover all scenery designs because of the infinite variety of possible visual solutions to any single staging problem. While it is recognized that one of the primary functions

of scenery is to help the audience transcend time and space, physical laws cannot be ignored. The purpose of these specifications and guidelines is to establish minimum safety standards without detracting from the artistic design.

**Following are specifications and guidelines for the design and production of scenery:**

### **Specifications and Guidelines**

**Design Hazards**—The design and use of scenery must not pose any health or safety risks to audience, actors, students or technicians.

**Materials Hazards**—Materials for construction of scenery that would pose a toxic risk to people or the environment must not be used.

**Fire Prevention Code**—All scenic elements described in these guidelines (such as flats, platforms, stairs, ramps, and trap doors) will be considered "decorative material" as covered by Section 805 of the International Fire Code; also refer to regulation EBA-RA, Fire Safety.

**Flame Retardant**—Combustible materials must be treated with an approved flame retardant (refer to regulation EBA-RA, Fire Safety).

### **Platforms**

**Standard Platforms**—Use standardized platform units whenever a raised walk surface is required for stage scenery. A standard platform is a reusable basic building block for creating larger, more complex surfaces.

**Following are specifications for the materials to be used for the construction of scenery walk surfaces:**

**Sizes**—Basic unit measures (4 feet x 8 feet), or the size of a sheet of plywood. Sizes of other stock units that may be useful include (2 feet x 8 feet), or (4 feet x 4 feet), and triangles with (4 x 4 leg and 4 x 8 right and left leg).

**Materials**—Top surface measures (3/4-inch thick) CDX grade plywood. This material is economical, stronger than particle board, and readily available.

**Frame**—Stud grade (2 x 4)

**Legs**—Stud grade (2 x 4)

**Leg Attachment**—Two (3/8 inch x 3 1/2-inch long) hex head bolts for each leg

**Platform-to-Platform Attachment**—Two to four (3/8-inch x 3-1/2-inch-long) hex head bolts (depending on length of contact surface)

**Top Surface Attachment**—2-inch long drywall or wood screws. Screws resist tension force (the tendency to pull apart) better than nails. The tops of platforms should not be glued, allowing for removal if replacement of a damaged framing member becomes necessary.

**Framing Attachment**—(3 ½ inch long) wood screws or galvanized deck screws. Regular drywall screws should not be used, since their resistance to shear force is not as great. Nails should not be used. They provide good resistance to shear force but perform poorly against tension force.

**Required Number of Legs**—Provide six legs for a standard (4 feet x 8 feet) platform. If more than one standard platform is used to create a single height surface, adjacent platforms that are properly bolted together may "share" support legs.

**Cross Braces** - Attach (1-inch x 3-inch) wood cross braces to the legs of any platform over (2 feet) in height. Cross braces should form an "X" pattern on the sides and ends of the platform. The braces should be attached within (9 inches) of the bottom of the leg.

### **Fall Protection**

**Design**—Incorporate sufficient area into the design of a raised platform. Actors must not be endangered by performing on a platform that is too small (refer to Appendix C).

**Off-Stage Railings**—Provide railing for all "off-stage" exposed edges of a raised platform with the railing (not less than 36 inches or greater than 48 inches in height). The railing must be strong enough to stop a person who has stumbled or inadvertently walked into it. Vertical and horizontal pieces of the railing must be made from (2 feet x 4 feet) or stronger material. Vertical supports must be bolted to the platform (with a maximum spacing of 48 inches).

**On-Stage Railings**—Whenever possible, provide railing for the "on-stage" exposed edges of platforms. If railing is inappropriate to the design of the scenery (such as a rock cliff), mark the top surface of all exposed edges with paint or tape of a contrasting color to the scenery.

**Visibility**—Whenever possible, avoid having performers move about in the dark. This is often impossible, and at such times *glow tape* should be used to mark the "on-stage" edges of hazards. Small, low wattage lamps should be used to illuminate "off-stage" platform edges and stairs.

### **Stairs**

**Risers**—Construct stair units with risers of equal size. The riser height for normal stage use is (either 6 inches or 8 inches).

**Treads**—Construct stair treads (with a minimum depth of 10 inches). Treads must be made (from ¾-inch plywood or 2 x 12).

**Handrails**—Provide handrails for all "off-stage" stairs, and whenever possible, for all "on-stage" stairs. Handrails must be constructed and mounted in the same way as those described in paragraph 2 of the "Fall Protection" section. *Ships ladder type stair units* are acceptable for use both on stage and off, but they must have a handrail on both sides of the stairs.

**Cross Bracing**—Provide substantial cross bracing and support for stairs. Stairs receive more physical abuse than platforms because of the repeated shock load of the body weight of actors climbing and descending the steps.

### **Ramps**

**Maximum Slope**—Avoid designing ramps with slopes greater than 1:4. (For every 4 inches of horizontal travel, the ramp should rise no more than 1 inch.)

**Slip Prevention**—If it is necessary to have a ramp with a slope greater than 1:4, provide a nonskid surface, such as sand-textured paint or a commercially available adhesive-backed nonskid surface.

### **Trap Doors**

**Design**—Use extreme caution when designing trap doors for stage sets. The trap door must have the same load-bearing capability as the rest of the platform surface. All edges of the trap door and the hole in the platform must be framed with 2 x 4 on edge. Hinges must be heavy-duty and closely spaced. The latch mechanism can best be accomplished using a section of 1-inch (inside diameter) schedule 40 steel pipe. The pipe is slipped through holes drilled into the platform and trap door frames.

**Notification and Inspection**—Notify the Division of Construction, 240-314-1000, if a trap door is planned for a show. The design must be reviewed and approved prior to construction and inspected before the first rehearsal use. Trap doors are usually simple devices to construct properly.

### **Flats**

**Size**—Design scenery flats (vertical surfaces) so that they can be easily handled. Flats wider than 6 feet and taller than 12 feet are difficult to move and store. Reusable stock scenery flats with standardized dimensions (such as 4 feet wide and (8 feet to 12 feet high) work well to create large wall surfaces, yet are not difficult to store.

**Materials**—Use flame-retardant scenery muslin (FR), and (1 x 3 framing) for traditional scenery flats. Make corner blocks and keystones to join the flat frame from 1/4-inch AC-grade plywood.

**Construction**—Align the wood grain of corner blocks and keystones so that they run perpendicular to the joint of the (1 x 3 frame).

**Hard Cover Flats**—Use masonite, upsom board, or lauan plywood to make hard cover flats. The framing is the same as for muslin flats, but no corner blocks or keystones are required.

**Hardwall Flats**—Hardwall flats should be used if a more stable scenery wall is required. Hardwall flats have a (1 x 3 frame) assembled on edge, not flat like those for muslin or hard cover flats. Corner blocks and keystones are not required, and the covering is the same as those for hard cover flats.

**Covering**—Use flame-retardant muslin over the hard surface if hard cover or hard wall flats are to have a smooth grain-free surface for painting.

**Bracing**—Brace all flats so that they cannot fall and cause injury or come in contact with hot stage lighting instruments.

**Borders**—Contact the Safety Section for approval to mount scenery borders that are constructed as flats from battens. Borders must be of lightweight construction and must be securely mounted to prevent falling. Borders must be tested to ensure flame resistance.

**Glass**—Do not use glass windows for stage scenery. The effect of glass can be created using heat shrink window insulating plastic or aluminum window screen.

**Flame Retardant**—Treat all combustible scenery with a flame retardant. Commercially available products in the form of powders and liquids can be used as a paint additive or sprayed onto fabrics (refer to Regulation EBA-RA, *Fire Safety*).

**Plastics**—Rigid cellular plastics, such as polystyrene "blue board" or other building insulation, may be used for scenery construction if they are completely encapsulated using plaster joint compound or some other approved coating. Approval from the fire marshal is required before construction can begin. Contact the Montgomery County fire marshal's office at 240-777-2465.

### Set Strikes

**Scheduling**—Schedule set strikes (dismantling) as soon after the final performance as possible. Strikes should be completed within 72 hours. Unattended sets attract the attention of vandals.

**Organization**—Carefully organize set strikes. All participants should be protected from accidents caused by haste. Teams of people with specific responsibilities should be established.

**Personal Protection**—Ensure that all those participating in a set strike have proper clothing and that they pay particular attention to hand and foot protection.

**Scrap**—Do not salvage lumber shorter than 2 feet in length. Such scraps are rarely used again and only become a fuel source for fire.

**Removal of Hardware**—Remove all nails, screws, and any other hardware from lumber before it is stored. This is a task that is often ignored because of time constraints, but carelessness in this area has become a major cause of injuries.

**Stage Floor**—Carefully check the stage floor after a set strike to ensure that all protruding hardware, such as nails and staples, have been removed. Pushing a snow shovel or a piece of plywood across the stage is a good way of finding any remaining hardware.

**Storage**—Establish well-defined areas for scenery storage. Emphasis should be placed on good housekeeping to prevent injury caused by falling over scenery or by being hit by dislodged set pieces.



**Fire Prevention**—Carefully stack and organize lumber and other scenery materials because a loose pile of boards provides greater exposure to the risk of fire. (Disorganized materials are too difficult for most people to access: therefore, used materials are rarely used again. Refer to Regulation EBA-RA, *Fire Safety*.)

### **Inspections**

**Structural**—Contact the Division of Construction, Department of Facilities Management, 240-314-1000 to request an inspection of stage scenery. Early inspections will prevent costly mistakes and omissions that can develop into safety hazards.

**Flammability**—Combustible materials that have been treated with a flame retardant should be tested to ensure fire resistance. (Refer to Regulation EBA-RA, *Fire Safety*.)

**Scheduling**—Send production schedules to the coordinator of Secondary Art, Theater, and Dance, Department of Curriculum and Instruction at 301-279-3834, and to the Division of Construction, 240-314-1000, as soon as possible for guidance and construction inspection purposes. Two dates should be identified, the first being prior to the start of construction. At this time, the design of the set will be discussed and potential hazards identified. Recommendations for structural safety and fire safety will be made. The second date should be when the scenery is completed and ready for the first use by actors. At this time the set will be inspected for structural and safety purposes. Any deficiencies will be explained and a course of corrective action recommended.

## **SPECIAL EFFECTS**

The purpose of theater is to tell a story using various effects. Actors use voice and body movement to create the effect of bringing the playwright's character to life, while designers create the effect of a different time and location. Skilled directors and their students make these effects seem natural, and take pride in pushing the audience to believe in the transformation presented on stage. Sometimes the script calls for events that do not occur naturally indoors. Fire, explosions, precipitation, or spirits flying through the air are all examples of "special effects." The techniques involved in creating special effects require particular attention to assure the safety of the cast, crew, and audience.

**The following are specifications and guidelines for the creation of special effects in theater:**

### **Specifications**

**Approved Electrical Equipment** – All electrical devices must be listed by a recognized independent testing laboratory—such as Underwriters Laboratories (UL), or Electrical Testing Laboratories (ETL)—and bear the appropriate label for that laboratory, certifying the approval listing.

**Flying**—Student performers are strictly prohibited from being “flown” or levitated by any means unless the effect is provided by an approved vendor. An approved vendor is one whose primary profession is flying performers and has an established history of safety. Vendor approval must be obtained from the coordinator of secondary art, theater, and dance, Department of Curriculum and Instruction at 301-279-3834, and to the Division of Construction, 240-314-1000.

## **Guidelines**

### **Chemical Fog**

**Approved Devices**—Ensure that the machine selected is designed for producing fog effects and that it bears a label showing that it has been tested by a recognized independent testing laboratory.

**Use Correct Fog “Juice”**—Make sure that the liquid selected for use is from the same manufacturer as the fog machine. Fog “juice” comes in a variety of scents that can counter audience concerns that an actual fire has broken out. Note that some products are designed to create a low ground fog, while others are designed to rise up in the air.

**Material Safety Data Sheet (MSDS) Availability**—Make sure that a Material Safety Data Sheet (MSDS) is available for the chemical that is used. The MSDS sheet is available from the vendor or manufacturer of the fog chemical. Read the MSDS sheet to learn of health hazards, proper handling, and proper disposal. Obtain approval of this product prior to use by submitting the MSDS to the Division of Maintenance, Environmental Services, at 301-926-4409, or Department of Facilities Management, Safety Services, at 240-314-1070.

**Avoid Fires**—Fog machines are generally safe, but the front end where the fog is emitted can become very hot. Avoid touching the machine near the front end, and place the machine where the heat cannot ignite any materials. Note that they typically require a few minutes to warm up.

**Avoid Activating Smoke Detectors**—Heavy use of fog can set off smoke detectors in some schools. Some stages have easily identifiable smoke detectors, similar in appearance to smoke detectors installed in homes. Other smoke detectors cannot be readily seen since they are installed inside of air ducts. The following are steps to be taken to determine if a fog machine can be used without activation of a smoke detector.

**Schedule a Test**—Notify the principal and building service manager of the intended use of a fog machine. Select a time after school when classes are not in session.

**Notify School Administration and School Security, Electronic Detection Unit**—Contact school administration (main office) and security at 301-279-3232. Inform the school’s main office that you are going to conduct a smoke/fog test that may activate the fire alarm system and request that school administration and the electronic detection unit operator be aware of this. If the fire alarm is activated follow fire notification procedures by dialing 9-911 and evacuating the building. Request permission to re-enter the building and explain what set off the fire alarm to the fire department. Only the fire department can grant re-entry back into the building once the fire alarm system has been activated.

**Activate the Fog Machine**—Produce the amount of fog that will be required for the performance. If the fire alarm does not activate, note the amount of fog to be used. If the fire alarm activates, follow fire evacuation procedures and reduce the amount of fog to the proper amount.

**Immediately Following the Test**—Contact school administration (main office) and School Security, Electronic Detection Unit, to inform them that the smoke/fog test is over.

**Audience Notification**—Post a lobby and program notice that a fog effect will be used and to contact a production representative if patrons have a question regarding safety. If the fire alarm is activated during the performance, fire evacuation procedures must be followed. (Persons with respiratory problems may be easily affected by chemical fog. Having the MSDS sheet available will help them determine if they need to take any action, such as selecting a seat farther away from the stage.)

### **Dry Ice Fog**

**Thermal Hazard**—*Dry ice*, the common name for frozen carbon dioxide, is extremely cold with a temperature of minus 109 degrees Fahrenheit. Bare skin will freeze very quickly when in contact, causing severe blistering or frostbite. Use heavy gloves and tongs whenever handling dry ice.

**Storage**—Dry ice will change from solid to gas very quickly unless properly stored (the process is called *sublimation*). Dry ice should be placed in a Styrofoam cooler with a lid that does not latch firmly in place. As dry ice sublimates, the gas expands causing pressure in whatever container in which it is stored. For this reason, never place dry ice in a sealed glass jar or metal can. The expanding gas will explode the vessel and can cause serious injury.

**Avoid Breathing Excessive Amounts of Gas**—Carbon dioxide gas is what is exhaled when we breathe. Inhaling too much can cause loss of consciousness with the possibility of suffocation. Avoid using dry ice in a closed room lacking good ventilation. When transporting dry ice, be sure to keep a window partially open. Whenever working with dry ice, be aware of the onset of the need for heavy breathing or gasping for air: this is a sign that carbon dioxide levels are too high, and fresh air is needed.

### **Snow**

**Artificial Snow**—Commercially available loose snow can be very effective for set dressing. Select the type that is biodegradable to avoid the problem of disposal.

**Snow Cradles**—Loose, artificial snow can be sprinkled from above the stage by using a snow cradle. A snow cradle can be easily constructed from a sheet with slits. One side of the sheet should be secured to a length of lumber or pipe that is mounted in a fixed position. The other side of the sheet is attached to a similar item but is attached to a pulley system. The two sides of the snow cradle are mounted within (12 inches to 24 inches) of each other. When the side mounted to the pulley system is jostled, the artificial snow falls randomly through the slits.

**Snow Machines**—Powered snow machines, which use a liquid chemical and a blower, can produce a very effective driving snow. Follow the same guidelines for chemical fog as stated above.

**Aerosol Snow**—Spray cans of artificial snow are easy to use for dressing the set. They are very effective for frosting windowpanes and “outdoor” foliage.

**Strobe lights**—Strobe lights have the potential to trigger epileptic seizures. Post a clearly visible sign at all entrances to the auditorium that states “Notice: Strobe Lights Will Be Used During This Performance.” Provide a similarly written warning in the printed program.

**Confetti Canons**—Plan the placement of confetti canons to avoid striking performers or audience members with confetti. Avoid directing confetti towards the lighting catwalk. If confetti is dispersed in the catwalk, remove the material using a shop vacuum cleaner. Follow all safety measures for working on catwalks.

**Other Special Effects**—Contact the coordinator of secondary art, theater, and dance, Department of Curriculum and Instruction, at 301-279-3834 to obtain approval if special effects other than outlined in this section are planned. Always use commercially available devices, whenever possible, to help ensure approval.

## LIGHTING SAFETY TEST

Name: \_\_\_\_\_

1. What do you do if you find a piece of lighting equipment that has a safety defect?

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2. What is the most important tool used when hanging lighting instruments?

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3. After an instrument is first clamped to the batten, what is the next immediate step to take?

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4. What special care must be taken when handling lamps for lighting instruments?

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5. Before an instrument is plugged in, what should the technician be sure of?

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6. Check ALL of the things below that are permitted to secure extension cables to battens.

- a. \_\_\_\_\_ Gaffers tape
- b. \_\_\_\_\_ Glow tape
- c. \_\_\_\_\_ Duct tape
- d. \_\_\_\_\_ Masking tape
- e. \_\_\_\_\_ Jute tie line
- f. \_\_\_\_\_ Cotton tie line
- g. \_\_\_\_\_ Safety cables

7. Other than the hazard of falling equipment, what serious hazards must the lighting technician be aware of at all times?

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8. When is food and drink allowed in the control booth?

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9. Can strobe effects be used in the theater, and, if so, what precautions must be taken?

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10. Describe how lighting cables should be stored.

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11. What are two types of adhesive tape that can be used to tape lighting cables to the floor?

a. \_\_\_\_\_

b. \_\_\_\_\_

12. Give the minimum distances permissible between (a) the lens end of a lighting instrument and a curtain or scenery and (b) the sides or back of a lighting instrument and a curtain or scenery.

a. \_\_\_\_\_

b. \_\_\_\_\_

**END "C" LICENSE**

13. How do you determine the gauge, number of conductors, and the insulation type of a stage lighting extension cable?

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14. When inspecting a lighting instrument prior to hanging, what seven things should the technician check for?

a. \_\_\_\_\_

b. \_\_\_\_\_

c. \_\_\_\_\_

d. \_\_\_\_\_

- e. \_\_\_\_\_
- f. \_\_\_\_\_
- g. \_\_\_\_\_

15. What special care must be taken when adding accessories such as color frame, gobo holder, barn door, or snoot to a lighting instrument?

\_\_\_\_\_

\_\_\_\_\_

16. What is the usual range of lamp wattages for lighting instruments?

\_\_\_\_\_

17. Name: the two types of gloves a lighting technician should have and the purpose for each type.

- a. \_\_\_\_\_
- b. \_\_\_\_\_

18. What are the first THREE precautions the technician must take prior to opening a lighting instrument in order to change the lamp?

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_

19. How many circuits will usually be attached to a single receptacle? Can that number be increased?

\_\_\_\_\_

20. How many receptacles will usually be attached to a single circuit? Can that number be increased?

\_\_\_\_\_

21. If a lamp for a lighting instrument is contaminated by accidental contact with the technician, what can be done to save the lamp?

\_\_\_\_\_

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22. What is the most common hazard of extension cables placed on the floor?

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23. How many instruments, each with a 750 watt lamp, can be plugged into a 20 ampere receptacle?

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24. How many instruments, each with a 500-watt lamp, can be plugged into a dimmer with a rating of "2.4 kW"?

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25. Describe how lighting instruments should be stored. In your description, include information about the electrical lead, the lens barrel, shutters, and yolk bolts.

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26. Where should lighting instruments be stored?

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27. What do you do if you find a "pig tail" (circuit strip cable with receptacle) that has cracked insulation or the insulation is pulling loose from the plug, but otherwise is still operational?

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28. How do you ensure that safety cables do not get lost?

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29. Under what circumstances can stage lighting instruments be allowed to remain on when a technician is not present?

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**END "B" LICENSE**



30. What is the proper gauge of wire for use as a lighting extension cable?

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31. What is the proper number of conductors (wires) that will be found in lighting extension cables?

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32. Check ALL of the cable insulation types below that are allowed for stage lighting extension cables.

- a.  S
- b.  SJ
- c.  ST
- d.  SO
- e.  SJO
- f.  SEO

33. Who must approve any purchases or donations of stage lighting equipment?

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34. In the process of changing a lamp, a technician has checked to make sure the wattage and the base type of the replacement match the burned out lamp. The technician notices that the two lamps do not look the same. What are TWO reasons why the lamps might look different?

- a. \_\_\_\_\_
- b. \_\_\_\_\_

35. What is the Name: of the three-letter code found on lamp bases and the boxes they come in? What makes it so important?

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36. What is the amperage of any lighting receptacle in a Montgomery County Public School theater?

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37. What is the minimum number of 2.4 kW dimmers required to provide full power to five, three-lamp cyclorama lights, with each lamp rated at 1000 watts?

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38. Using the same conditions listed in the problem above, what would be the minimum number of dimmers if each of the instruments were colored with the three primaries, and you wanted to be able to have separate color washes?

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## AUDIO TEST

Name: \_\_\_\_\_

1. Who needs to approve making any alterations or adjustments to the permanent audio system?  
\_\_\_\_\_
  
2. For how long is it permissible to expose an audience to 95 decibels (dB) of sound?  
\_\_\_\_\_
  
3. Choose all permissible adjustments by a student technician.
  - a. \_\_\_ Plugging in and placing microphones, cables and stands
  - b. \_\_\_ Plugging in and placing monitor speakers and cables
  - c. \_\_\_ Plugging in and placing intercom headsets
  - d. \_\_\_ Patching cables to auxiliary inputs of the non-rack mounted mixers
  - e. \_\_\_ Making adjustments to the "front of panel" controls such as volume, equalization, and channel selector
  - f. \_\_\_ Replacement of batteries and adjustments to wireless microphones
  - g. \_\_\_ Making repairs to the internal hardware in mixers or equalizers
  - h. \_\_\_ Making repairs to the intercom headsets
  
4. What is the single most common hazard associated with use of audio equipment in high school theaters?  
\_\_\_\_\_
  
5. What can result when a student technician removes the protective hardware from audio equipment?  
\_\_\_\_\_
  
6. When the audio mixer is relocated from the booth to the audience area, it may be placed over seats as long as the remaining number of usable chairs in the row does not exceed \_\_\_\_\_.
  
7. Once a cable in the audience has been secured with gaff tape or a commercially available cord cover, what additional step must be taken to help insure audience safety?  
\_\_\_\_\_  
\_\_\_\_\_

8. Check the two best methods for securing audio/microphone cables to battens.

- a.  Zip ties
- b.  Tie lines
- c.  Masking tape
- d.  Electrical tape

9. What are the two differences between ¼-inch speaker cable and ¼-inch instrument cable?

- a. \_\_\_\_\_
- b. \_\_\_\_\_

10. How should microphone cables be run in relation to power cables? Why?

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## CATWALK TEST

Name: \_\_\_\_\_

1. What are the minimum and maximum number of technicians and adult sponsors permitted on the CATWALK?

\_\_\_\_\_

2. What are two primary safety risks when working on the CATWALK?

a. \_\_\_\_\_

b. \_\_\_\_\_

3. Where should the adult supervisor be when the student technicians are working on the CATWALK?

\_\_\_\_\_

4. What are three of the ways technicians working on a CATWALK can reduce the hazards to the people below?

\_\_\_\_\_

5. Check **ALL** of the areas above an auditorium ceiling that technicians are permitted to walk, stand, or crawl on.

- a. \_\_\_\_\_ Steel roof trusses
- b. \_\_\_\_\_ Air conditioning ducts
- c. \_\_\_\_\_ Electrical conducts
- d. \_\_\_\_\_ Plumbing pipes
- e. \_\_\_\_\_ CATWALK
- f. \_\_\_\_\_ Metal support grid for ceiling

6. Describe two (2) safe ways to transport lighting equipment and accessories to and from the catwalk.

a. \_\_\_\_\_

b. \_\_\_\_\_

7. What items can be dropped from the catwalk?

\_\_\_\_\_

8. What is the procedure to install a temporary batten in the CATWALK area?

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9. What accessory must be used when working with tools in the CATWALK area?

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10. What extra precaution must be taken with lighting instruments that are stored on the CATWALK and not hung for use?

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## LADDERS TEST

Name: \_\_\_\_\_

1. Check all of the ladder types that are allowed for student technician use.

- a. \_\_\_\_\_ A-frame ladder with center extension
- b. \_\_\_\_\_ Stepladder
- c. \_\_\_\_\_ Extension ladder
- d. \_\_\_\_\_ A-frame ladder without center extension
- e. \_\_\_\_\_ Platform ladder

2. Ladders used for lighting must be manufactured from either one of two types of materials. What are those two materials?

a. \_\_\_\_\_

b. \_\_\_\_\_

3. A ladder must be inspected by the climber prior to use. What should you do if you find any damage, such as bent hardware or broken steps?

\_\_\_\_\_  
\_\_\_\_\_

4. What should you do with tools when you are working on a ladder?

\_\_\_\_\_  
\_\_\_\_\_

5. Under what circumstances may a ladder be moved while a person is on it?

\_\_\_\_\_  
\_\_\_\_\_

6. How high up on a ladder may a person climb?

\_\_\_\_\_  
\_\_\_\_\_

7. For prolonged work such as painting scenery, is it permissible to sit on the top step of a step-ladder?

\_\_\_\_\_

8. How many people can be on a ladder at one time?

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9. The use of a ground spotter to help steady a ladder is advisable. What is the other most important function of a spotter?

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10. If a ladder is being used near a door that opens toward a ladder, and no ground spotter is available, what should be done?

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11. If a stepladder is too short for a specific job, can four equal sized, heavy, wood boxes be placed under the ladder's legs to extend the ladder safely to the required height?

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12. How should a ladder be stored when not in use?

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13. How can a ladder be safely used on a sloped surface, such as a ramp, on a stage set?

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**END OF "C" LICENSE TEST**



## LADDERS

14. How do you determine the OSHA rating of a ladder?

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15. How do you repair a wooden ladder with a cracked side rail?

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### END OF "B" LICENSE TEST

16. Check off all of the OSHA ladder ratings listed below that are approved for use by student technicians?

- a. \_\_\_\_\_ Type III
- b. \_\_\_\_\_ Type II
- c. \_\_\_\_\_ Type I
- d. \_\_\_\_\_ Type IA

17. Why must a wooden ladder never be painted?

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### END OF "A" LICENSE TEST

## SCAFFOLDS TEST

Name: \_\_\_\_\_

1. When technicians are on a scaffold and they need to be moved to another position, what is the proper procedure that must be used prior to moving the scaffold?

\_\_\_\_\_

\_\_\_\_\_

## END "C" LICENSE TEST

2. Prior to climbing a scaffold, what are the three main things that must be looked for during an inspection?

a. \_\_\_\_\_

b. \_\_\_\_\_

c. \_\_\_\_\_

3. After positioning a scaffold for use, what must be done to it prior to climbing?

\_\_\_\_\_

4. In order to gain extra height, what is the proper procedure to use a step-ladder on the top platform of a scaffold?

\_\_\_\_\_

5. When looking at the side of a scaffold, how should the cross braces be structured?

\_\_\_\_\_

6. What is the proper way to ascend and descend a scaffold?

\_\_\_\_\_

7. How should a scaffold be stored?

\_\_\_\_\_

8. What should be the condition of the work area around a scaffold?

\_\_\_\_\_

9. What are two obstructions that must be avoided when moving a scaffold?

a. \_\_\_\_\_

b. \_\_\_\_\_

**END "B" LICENSE TEST**

10. At what height (and above) must handrails be used on a scaffold?

\_\_\_\_\_

11. The maximum height of the top platform must not exceed how many times the width of the narrowest side dimension?

\_\_\_\_\_

12. When the maximum height of a scaffold is reached (according to the width of the narrowest side), what can be done to the scaffold to safely add more vertical sections?

\_\_\_\_\_

13. At what height (and above) must a toeboard be used on a scaffold?

\_\_\_\_\_

14. If a scaffold is three sections high, which sections *must* have cross braces?

\_\_\_\_\_

**END OF "A" LICENSE TEST**

## WINCH/BATTEN TEST

Name: \_\_\_\_\_

1. What two senses are most important to use when a winch is being operated?

a. \_\_\_\_\_

b. \_\_\_\_\_

2. What four things should the spotters do when a winch is being operated?

a. \_\_\_\_\_

b. \_\_\_\_\_

c. \_\_\_\_\_

d. \_\_\_\_\_

3. Where do the spotters stand when a batten is being moved? Where should they not stand?

a. \_\_\_\_\_

b. \_\_\_\_\_

4. In the event of a runaway batten, what is the warning that must be shouted?

\_\_\_\_\_

### END OF "C" LICENSE TEST

5. What supervision is required when operating a batten winch?

\_\_\_\_\_

6. What is the minimum number of people required to fly a batten?

\_\_\_\_\_

7. Before operating a winch, what should be checked?

\_\_\_\_\_

8. Why should the technician keep his/her hand on the winch handle the entire time that the batten is being moved?

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9. In the event of a runaway batten, what might happen once the batten has come to a stop?

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10. Who must be notified if there is an unusual situation or runaway with any winch?

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**END OF "A and B" LICENSE TEST**

## POWER TOOLS

Name: \_\_\_\_\_

1. Can gloves be worn when working with hand tools? Why or why not?

\_\_\_\_\_

2. Can gloves be worn when working with power tools? Why or why not?

\_\_\_\_\_

3. What two “generic” parts of all power tools pose a hazard to long hair?

a. \_\_\_\_\_

b. \_\_\_\_\_

4. What are two proper ways to wear long sleeve clothing when working with power tools?

a. \_\_\_\_\_

b. \_\_\_\_\_

5. Must eye safety goggles be worn with all power tools? Explain: What is the threat from power tools?

\_\_\_\_\_

6. Name two things that must be checked before using a power tool that has changeable bits or blades.

a. \_\_\_\_\_

b. \_\_\_\_\_

7. At what time should the item that is being worked on be secured with clamps or a vise prior to using a tool?

\_\_\_\_\_

8. If a student owns a “non-approved” power tool, but is thoroughly familiar with the safe operation of that tool, can he/she use it for work in the school?

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9. For each power tool that a technician intends to use, what is the required percentage of correct answers that must be achieved on the written and practical skills test?

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**END OF “C” LICENSE TEST**

10. Check **all** of the power tools that are approved for high school theater student use.

- a.  Power drill
- b.  Belt sander
- c.  Pad sander
- d.  3-inch battery circular saw
- e.  5-inch panel circular saw
- f.  7 ¼-inch standard circular saw
- g.  10-inch circular miter box saw
- h.  Saber saw
- i.  Reciprocating saw
- j.  Drywall screw gun

11. In addition to accidental contact with the hot end of the tool, what is the other most common hazard associated with hot glue guns?

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12. What advantage is there to clamping the project being worked on?

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13. What should be done prior to changing a blade or bit on a power tool?

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14. If a tool is found to be defective, what should be done?

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15. Why is a battery-powered tool potentially more dangerous than one powered with a cord?

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## LIGHTING ANSWER KEY

1. What do you do if you find a piece of lighting equipment that has a safety defect?

Remove the equipment from use. Label it, "Danger, Do Not Use." Write a brief description of the problem on the label. Notify the theater teacher, so that a work order to repair the equipment can be submitted.

2. What is the most important tool used when hanging lighting instruments?

Use an 8-inch adjustable crescent wrench (or any other adjustable wrench).

3. After an instrument is first clamped to the batten, what is the next immediate step to take?

Secure the fixture to the batten with a safety cable.

4. What special care must be taken when handling lamps for lighting instruments?

Do not touch the glass envelope with bare hands.

5. Before an instrument is plugged in, what should the technician be sure of?

Be sure that the power to the circuit is turned OFF.

6. Check ALL of the things below that are permitted to secure extension cables to battens:

- a.  Gaffers tape
- b.  Glow tape
- c.  Duct tape
- d.  Masking tape
- e.  Jute tie line
- f.  Cotton tie line
- g.  Safety cables

7. Other than the hazard of falling equipment, what serious hazards must the lighting technician be aware of at all times?

Serious hazards to be aware of at all times are fire and electrocution.

8. When is food and drink allowed in the control booth?

Food and drink are NEVER allowed in the control booth.

9. Can strobe effects be used in the theater, and, if so, what precautions must be taken?

Yes. Strobe effects can be used in the theater. A sign must be placed at each entrance to the theater stating, NOTICE: STROBE LIGHTS WILL BE USED.

10. Describe how lighting cables should be stored.

Lighting cables should be individually coiled and tied. They should be stored in a dry area and protected from hazard—such as being walked on or other equipment being placed on them. (Hanging the cables works best.)

11. What are two types of adhesive tape that can be used to tape lighting cables to the floor?

The two types of adhesive tape that can be used are gaffers tape and duct tape.

12. Give the minimum distances permissible between (a) the lens end of a lighting instrument and a curtain or scenery and (b) the sides or back of a lighting instrument and a curtain or scenery.

- a. 48 inches
- b. 18 inches

#### END “C” LICENSE

13. How do you determine the gauge, number of conductors, and the insulation type of a stage lighting extension cable?

Look for the permanent markings on the outer insulating jacket of the cable.

14. When inspecting a lighting instrument prior to hanging, what five things should the technician check for?

- a. Cracked C-clamp
- b. Stripped or missing bolts
- c. Loose wires or fiberglass insulating sleeve
- d. Exposed electric conductors
- e. Rattling parts

15. What special care must be taken when adding accessories, such as color frame, gobo holder, barn door, or snoot, to a lighting instrument?

Check to see that the accessory is properly attached to the instrument so it cannot fall.

16. What is the usual range of lamp wattages for lighting instruments?

500–100 watts.

17. Name the two types of gloves that a lighting technician should have and the purpose for each type.

- a. Latex or cotton to change lamps
- b. Leather to focus hot lighting instruments

18. What are the first THREE precautions that the technician must take prior to opening a lighting instrument in order to change the lamp?

- a. Make sure the power to the circuit is turned OFF.
- b. Make sure that the instrument is unplugged.
- c. Wait until the instrument has cooled down.

19. How many circuits will usually be attached to a single receptacle? Can that number be increased?

One circuit will usually be attached to a single receptacle. No, the number of circuits cannot be increased.

20. How many receptacles will usually be attached to a single circuit? Can that number be increased?

One receptacle will usually be attached to a single circuit. This number can be increased through the use of a “two-fer.” Your school may have a few dual circuits—answers may vary according to space.

21. If a lamp for a lighting instrument is contaminated by accidental contact with the technician, what can be done to save the lamp?

Immediately clean the glass envelope with rubbing alcohol and allow it to air dry.

22. What is the most common hazard caused by extension cables placed on the floor?

Tripping is the most common hazard.

23. How many instruments, each with a 750-watt lamp, can be plugged into a 20-ampere receptacle?

Three (3) instruments, each with a 750-watt lamp, can be plugged into a 20-ampere receptacle.

24. How many instruments, each with a 500-watt lamp, can be plugged into a dimmer with a rating of “2.4 kW”?

Four (4) instruments, each with a 500-watt lamp, can be plugged into a dimmer with a rating of “2.4 kW.”

25. Describe how lighting instruments should be stored. In your description, include information about the electrical lead, the lens barrel, shutters, and yolk bolts.

Lighting instruments should be stored as follows: Yoke should be tightened; shutters and barrel should be pushed fully in; and, lead should be coiled gently around the yoke.

26. Where should lighting instruments be stored?

Lighting instruments should be clamped to a storage batten or pipe whenever possible. If not possible, store lens down on a clean surface—out of the way of other activity.

27. What do you do if you find a “pig tail” (circuit strip cable with receptacle) that has cracked insulation or the insulation is pulling loose from the plug, but otherwise is still operational?

Label it, DANGEROUS: DO NOT USE, remove it from service, and report it

28. How do you ensure that safety cables do not get lost?

Never separate the cables from the instruments.

29. Under what circumstances can stage lighting instruments be allowed to remain on when a technician is not present?

NEVER leave stage lighting instruments on without a technician present.

### END “B” LICENSE

30. What is the proper gauge of wire for use as a lighting extension cable?

A 12-gauge wire should be used as a lighting extension cable.

31. What is the proper number of conductors (wires) that will be found in lighting extension cables?

Three (3) conductors will be found in lighting extension cables.

32. Check ALL of the cable insulation types below that are allowed for stage lighting extension cables.

- a.  S
- b.  SJ
- c.  ST
- d.  SO
- e.  SJO
- f.  SEO

33. Who must approve any purchases or donations of stage lighting equipment?

The Division of Construction, Department of Facilities Management, must approve any purchases or donations of stage lighting equipment.

34. In the process of changing a lamp, a technician has checked to make sure the wattage and the base type of the replacement match the burned out lamp. He/she notices that the two lamps do not look the same. What are TWO reasons why the lamps might look different?

- a. The Light Center Length (LCL) is different, which means the chosen replacement lamp is incorrect.
- b. The replacement lamp is of a different manufacturer, which will not affect the operation of the instrument.

35. What is the name of the three-letter code found on lamp bases and the boxes they come in? What makes it so important?

ANSI code represents the American National Standards Institute. The ANSI code is universal among the manufacturers of lamps. Any lamp with the same code will be identical in all critical areas.

36. What is the amperage of any lighting receptacle in a Montgomery County Public School theater?

The amperage of any lighting receptacle in a Montgomery County Public School theater is 20.

37. What is the minimum number of 2.4 kW dimmers required to provide full power to five, three-lamp cyclorama lights, with each lamp rated at 1000 watts?

The minimum number of 2.4 kW dimmers required to provide full power to five, three-lamp cyclorama lights—with each lamp rated as 1000 watts—is 8 dimmers.

38. Using the same conditions listed in the problem above, what would the minimum number of dimmers be if each of the instruments were colored with the three primaries, and you wanted to be able to have separate color washes?

Nine (9) dimmers would provide full power to five, three-lamp cyclorama lights—if each of the instruments were colored with the three (3) primary colors, and you wanted to have separate color wash capability

## AUDIO ANSWER KEY

1. Who needs to approve making any alterations or adjustments to the permanent audio system?

The Department of Facilities Management must approve any alterations or adjustments to the permanent audio system.

2. For how long is it permissible to expose an audience to 95 decibels (dB) of sound?

It is permissible to expose an audience to 95 decibels (dB) of sound for no more than 90 seconds.

3. Choose **all** permissible adjustments by a student technician:

- a.  Plugging in and placing microphones, cables and stands
- b.  Plugging in and placing monitor speakers and cables
- c.  Plugging in and placing intercom headsets
- d.  Patching cables to auxiliary inputs of the non-rack mounted mixers
- e.  Making adjustments to the “front of panel” controls such as volume, equalization, and channel selector
- f.  Replacement of batteries and adjustments to wireless microphones
- g.  Making repairs to the internal hardware in mixers or equalizers
- h.  Making repairs to the intercom headsets

4. What is the single most common hazard associated with the use of audio equipment in high school theaters?

The single most common hazard associated with the use of audio equipment in high school theaters is tripping over audio cables.

5. What can result when a student technician removes the protective hardware from audio equipment?

Answers may vary, but one of them must be *electrical shock*.

6. When the audio mixer is relocated from the booth to the audience area, it may be placed over seats as long as the remaining number of usable chairs in the row does not exceed 16.

7. Once a cable in the audience has been secured with gaff tape or a commercially available cord cover, what additional step must be taken to help insure audience safety?

Mark the cable path with highly visible tape.

8. Check the two best methods for securing audio/microphone cables to battens.
  - a. Zip ties
  - b. Tie lines
9. What are the two differences between ¼” speaker cable and ¼” instrument cable?
  - a. The instrument cable conductors are a smaller gauge.
  - b. The instrument cable conductors are shielded.
10. How should microphone cables be run in relation to power cables? Why?

Microphone/audio cables should be run perpendicular to power cables to avoid feedback and interference.

### **CATWALKS TEST ANSWER KEY**

1. What are the minimum and maximum numbers of student technicians permitted on the CATWALK?

The minimum and maximum number of student technicians permitted on the CATWALK are: 2, 2.

2. What are two primary safety risks when working on the CATWALK?

- a. The risk of falling.
- b. The risk of dropping an object on someone below.

3. Where should the adult supervisor be when the student technicians are working on the CATWALK?

The adult supervisor should be on the CATWALK.

4. What are three of the ways technicians working on a CATWALK can reduce the hazards to the people below?

Count as correct any of the following:

- a. Empty pockets of loose items prior to entering catwalk.
- b. Use safety tie lines to secure all items to body when working.
- c. Do not store loose items in the catwalk.
- d. Do not throw items, such as pattern holders, down from the catwalk.
- e. Warn people not to stand below the catwalk when technicians are working on it.
- f. Devote full attention to working safely.

5. Check **ALL** of the areas above an auditorium ceiling that technicians are permitted to walk, stand, or crawl on.
- a.  Steel roof trusses
  - b.  Air condition ducts
  - c.  Electrical Conduits
  - d.  Plumbing pipes
  - e.  Catwalk
  - f.  Metal support grid for ceiling
6. Describe two safe ways to transport lighting equipment and accessories to and from the catwalk.
- a. lace small items in hand, pocket, or bucket with a rope.
  - b. Pull larger items up with a rope or rope attached to bucket.
7. What items can be dropped from the CATWALK?
- Nothing can be dropped from the CATWALK.
8. What is the procedure to install a temporary batten in the CATWALK area?
- Contact the Division of Construction, Department of Facilities Management, to discuss the proposed installation.
9. What accessory must be used when working with tools in the CATWALK area?
- Safety tie lines/cables must be used when working with all tools.
10. What extra precaution must be taken with lighting instruments that are stored on the catwalk and not hung for use?
- Use a safety cable for all fixtures—functioning and idle—on the CATWALK.



## LADDERS TEST ANSWER KEY

1. Check all of the ladder types that are allowed for student technician use.
  - a.  A-frame ladders with center extension
  - b.  Step-ladders
  - c.  Extension ladders
  - d.  A-frame ladders without center extension
  - e.  Platform ladders
  
2. Ladders used for lighting must be manufactured from either one of two types of materials. What are those two materials?
  - a. Wood
  - b. Fiberglass
  
3. A ladder must be inspected by the climber prior to use. What should you do if you find any damage, such as bent hardware or broken steps?
  - a. Withdraw the ladder from use.
  - b. Place a DANGEROUS label on the ladder.
  - c. Notify a teacher or administrator.
  
4. What should you do with tools when you are working on a ladder?

Secure tools to body (belt or wrist) with safety cables.
  
5. Under what circumstances may a ladder be moved while a person is on it?

A ladder must never be moved while a person is on it.
  
6. How high up a ladder may a person climb?

A person may climb no higher than the second step from the top of a ladder.
  
7. For prolonged work such as painting scenery, is it permissible to sit on the top step of a step ladder?

No, it is not permissible to sit on the top step of a step ladder.
  
8. How many people can be on a ladder at one time?

One (1) person should be on a ladder at one time.

9. The use of a ground spotter to help steady a ladder is advisable. What is the other most important function of a spotter?

The spotter should keep others away from the ladder.

10. If a ladder is being used near a door that opens toward the ladder, and no ground spotter is available, what should be done?

Prop open the door so that the ladder is visible from both sides of the doorway.

11. If a step-ladder is too short for a specific job, can four equal sized heavy wood boxes be placed under the ladder's legs to extend the ladder safely to the required height?

No, wood boxes should not be used to extend the height of the ladder.

12. How should a ladder be stored when not in use?

A ladder should be folded and located in a dry place where nothing will be placed on top or against it. It is recommended that the ladder be secured with a lock and chain to prevent unauthorized use.

13. How can a ladder be safely used on a sloped surface such as a ramp on a stage set?

Under no circumstances should a ladder be used on a sloped surface.

#### **END OF "C" LICENSE LADDERS TEST**

14. How do you determine the OSHA rating of a ladder?

The ladder will have a label indicating the rating. Do not use a ladder without a label.

15. How do you make a repair on a wooden ladder with a cracked side rail?

You should notify the theater director or administrator to get the ladder repaired through a work order.

#### **END OF "B" LICENSE TEST**

16. Check all of the OSHA ladder ratings that are allowed for student technician use.

a.  Type III

b.  Type II

c.  Type I

d.  Type IA

17. Why must a wooden ladder never be painted?

Paint could conceal cracks or other damage

**END OF "A" LICENSE TEST**

**SCAFFOLDS SAFETY TEST ANSWER KEY**

1. When technicians are on a scaffold and need to be moved to another position, what is the proper procedure prior to moving?

Have all technicians descend and leave the platform before moving the scaffold.

**END "C" LICENSE TEST**

2. Prior to climbing a scaffold, what are the three main things that must be looked for during an inspection?

- a. All sections and cross braces are properly located
- b. All connections between sections and braces are tight
- c. All hardware/fittings (including casters) work properly

3. After positioning a scaffold for use, what must be done to it prior to climbing?

Lock all casters in place before climbing a scaffold.

4. In order to gain extra height, what is the proper procedure to use a step ladder on the top platform of a scaffold?

Ladders, boxes, chairs, or any other method to gain height are prohibited.

5. When looking at the side of a scaffold, what pattern should the cross braces form?

The braces should be of a length and design that will square and align vertical members (could be an "X", depending on the design of the platform).

6. What is the proper way to ascend and descend a scaffold?

Use the scaffold's climbing ladder or stairs to ascend and descend from a scaffold.

7. How should a scaffold be stored?

The scaffold should be stored in a dry place and located so that other objects cannot be placed against it. It should be secured with a chain and padlock to prevent unauthorized use. The casters should be locked to prevent accidental movement.

8. What should be the condition of the work area around a scaffold?

The floor should be clear of all debris that may get caught under a wheel. All other work projects must be located away from the work area of the scaffold.

9. What are two obstructions that must be avoided when moving a scaffold?
- a. lighting instruments
  - b. curtains

**END "B" LICENSE TEST**

10. At what height (and above) must handrails be used on a scaffold?

Handrails must be used on a scaffold at the height of 10 feet and above.

11. The maximum height of the top platform must not exceed how many times the width of the narrowest side dimension?

The maximum height of the top platform must not exceed four (4) times the width of the narrowest side dimension.

12. When the maximum height of a scaffold is reached (according to the width of the narrowest side), what can be done to the scaffold to safely add more vertical sections?

Use factory supplied outriggers to achieve proper base width.

13. At what height (and above) must a toeboard be used on a scaffold?

A toeboard must be used on a scaffold at ten (10) feet or above.

14. If a scaffold is three sections high, which sections must have cross braces?

All sections of a scaffold must have cross braces on them.

**END OF "A" LICENSE TEST**



## GLOSSARY

**A-FRAME LADDER:** A freestanding ladder that consists of two sections, hinged together at the top. Both sections have rungs for climbing.

**ADJUSTING KEYS and WRENCHES:** Any tools or devices used to tighten or release the locking mechanism of the chuck that holds the bit (or blade) of the tool.

**AMPACITY:** The current handling capacity of an electrical device, measured in amperes (amps).

**BARN DOOR:** A device for shaping the light emitted from a fresnel. It consists of two or four metal flippers, and is attached to the fresnel by inserting it in the color frame holder.

**BATTEN:** A steel pipe, usually measuring 1 1/2 inches (inside diameter), suspended above a stage; used for mounting lighting instruments or curtains.

**BORDERS:** (1) Valance curtains that are hung above the stage and serve to mask the overhead equipment from the audience's view. They are usually made from black fabric; also called teaser curtains. (2) Temporary scenery constructed from flats or unframed painted fabric that serves the same purpose as in definition #1 above, but also functions as a visual extension of the stage set.

**BUMP CAP:** Protective headgear that guards against minor blows but does not afford the protection of a true hard hat.

**C-CLAMP:** A malleable iron clamp shaped like the letter "C" that is used to bolt lighting instruments to battens.

**CASEIN PAINT:** Scenery paint that has casein (a chemical derived from sour milk) as a binder. This type of paint is sold as a thick concentrated paste (also called protein-based paint), and must be diluted with water prior to use.

**CATWALK:** The lighting area that is located in the ceiling above the audience seating area, including a walking surface, instrument mounting positions, and electrical circuits.

**COLOR FRAME:** A device for holding the color medium in place on a lighting instrument. It is generally made of lightweight sheet metal.

**CONDUCTOR:** The metal part of an electrical cord or wire that carries the electrical current.

**CONDUIT:** Permanently installed metal pipe used to house and protect electrical wiring.

**CORNER BLOCK:** A 45-degree right triangle made from 1/4-inch AC-grade plywood. A corner block is fastened to each corner of a 1 x 3 wood-framed muslin scenery flat to strengthen the joint and to maintain a square corner.

**CROSS BRACES:** Structural members of a scaffold that are mounted at an angle to the horizontal and vertical sections. A cross brace consists of a single tube for aluminum or fiberglass scaffolds or an adjustable "X" shape of angle iron for steel scaffolds.

**CYC-LIGHT** (also called FAR-CYC, SKY-CYC, or IRIS, all trade names.): A lighting instrument that is designed for lighting a cyclorama or backdrop and is hung above the stage. A single instrument has from one to four lamps, each with a separate plug.

**CYCLORAMAS** (also called cyps): These curtains cover the width of the stage and are usually hung furthest upstage (away from the audience). They are most often off-white in color, although some are sky blue. They are sewn flat with no pleats and are used as a surface to project washes of colored light.

**DIMMER:** A device that regulates the voltage supplied to lighting circuit outlets. Dimmers are located near the stage and are controlled by electronic signals from the control panel.

**DIMMER MODULE:** A component of the stage lighting control system. A module will contain anywhere from one to four dimmers, each protected by an individual circuit breaker.

**DIMMER RACK:** The metal cabinet that contains the individual dimmer modules. The rack has power line cables that energize the dimmers and circuit load wires that energize the lighting receptacles. The rack typically will have cooling fans and grills and a metal protective door.

**DUCT TAPE:** Adhesive tape with bright metallic silver finish intended to seal air ducts. Commonly used on stage to tape down stage cables. While not as strong as gaffers tape, it is cheaper and readily available at all hardware stores.

**DUCTWORK:** Elongated sheet metal tube or box structure used to transport air from the heating or air conditioning source. Ducts are often wrapped with fiberglass insulation.

**ELLIPSOIDAL** (also called an ERS, which stands for Ellipsoidal Reflector Spotlight, or a LEKO, which is a trade name): A lighting instrument that can produce a hard-edged beam of light. Ellipsoidals are used on CATWALKS, on box booms, or above the stage. An ellipsoidal has an adjustable lens barrel to focus the beam and four steel shutters to shape the beam. Ellipsoidals are classified by the diameter of their lenses and either the focal length or the beam spread (e.g., 6" x 9", 6" x 50 degrees).

**EXIT ACCESSWAYS:** Areas of the auditorium that are free of fixed seating and that are not considered aisles, but are used by the audience as walking areas. Exit access ways include vestibules, foyers, and, in some cases, the areas behind the last row of seats.

**EXTENSION LADDER:** A ladder that consists of two straight single ladders that are attached to each other by their side rails. The length of the ladder can be adjusted by sliding the two sections closer together or farther apart. (Extension ladders may not be used in the theater program.)

**FLAME RETARDANT:** (adj. A combustible material that has been chemically treated not to support combustion; (noun) A chemical used to render a combustible material resistant to flame,

but not necessarily fireproof. A fire retardant is usually sprayed on as a clear liquid or added to paint as a powder.

**FLASHPOT:** A device used to electrically ignite chemicals to produce a flash of light, an explosion, and/or smoke.

**FLATS:** Large vertical surfaces of stage scenery often used to represent walls but made of lightweight materials such as thin plywood, fabric, or dense cardboard.

**FRESNEL:** A lighting instrument (generally hung above the stage) that produces a soft-edged beam of light. This instrument has an adjustable lamp socket and reflector assembly to focus the beam of light. A fresnel is classified by the diameter of its lenses (e.g., 6 inches or 8 inches).

**GAFFERS TAPE:** Heavy-duty adhesive tape for stage use. Usually supplied in two-inch-wide by 60-yard-long rolls. This tape has a durable base of woven fibers and is strong enough to hold stage cables to battens. Gaffers tape comes in black and several other colors and is available through theatrical supply vendors.

**GAUGE:** The size or thickness of the conductors in an electrical cord. The lower the gauge number, the larger the conductor. The gauge number is printed on or embossed into the outer insulation of stage cables. Often the gauge number is followed by the number of conductors in the cable. Example: 12/3 = 12 gauge conductor, three conductors.

**GLASS ENVELOPE:** The clear part of a lamp, containing the filament.

**GLOW TAPE:** An adhesive tape that is luminescent. After exposure to a light source, this tape will appear as a green glow in the dark. Glow tape is available through theatrical supply vendors.

**GRAND DRAPE:** See MAIN ACT CURTAIN.

**GRAND TEASER:** The border curtain that hangs above the main act curtain and is made from the same color and type of fabric as is the main act curtain..

**HARDWALL FLATS:** Scenery flats that have 1 x 3 lumber frames assembled on edge, not flat like those for muslin or hard-cover flats. Corner blocks and keystones are not used, and the frame is covered with a hard surface sheet material such as masonite, upsom board, or lauan plywood.

**HOT PATCH:** To plug a lighting instrument into an outlet that has been energized. This unsafe practice causes sparks and burned electrical contacts.

**HYPOALLERGENIC:** Having a low capacity to induce allergic reaction.

**INSULATING SLEEVE:** A hollow, flexible, woven fiberglass tube that is used as a covering to protect the wires that form the electrical lead of a lighting instrument.



**KEYSTONE:** A trapezoid-shaped wood block made from 1/4-inch plywood for the purpose of strengthening the joint between horizontal (toggle rail) and vertical (stile) framing members of a scenery flat.

**LAMP:** The light-producing component of a lighting instrument. The lamp consists of a metal base, a glass envelope, and a filament. While lamps are most commonly classified by wattage output, many other factors must be specified when ordering lamps. Using the three-letter ANSI (American National Standards Institute) standard code guarantees that a replacement lamp will match the original.

**LAMP HOUSING:** The part of the lighting instrument that contains the lamp and lamp socket.

**LATEX PAINT:** Water-soluble, latex rubber-based paint. This type of paint is the most commonly available household paint.

**LAUAN:** A tight-grained plywood made from Philippine mahogany. Often used for manufacturing hollow-core interior doors and stage scenery

**LEGS (also called Tormentors):** Curtains that hang at each side of the stage that are usually made from black fabric and serve to mask the backstage wings from the audience's view.

**LENS BARREL:** The moveable part of an ellipsoidal lighting instrument that contains one or two lenses used to change the focus of the light.

**LENS DOOR:** The front access door of a fresnel lighting instrument that holds the lens in place. This door is used to gain access to the reflector and lamp, and it has metal tabs to hold the color frame and/or the barn door assembly.

**LIFT LINES:** The wire ropes that attach to the batten. When wound on a winch, these lines lift the batten. Usually there are anywhere from three to seven lift lines for each batten.

**LIGHT CENTER LENGTH (L.C.L.):** The distance from the tip of a lamp base to the middle of the filament.

**LOFT BLOCK:** An individual pulley mounted to the ceiling over the stage. Each lift line of a batten passes over a loft block.

**LIGHTING INSTRUMENT:** A complete lighting fixture including housing shell, lenses, reflector lamp, socket, electrical lead, plug, and mounting devices.

**MAIN ACT CURTAIN:** The traveler curtain that is hung closest to the audience. This curtain is usually made from a heavy velour fabric, and often has a color different from the leg and border masking curtains.

**MANUAL PULL STATION:** A manually operated switch that activates a building's fire alarm system.

**MASONITE:** A dark brown sheet material made from wood fibers. Masonite (a trademark) is available in several thicknesses and is either tempered or untempered. Masonite is used in scenery construction as a covering for flats or as a veneer surface for stages or platforms. This material is not structurally sound and must not be used as a weight-bearing surface.

**MINERAL SPIRITS:** A paint thinner used to dilute oil-based paints.

**MIXER:** A component of the audio system that allows a technician to adjust input signals from microphones, tape decks, and other sources and to channel the signal to various speakers and other outputs.

**MUSLIN:** A plain, woven, cotton fabric used to cover scenery flats or to cover plywood to mask the grain. This material is available from scenery supply companies in a natural or flame-resistant (FR) form. Non-FR muslin must be treated with a flame retardant prior to use on stage.

**OFFSTAGE** (also called backstage or wings): The areas of the stage that are not readily visible to the audience.

**ONSTAGE:** The part of the stage that is within the audience's view. This area is defined by the location of masking curtains, scenery, or acoustic shells.

**OSHA:** Occupational Safety and Health Administration (OSHA), the federal agency that is responsible for establishing and enforcing safety and health standards for general industry. The Maryland Division of Labor and Industry is responsible for administering and enforcing occupational safety and health activities, as required by the Federal Occupational Safety and Health Act of 1970.

**OUTRIGGERS:** (1) Angled support braces on scaffolds that connect the vertical members to the floor. The surface that contacts the floor has a nonskid pad, usually made of rubber. (2) The horizontal support braces on a powered personnel lift that are attached to the lift at floor level, and are used to stabilize or level the lift.

**PANIC BAR:** A horizontal bar on a fire-exit door that releases the latch mechanism when the bar is pushed or struck.

**PARcan:** A lighting instrument that uses a PAR (parabolic aluminized reflector) lamp to produce a soft-edged beam of light. This instrument has no lenses and does not have any means of adjusting the beam of light. PARcans are classified by the size of lamp that they use (e.g., PAR 38, PAR 56, PAR 64).

**PATTERN HOLDER:** A device for holding a steel pattern, or gobo, in place inside of an ellipsoidal.

**PLATFORM LADDER:** A step ladder that has a platform surface positioned at, and replacing, the highest safe step. This platform allows the worker to turn his or her body and to shift his or her feet to reduce fatigue. The top part of the ladder (where the two sections meet) serves as a safety rail.

**PROTECTIVE WOOD CURB AND GUTTER:** A device made of two strips of wood connected by a strip of plywood 3/8 inch thick or thicker. The air space between the two strips and below the plywood is used to house cables placed on the floor. The outside top edges of the two strips are beveled to reduce the possibility of tripping, and the entire device is secured to the stage with nails and/or gaffers tape.

**PYROTECHNICIAN:** A person trained, tested, and licensed in the use of flashpots and explosive stage effects.

**RECIRCUITING:** Replugging an instrument into an outlet of a different electrical circuit.

**REPATCHING:** Moving a lighting outlet patch cord (or slider) from one dimmer to another.

**ROLLER DROP:** A mechanical device used to roll a backdrop from the bottom up. A roller tube at the bottom of the backdrop is manually raised with rope and pulleys.

**ROTO-DRAPER:** A swivel device centered on a short length of pipe that a leg curtain is tied to. The roto-draper is attached to a track that allows the curtain to be turned at an angle and travel sideways.

**S, SO, SOO, SE, SEO, ST, STO, STOO, SJ:** Designation codes for the type of external insulating covering of flexible electrical cords.

**SAFETY TIE LINES:** A general term used for any type of lightweight rope or cord used to connect a tool to the technician's body. The tie line serves as a means of catching a tool that is accidentally dropped by a person working above floor level.

**SCOOP:** A lighting instrument that produces a large flood of diffused light. The entire body of this instrument is a parabolic reflector, and it does not have any means of adjusting the beam of light. Scoops are hung above the stage and are often used for lighting painted backdrops or cycloramas. They are classified by body opening diameter (e.g., 10 inches or 16 inches).

**SCRIM:** A curtain that is made from a seamless, open weave, black or white material. Scrimms are used to visually soften and blend the lighting on cycloramas and can also be used to dramatically reveal or hide an area of the stage, depending on how it is illuminated.

**SHEAR FORCE:** The stress resulting from pressure that causes two objects to slide relative to each other in a direction parallel to their plane of contact.

**SHIP'S LADDER:** Stairs that are set at an angle steep enough to require the use of handrails. Access to lighting catwalks is often gained by the use of a ship's ladder. A ship's ladder is one method of exiting the off-stage side of scenery platforms.

**SHOCK LOAD:** The abrupt application of weight to something.

**SINGLE-USE DUST MASK:** An inexpensive, disposable face mask that covers the nose and mouth. This type of mask provides protection from sawdust and other large particles only and will not protect the user from paint fumes.

**SNOOT:** A sheet metal tube that is affixed to the front of a fresnel to narrow the field of light emitted from the instrument; sometimes used on ellipsoidals, not to shape the emitted light but to reduce glare that might be offensive to the audience; also called a high hat or top hat.

**SPREADERS:** A metal hinge device on a freestanding ladder that secures the two sections to each other at a fixed angle.

**STEP LADDER:** A freestanding ladder that consists of two sections, hinged together at the top. One section has steps and the other has braces only.

**STRAIGHT SINGLE LADDER:** A ladder that consists of a single section of two side rails connected by rungs. In order to use this type of ladder, one must lean it against a wall or other structure.

**STRIPLIGHT:** A lighting instrument hung above the stage that consists of a row of sockets and reflectors. The sockets are wired in a repetitive series of either three or four circuits. No adjustments to the beam of light can be made, but provisions are made for the mounting of color media or colored glass roundels.

**STRUCTURAL STEEL:** Steel angles, rods, beams, or trusses that are part of a building's main structure.

**TEASERS:** (See BORDERS.)

**TENSION FORCE:** The stress resulting from pressure that causes two objects to pull apart in opposite directions.

**THREE-PRONG GROUNDED PLUG:** A plug for a three-wire extension cord that includes the hot, neutral, and ground conductors. The grounding wire and plug prong do not carry any current, unless there is a malfunction of the equipment and electrical current comes in contact with the outer shell of the piece of equipment.

**TOEBOARD:** A barrier surrounding the work-surface level platform (usually the top platform) of a scaffold that prevents materials or a technician's feet from sliding off the edge.

**TORMENTOR:** (See LEGS.)

**TOXIC RISK:** The possibility of a person being poisoned by something.

**TRAVELER CURTAIN:** A curtain that is hung on wheeled carriers that travel on a track and is operated by a rope-and-pulley system or pulled by hand. These curtains include the main act curtain (also called the grand drape), mid-stage, and up-stage dividing curtains.

**TWO-WIRE EXTENSION CORD:** An electrical extension cord that has only two conductors (hot and neutral) and does not have a protective ground wire.

**UPSOM BOARD:** An off-white, pebbled-surface, dense cardboard sheet material that is used to cover flats, or as a veneer surface for stages or platforms. This material is not structurally sound and must not be used as a weight-bearing surface.

**WATTAGE:** The measure of power in an electrical device.

**WINCH:** A steel spool with a crank handle that is mounted to the building's structure. It is used for pulling and winding the wire rope that is used to suspend a batten.

**WIRE ROPE:** (also called "aircraft cable"): The material used for lift lines on a flown batten.

**YOKE BOLT:** The bolt that attaches the yoke of the lighting instrument to the C-clamp. The vertical adjustment bolts of an instrument are also called yoke bolts, because they attach the instrument to the yoke.