



# THEATRICAL HAZARDS REFERENCE FOR SCHOOL DISTRICTS and SUPERVISORY UNIONS

Presented By:

VSBIT Multi-line Program



**EVALUATION**  
**ERGONOMICS**  
**STRATEGY**  
**AUDIT**  
**INSPECTIONS**  
**TRAININGS**  
**REMEDIATION**  
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**HUMAN FMLA RESOURCES**  
**RESOURCES**  
**GRANTS**  
**DE-ESCALATION & DON'TS**  
**ERGONOMIC ASSESSMENTS**  
**FALL PREVENTION**  
**COST SAFETY**  
**SECURITY**  
**PLAYGROUNDS**  
**RISK**  
**MANAGEMENT**  
**DO'S**  
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**METHOD**

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## INTRODUCTION

The following reference lists hazards associated with the theatrical industry common in school settings.

It is necessary to identify the areas that may cause potential injuries to students, staff or the visiting public. The recognition of these areas and the controls placed to eliminate potential problems are needed to prevent unwanted accidents from occurring in the first place. By identifying the basic areas of exposure and hazards involved in the theatrical setting and then implementing the best practices, we hope to reduce these exposures and prevent accidents. Hazard recognition must be of the foremost importance in the chain of accident prevention.

**Hazards include, but are not limited to:**

- Falls
- Electrical Hazards
- Fires
- Lifting Hazards
- Improper use of tools and equipment
- Chemical Handling
- Burns
- Loud Noises
- Work Location Access Hazards
- Welding and Cutting Hazards
- Stage Rigging

Let's take a look at some of the hazards and how we can reduce the risks associated with them. Some excerpts have been taken from the Voluntary Compliance Outreach Program offered by the US Department of Labor.

## **PREVENTING FALLS**

According to the National Safety Council's 2018 Accident Facts, the top two leading causes of work-related injuries are **overexertion** (such as lifting, pushing, turning, holding, carrying, or throwing) and **slips, trips and falls**, making up **58%** of all occupational injuries involving days away from work in the US.

### **Where can FALLS occur?**

Slips, trips, and falls are of major concern for SU/SD's. They make up the majority of workers' compensation claims. With safety in mind, they may be eliminated from the injury list. Falls may occur from:

- 1. Slips and trips from housekeeping concerns**
- 2. Ladders**
- 3. Elevated surfaces, runways, and scaffolding**

### **How can we prevent these types of slips, trips, and falls?**

- Maintain a good standard of housekeeping.
- Promptly clean up liquid spills.
- Wet locations should be controlled.
- Ensure that staff and students wear appropriate footwear for the job.
- Doorways, aisles, stairways, and other walking or working surfaces shall be kept clear of trash, debris, tools, equipment, and other items, which may cause tripping or other accident hazards. All passageways, storerooms, service rooms, aisles, and working spaces should remain free from clutter.
- Protruding nails, splinters, holes or loose boards should be removed.
- Trash, debris, or other refuse will not be thrown or dropped from upper levels unless the area below is properly barricaded and adequate warnings are posted.
- Adequate number and size of refuse containers should be provided in the workspace.
- Rags, shop cloths, disposable towels, etc., contaminated with flammable or combustible liquids, or harmful chemicals should be stored in labeled metal containers equipped with a cover and discarded in accordance with federal, state, and local regulations.

*Reference: OSHA Standard for General Requirements Subpart D Walking and Working Surfaces 1920.22*

## 1. Ladders



- Use ladders with care.
- Ladders should be in good condition with sufficient size and strength to securely hold the weight of the load. Check for the specification label on the ladder. Commercial Type 1A, rated for 300 lbs. is recommended.
- They should be inspected prior to each use, and taken out of service if needed. Paint on a ladder hinders inspection.
- Ladders should be placed with a secure footing, or be held in position.
- The foot of a ladder should be used at such a pitch that the horizontal distance from the top support to the foot of the ladder is one-quarter of the working length of the ladder.
- Always face the ladder when climbing up or down.
- Short ladders should not be spliced together to make long ladders.
- Ladders should not be used in the horizontal position as scaffolds or work platforms.
- Use both hands when climbing or descending ladders. Don't carry objects.
- The top rung of a ladder should not be used as a seat or a step.
- Metal ladders shall never be used near electrical equipment.
- Fixed ladders should remain in good condition and be inspected regularly.
- Training should be provided to persons using ladders.
- Moveable ladders should never be moved while persons are on them. Moveable ladders should have a breaking/locking system for wheels and system should be activated when in use.
- Ladders should be secured during storage to prevent accidental tip over. Ideally, ladders should be stored horizontally on hooks between shoulder and knee height for ease of handling

Reference:

*OSHA Standard for General Requirements Subpart D Walking and Working Surfaces 1910.25, 26, and 27. 1926.1050 Subpart X Stairways and Ladders*

## 2. Elevated surfaces, runways, and scaffolding

- **Open sided floors, platforms or runways** six feet or more above the adjacent floor or ground level should be guarded by a standard railing or some other approved fall protection system (i.e., safety net system, fall arrest system or other approved fall protection plan), except where there is an entrance to a ramp, stairway, or fixed ladder.
  1. The guardrail systems should be constructed of wood, metal angle iron or other equivalent strength metal materials. They should withstand a minimum applied (from any direction) load of two hundred (200) pounds with minimal deflection.
  2. The guardrail system should consist of a top and intermediate rail, and upright supports spaced no less than eight (8) feet on center.
  3. The top rail should be forty-two (42) inches plus or minus three (3) inches from the floor or platform to the upper surface of the top rail. The intermediate railing should be midway between the floor or platform and the top edge of the guardrail system.
  4. The railing shall be provided with a **toe board** beneath the open sides, wherever:
    - ✓ Persons can pass,
    - ✓ There is moving machinery, or
    - ✓ There is equipment with which falling materials could create a hazard. Care should be taken to ensure that tools, equipment and other objects are secure.
  5. Personal fall arrest systems are recommended for productions where performers or stage personnel are working at heights greater than six (6) feet.
- Training should be provided to persons that may be exposed to fall hazards.

Reference:

*OSHA Standard for General Requirements Subpart D Walking and Working Surfaces 1910.22, 23, 24 and 1926.500 Subpart M Fall Protection*

Because of the many types of **scaffolds** available an attempt to deal with every unit individually will not be made, however, general requirements which apply to all scaffolds include:

1. The footing or anchorage for scaffolds should 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 should not be used to support scaffolds or planks.
2. Scaffolds and their components should be capable of supporting at least four (4) times the maximum intended load.
3. Scaffolds should be maintained in a safe condition and shall not be altered or moved horizontally while they are in use or occupied.
4. Damaged or weakened scaffolds should be immediately repaired and should not be used until repairs have been completed.
5. A safe means must be provided to gain access to the working platform.
6. Overhead protection must be provided for persons on a scaffold exposed to overhead hazards.
7. Guardrails, midrails, and toe boards should be installed on all open sides and ends of platforms more than ten (10) feet above the ground or floor.

Reference:

*OSHA Standard for General Requirements Subpart D Walking and Working Surfaces 1910.28, 29, and 1926.450 Subpart L Scaffolds 1926.104 Safety Belts and Lanyards*

## ELECTRICAL HAZARDS

Though you cannot see electricity, you are aware of it every day. You see it used in countless ways. You cannot taste or smell electricity, but you can feel it.



The **primary hazards** associated with electricity and its use are:

- **SHOCK**- Electrical shock occurs when the human body becomes part of a path through which electrons can flow. The resulting effect on the body can be either direct or indirect.
  - Direct**- Injury or death can occur whenever electric current flows through the human body. Currents of less than 30 mA can result in death.
  - Indirect**- Although the electric current through the human body may be well below the values required to cause noticeable injury, human reaction can result in falls from ladders or scaffolds, or movement into operating machinery. Such reaction can result in serious injury or death.
- **BURNS**- Burns can result when a person touches electrical wiring or equipment that is improperly used or maintained. Typically such burn injuries occur on the hands.
- **FIRE**- Electricity is one of the most common causes of fire, both in the home and in the workplace. Defective or misused electrical equipment is a **MAJOR** cause.
- **EXPLOSIONS**- Explosions occur when electricity provides a source of ignition for an explosive mixture in the atmosphere. Ignition can be due to overheated conductors or equipment, or normal sparking of switch contacts.

**Other hazards include:** Arc-blasts, thermal radiation, pressure wave, and projectiles.

### How can I protect myself?

- ✓ Handle all electrical powered equipment in a manner that will not cause damage. Flexible cords should not be used for raising or lowering the equipment. Flexible cords should not be fastened with staples or otherwise hung in such a fashion as could damage the outer jacket or insulation.

- ✓ Visually inspect cords and equipment before use. Defective or damaged items should be removed from service until repaired or replaced. Extension cords are for temporary use only.
- ✓ Damaged insulated tools need to be removed from service until repairs have been made.
- ✓ Attachment plugs and receptacles may not be altered in a manner that would prevent proper continuity of the equipment's grounding conductor.
- ✓ Lights should not be placed where accidental contact can be made.
- ✓ Care should be given to conductivity issues. Cords, lights and electrical equipment should not be used in locations where persons may come into contact with water or other liquids. Care should be given when using flammable materials near electrical sources.

### **Remember**

Use Personnel Protective Equipment (PPE) appropriate for the specific parts of the body to be protected and for the work being performed. Some PPE includes: non-conductive head-protection, gloves made from insulating materials, and protective shields.

Do not approach or come into contact with someone who is being shocked. First, shut off the power, then provide care. Always call for emergency medical assistance when electrical injuries occur. Electricity can cause internal injuries.

**Ask yourself?** Do I know where the emergency electrical shut off is located?

***As with all matters of Electrical Safety, always consult with a licensed electrician before working on any electrical components, attempting repairs etc.***

#### *Reference:*

*29 CFR 1910 Subpart S*

*29 CFR 1910.147 Lockout/Tagout NFPA 70 National  
Electrical Code*

## **FIRES**

Fires can be a friend or a foe. They can play the role of a hero or a villain. But whichever role is played, **FIRE** commands respect.

### **What causes fire?**

Fires are only possible when 1, 2 and 3 are combined in the fire triangle.

1. fuel (wood, paper, gas, oil, etc.),
2. heat (ignition source), and
3. oxygen

**Think of fire as a three-legged stool. If one of the legs is removed, the stool will not stand. If one of the components of the fire triangle is removed there is no fire.**

**Some of the most common theatrical fires are caused by:**

- Improperly used or maintained electrical equipment, including lighting
- Poor housekeeping
- Improper use or storage of flammable liquids
- Careless use of space heaters

### **Be aware of the Don'ts**

- ✓ Don't use temporary wiring or extension cords that are in bad shape.
- ✓ Don't overload motors, circuits, and outlets.
- ✓ Don't leave heating equipment or machinery running unattended or overnight.
- ✓ Don't dispose of oily rags and combustible materials in the regular trash.
- ✓ Don't use flammable materials near source of ignition.
- ✓ Don't store oxygen cylinders near combustible materials.

### **Be aware of the Do's**

- ✓ DO replace wires when insulation gets frayed or worn.
- ✓ DO use the correct fuse for the job or equipment.
- ✓ DO check the ground connection to ensure a safe path.
- ✓ DO keep combustibles away from lights and machinery.

- ✓ DO use good ventilation.
- ✓ DO store oily rags in a covered metal container.
- ✓ DO clean up spills and leaks quickly.
- ✓ DO keep passageways and fire exits clear.



### **Fire Extinguisher Tips**

Remember the **PASS**-word

**P- Pull the pin.**

**A- Aim at the base of the fire.**

**S- Squeeze the trigger.**

**S- Sweep the hose side to side.**

*P.S. -- Annual fire extinguisher training is required for school personnel. Please contact your local fire department or the Multi-line program for more information.*

### **Remember:**

Prevention may be the main key to fire control. Housekeeping, appropriate storage of chemicals, proper placement of heater and readily accessible fire extinguishers are all important steps in the prevention of fires. Fire extinguishers should only be used on **incipient fires**, (a small fire just beginning to burn, or a discovered small fire not involving structural members of a building). Hands-on fire extinguisher training is recommended.

### **Special Note:**

Drops should be made of fire resistant material. The drops may be tested by the local fire authority to verify the material is continuing to maintain fire resistance.

Contact a theatrical stage and rigging company to assist with treatment of the theater curtains. The curtains should meet NFPA 701 class A standards. The following contact information is known to service Vermont schools: Ron Kline, Production Advantage Inc., [1-800-424-9991](tel:1-800-424-9991), [ronk@proadv.com](mailto:ronk@proadv.com).

### *Reference:*

*29 CFR 1910.38*

*29 CFR 1910.157*

*NFPA 1*

*NFPA 10*

*Uniform Fire Code Volume # 1 and # 2 Uniform Building Code Volume #1 and #2*

## 1997 Uniform Building Code, Volume 1

### Chapter 4: SPECIAL USE AND OCCUPANCY

*Note: Although Vermont does not use the 1997 uniform building code, the Multi-Line program considers it a best practice standard. In most cases it is stricter than the BOCA, NFPA 101 and the NEC codes required by the state of Vermont.*

#### SECTION 405 - STAGES AND PLATFORMS

##### 405.1 Scope.

**405.1.1 Standards of quality.** Stages, platforms and accessory spaces in assembly occupancies shall conform to the requirements of Section 405. The standards listed below labeled a "UBC Standard" are also listed in Chapter 35, Part II, and are part of this code.

1. UBC Standard 4-1, Proscenium Fire safety Curtains
2. UBC Standard 7-1, Fire Tests of Building Construction and Materials
3. UBC Standard 8-1, Test Method for Surface-burning Characteristics of Building Materials
4. UBC Standard 9-1, Installation of Sprinkler Systems

**405.1.2 Definitions.** For the purpose of this chapter, certain terms are defined as follows:

**BATTEN** is a suspended metal pipe or shape on which lights or scenery are fastened.

**DROP** is a large piece of scenic canvas or cloth that hangs vertically, usually across the stage area.

**FLY** is the space over the stage of a theater where scenery and equipment can be hung out of view. Also called lofts and rigging lofts.

**FLY GALLERY** is a raised area above a stage from which the movement of scenery and operation of other stage effects are controlled.

**GRIDIRON** is the structural framing over stage supporting equipment for hanging or flying scenery and other stage effects. A gridiron grating shall not be considered a floor.

**LEG DROP** is a long narrow strip of fabric used for masking. When used on either or both sides of the acting area, it is provided to designate an entry onto the stage by the actors. It is also used to mask the side stage area. They may also be called "wings."

**PINRAIL** is a rail on or above a stage that has belaying pins to which lines are fastened.

**PLATFORM** is that raised area within a building used for the presentation of music, plays or other entertainment; the head table for special guests; the raised area for lectures and speakers; boxing and wrestling rings; theater in the round; and similar purposes wherein there are not overhead hanging curtains, drops, scenery or stage effects other than lighting.

**PLATFORM, PERMANENT**, is a platform used within an area for more than 30 days.

**PLATFORM, TEMPORARY**, is a platform used within an area for not more than 30 days.

**PROSCENIUM WALL** is the wall that separates the stage from the auditorium or house.

**STAGE** is a space within a building used for entertainment or presentations, with a stage height of 50 feet (15 240 mm) or less. Curtains, drops, scenery, lighting devices and other stage effects are hung and not retractable except for a single lighting bank; single main curtain, border and legs; and single backdrop.

**STAGE AREAS** are the entire performance area and adjacent backstage and support areas not separated from the performance area by fire-resistive construction.

**STAGE HEIGHT** is the dimension between the lowest point on the stage floor and the highest point of the underside of the roof or floor deck above the stage.

**STAGE, LEGITIMATE**, is a stage wherein curtains, drops, leg drops, scenery, lighting devices or other stage effects are retractable horizontally or suspended overhead and the stage height is greater than 50 feet (15 240 mm).

**THEATER-IN-THE-ROUND** is an acting area in the middle of a room with the audience sitting all around it.

**405.1.3 Materials and design.** Materials used in the construction of platforms and stages shall conform to the applicable materials and design requirements as set forth in this code. All assumed design live loads shall be indicated on the construction documents submitted for approval.

**405.2 Platforms.** Temporary platforms may be constructed of any materials. The space between the floor and the platform above shall not be used for any purpose other than electrical wiring or plumbing to platform equipment.

Platforms shall be constructed of materials as required for the type of construction of the building in which the platform is located.

When the space beneath a raised platform is used for storage or any purpose other than equipment wiring or plumbing, the floor construction shall not be less than one-hour fire-resistive construction.

When the space beneath the platform is not used for any purpose other than equipment wiring or plumbing, the underside of the platform shall be fire blocked and may be constructed of any type of materials permitted by this code. The floor finish may be of wood in all types of construction.

### **405.3 Stages.**

**405.3.1 Construction.** The minimum type of construction for stages shall be as required for the building except that the finish floor, in all types of construction, may be of wood.

Stages having a stage height exceeding 50 feet (15 240 mm) shall be separated from the balance of the building by not less than a two-hour occupancy separation.

**EXCEPTION:** The opening in the proscenium wall used for viewing performances may be protected by a proscenium fire safety curtain conforming to UBC Standard 4-1.

Where permitted by the building construction type or where the stage is separated from all other areas as required in the paragraph above, the stage floor may be of unprotected noncombustible or heavy-timber framing members with a minimum 1 1/2-inch-thick (38 mm) wood deck.

Where a stage floor is required to be of one-hour fire-resistive-rated construction, the stage floor may be unprotected when the space below the stage is sprinklered throughout.

Where the stage height is 50 feet (15 240 mm) or less, the stage area shall be separated from accessory spaces by a one-hour fire-resistive occupancy separation.

**EXCEPTION:** Control rooms and follow spot rooms may be open to the audience.

**405.3.2 Accessory rooms.** Dressing rooms, workshops, storerooms and other accessory spaces contiguous to stages shall be separated from one another and other building areas by a one-hour fire-resistive occupancy separation.

**EXCEPTION:** A separation is not required for stages having a floor area not exceeding 500 square feet (46.5 m<sup>2</sup>).

**405.3.3 Ventilation.** Emergency ventilation shall be provided for all stage areas greater than 1,000 square feet (93 m<sup>2</sup>) or with a stage height of greater than 50 feet (15 240 mm) to provide a means of removing smoke and combustion gases directly to the outside in the event of a fire. Ventilation shall be by one or a combination of the following methods in Section 405.3.3.1 and 405.3.3.2.

**405.3.3.1 Smoke control.** A means shall be provided to maintain the smoke level not less than 6 feet (1829 mm) above the highest level of assembly seating or above the top of the proscenium opening where proscenium wall and opening protection is provided. The system shall be activated independently by each of the following: (1) activation of the sprinkler system in the stage area and (2) by a manually operated switch at an approved location. The emergency ventilation system shall be connected to both normal and standby power. The fan(s) power wiring and ducts shall be located and properly protected to ensure a minimum 20 minutes of operation in the event of activation.

**405.3.3.2 Roof vents.** Two or more vents shall be located near the center of and above the highest part of the stage area. They shall be raised above the roof and provide a net free vent area equal to 5 percent of the stage area. Vents shall be constructed to open automatically by approved heat-activated devices. Supplemental means shall be provided for manual operation of the ventilator from the stage floor. Vents shall be of an approved type.

**405.3.4 Proscenium walls.** The proscenium opening shall be protected by an approved fire curtain or an approved water curtain complying with UBC Standard 4-1. The fire curtain shall be designed to close automatically upon automatic detection of a fire and upon manual activation and shall resist the passage of flame and smoke for 20 minutes between the stage area and the audience area.

**405.3.5 Gridirons, fly galleries and pinrails.** Beams designed only for the attachment of portable or fixed theater equipment, gridirons, galleries and catwalks shall be constructed of materials consistent with the building type of construction. A fire-resistance rating is not required.

**EXCEPTION:** Combustible materials shall be permitted for use as the floors of galleries and catwalks of all types of construction.

**405.3.6 Flame-retardant requirements.** Combustible scenery of cloth, film, dry vegetation and similar materials shall meet the requirements of the Fire Code. Foam plastics shall have a maximum heat release rate of 100 kilowatts.

## LIFTING

Have you ever had a stiff, nagging pain in your back? If you haven't, you may be one of a lucky few. Or should we say you must be doing something right. Since the back is more fragile than you would expect, and it is the center of our structural support, it is one of the very most important body areas to protect.

### Rules of Good Body Mechanics

Before initiating any lift you should review a "mental checklist".

1. **Test the load.** Prior to lifting or moving an object, test the weight of the load to make sure it can be moved safely. Get help if you need it. Use a lift assist device.
2. **Plan the move.** Check the path of travel or destination of the load to make sure it is clear. Clear the path before picking up the load.
3. **Use a wide, balanced stance with one foot ahead of the other.** A solid base of support reduces the likelihood of slipping and jerking movements.
4. **Keep the lower back in its normal arched position while lifting.** Bend at the knees or hips. With the back arched, the forces are more evenly distributed on the support structures.
5. **Bring the load as close to the body as possible.** This keeps your back from acting as the fulcrum and reduces the stress.
6. **Keep the head and shoulders up as the lifting motion begins.** This helps to keep the arch in the lower back.
7. **Tighten the stomach muscles as the lift begins.** This causes the abdominal cavity to become a weight bearing structure, thus unloading the spine.
8. **Lift with the legs and stand up in a smooth, even motion.** Using the strength of the legs to straighten the knees and hips as the lift is completed, decreases the lower back stress.
9. **Move the feet (pivot) if a direction change is necessary.** This eliminates the need to twist at the waist, thus significantly reducing the stress on the supporting structure of the back.
10. **Communicate if two or more individuals are involved in the movement.** This reduces the likelihood of an error, which could result in sudden or jerking movements.

**Remember:**

By following these simple rules, the stresses on the discs, facet joints, muscles and ligaments are reduced. In this way, the factors that add up over time to produce a back problem are minimized.

Many different roles are played while working in the theater. But the most important one of all will be the role of protecting yourselves and others from injuries.

*You have the knowledge and the ability.*

***Now It's Up To You!***





## **HAND AND PORTABLE POWERED TOOL USE**

Tools are such a common part of our lives that it is difficult to remember that they may pose hazards. All tools are manufactured with a specific task and safety in mind. In the process of removing or avoiding hazards, instructors and students must learn to recognize the hazards associated with the different types of tools and the safety precautions necessary to prevent those hazards. Instructors must inspect student's tools before they are used. Non-powered and power tools all pose hazards if not handled correctly.

- **Hand tools:**

A few examples are: hammers, screwdrivers, files, hacksaws, and handsaws. They include anything from axes to wrenches. Some of the greatest hazards posed by hand tools result from misuse and improper maintenance.

**Examples of misuse:**

Using a screwdriver as a chisel. Screwdrivers were not intended to be hammered on, and could easily break causing damage or injuries.

**Example of improper maintenance:**

The handle of a hammer or ax is loose, cracked or broken. The head of the tool may fly off and strike the user or another person.

- **Power tools:**

Some examples are: drills, abrasive wheels, and sanders. They can be electric, pneumatic, liquid fuel, hydraulic, and powder-actuated. Power tools can be hazardous when improperly used.

**Examples of misuse:**

Taping a safety switch in the on position. This disables the users' ability to shut of the equipment in a timely manner.

**Examples of improper maintenance:**

Guards taken off or not maintained. Guards are designed for a purpose. They are in place to protect persons from coming into contact with moving parts.

### **Safety tips for handling all types of tools**

- ✓ Tools should only be used for the purpose for which they were designed. Manufacturer recommendations for safe operation of **all** tools should be followed.
- ✓ Eye protection and other personal protective equipment (PPE) should be worn according to the hazard present (i.e., dust mask when sanding).

- ✓ Damaged tools need to be removed from service.
- ✓ When working overhead, unused tools should be kept in containers or otherwise secured to prevent them from falling.
- ✓ Tools shall not be left in passageways, accesses, walkways or on ramps, platforms, stairways or scaffolds where they can create a tripping hazard.
- ✓ Tools should not be thrown or dropped to another level.
- ✓ All power tools designed to accommodate guards shall be equipped with such guards when in use.
- ✓ Tools should be kept clean and free from oil and grease to prevent slipping.
- ✓ Never carry tools by the cord or hose. Inspect cord and ground plug before each use.
- ✓ Keep cords and hoses away from heat, oil, and sharp edges.
- ✓ Tools with sharp edges should have the cutting edge guarded when in storage or being carried. Edges should be pointed away from the body when being used. Tools should be sharpened as needed. Dull tools are very dangerous.
- ✓ Use extensions and universal joints when reaching for difficult parts with a wrench. Keep hands out of the danger zone.
- ✓ Care should be given to prevent clothing from being wound around moving parts.
- ✓ Damaged extension cords should be removed from service. Ground plugs on cords do serve a purpose. Don't remove them.
- ✓ The instructor needs to conduct and have written documentation of training on all tools used.

**Remember:**

These are only a few of the tips to use to avoid injuries while working with tools. Hand and powered tools can make a job much easier, but they need to be treated with respect. **Understand** how to properly use the tools you are working with. Then **follow** those rules to keep a safe environment around you.

***Note: The Multi-Line program encourages all school personnel to consult with their facilities/maintenance staff before operating any hand or power tools.***

*Reference:*

*29 CFR 1910. 241 Subpart P*

## CHEMICAL HANDLING

In the modern world, chemicals play an important role in our jobs and in our daily lives. Any chemical regardless of its characteristics can be dangerous if handled improperly. To ensure that chemicals and materials do not injure you, follow these basic rules.

- ✓ **Know the chemicals.** Know how to handle chemicals or materials. Know what the chemical or material is and how it should be used. Always read the container label and the manufacturer's instructions. If incompatible chemicals are mixed, a violent reaction could occur or harmful gases could be produced.
- ✓ **Handle with care.** Handle chemicals and materials with care; be sure the containers are not damaged and the original label remains on the container. If you transfer the chemical to a second container, re-label that container with the name of the chemical. Always transfer chemicals carefully. Dispose of chemical and waste according to regulations, and be extremely cautious if the hazardous chemical or material is flammable.
- ✓ **Protect yourself.** Use **personal protective equipment (PPE)** as prescribed by the chemical manufacturer. Always avoid contact with harmful dust, fumes, or mist. Never drink or eat when you are using chemicals or material. Practice good personal hygiene when you handle hazardous chemicals or materials.

### TYPES of PPE Include

1. Safety Glasses/Goggles
2. Gloves
3. Respirators
4. Ear plugs
5. Foot protection (sturdy foot wear)
6. Head protection (hard hat)
7. Special (i.e., safety harnesses, lanyards)



- ✓ **Instruction.** Be sure you are taught how to handle specific chemicals or materials, especially if you have questions about how to handle them safely.
- ✓ **If in doubt.** If you are not sure how to safely handle a chemical or material, DO NOT TAKE A CHANCE. Ask for help. Review the **Safety Data Sheets (SDS)**.

## What is a SDS?

**SDS** (Safety Data Sheet) formerly called Material Safety Data Sheets, MSDS Safety Data Sheets, if read and followed, are a powerful means of controlling chemical exposures. Chemical manufacturers write SDS's for the chemicals they produce or import. The purpose of the SDS is to communicate information on the recommended safe use and handling procedures for that chemical.

### Chemical/Materials Overview

These are by far only a few of the chemicals or materials you may come into contact with during your theatrical work. Remember to read the label and follow the manufacturer handling instructions.

<b>Solvents &amp; Adhesives (paint thinners, glue adhesives, alcohols)</b>			
<b>Hazards</b>	<b>Effects</b>	<b>How can I protect myself?</b>	<b>Storage</b>
Some are flammable or reactive and cause irritations to the eyes; dissolves the protective oil on the skin	headaches, dizziness, nausea, irritation to the respiratory tract, cramps, change in skin color	Wear protective gloves and safety glasses. Keep away from open flames. Have adequate ventilation.	Store in a flammable liquids cabinet.
<b>Paints (liquid paints, lacquer, enamel, aerosol paints)</b>			
<b>Hazards</b>	<b>Effects</b>	<b>How can I protect myself?</b>	<b>Storage</b>
Some cause irritations to the eyes; dissolves the protective oil on the skin; aerosols can become airborne, causing skin and eye irritation; spray cans are sensitive to heat, fire, and damage	headaches, dizziness, nausea, irritation to the respiratory tract, cramps, change in skin color; damaged spray cans can explode	Wear protective gloves and safety glasses. Have adequate ventilation. Keep aerosol cans protected from heat or damage.	Store in a flammable liquids cabinet.

*Reference:*

*OSHA CFR 1910.1200 Hazard Communication Standard*

*CFR 1910.132 Personal Protective Equipment*

*CFR 1910.134 Respirators*

*ANSI Z 400.1-1990 Eye Wash and Shower Equipment*

## **BURNS**

Burns can come from many sources, such as hot work, lighting, and chemicals. A hazard assessment should be performed to determine what type of burn hazards might be present.

### **Burns can occur from:**

1. Hot lighting instruments/electricity
2. Glue guns
3. Foam cutting
4. Welding

Does the equipment you are using produce heat? If so, added precautions are needed.

- Use equipment according to the manufacturer's recommendations.
- Work in a well-lighted area.
- Limit contact with hot surfaces.

When handling lights, glue guns or any other equipment that may be heat producing, remember to protect yourself from that heat. You must use and wear personal protective equipment (PPE) to protect your eyes, face, lungs, and other body parts from burn hazards.

### **Remember:**

The hands are especially susceptible to injuries from burns. If a burn does occur, seek medical attention as soon as possible.

### **Some first aid tips to remember:**

1. Cool partial thickness burns (in which the skin has not been broken) with cold water to help stop burning.
2. Cover with clean dry dressing to protect from infection. Bandage loosely as swelling may occur and so adjacent burns do not touch.
3. Seek additional medical treatment.

*Reference:*  
29CFR1910.132and.138 ASTM F1461

## LOUD NOISES

We have all heard the old saying, if a tree falls in the woods and no one is there to hear it, does it make any sound? Well, you decide. But we do know that **noise** is in the ear of the beholder. One person's noise is someone else's MUSIC. Exposure to high noise levels can cause hearing loss or impairment. It can create physical and psychological stress. There is **no cure** for noise-induced hearing loss, so the prevention of excessive noise exposure is the only way to avoid hearing damage. If noise levels cannot be reduced then they need to be protected against.

### How loud is too loud?

The Occupational Safety and Health Association (OSHA) standard states that when you are working in sound levels of 85 TWA dBA, 8 hours a day, you are required to have a hearing conservation plan in place. One area this plan focuses on is the type of hearing protection needed. So what type of noise constitutes 85 dBA? Here are a few examples of typical A-weighted sound levels, dBA.

Typical A-weighted Decibels (dBA)	
0	Threshold of Hearing
25	North Rim of the Grand Canyon
50	Urban Residence
70	Vacuum Cleaner (at 10 feet)
83	Heavy Truck (at 49 feet)
95	Jackhammer (at 49 feet)
110	Night Club Music
125	Jet Take-off (1/2 mile)
140	Threshold of Pain

### **Theatrical Noise Hazards include, but are not limited to:**

- Loud music
- Tool or equipment use
- Air compressors

### Types of hearing protection available:

#### ✓ **Ear Plugs**

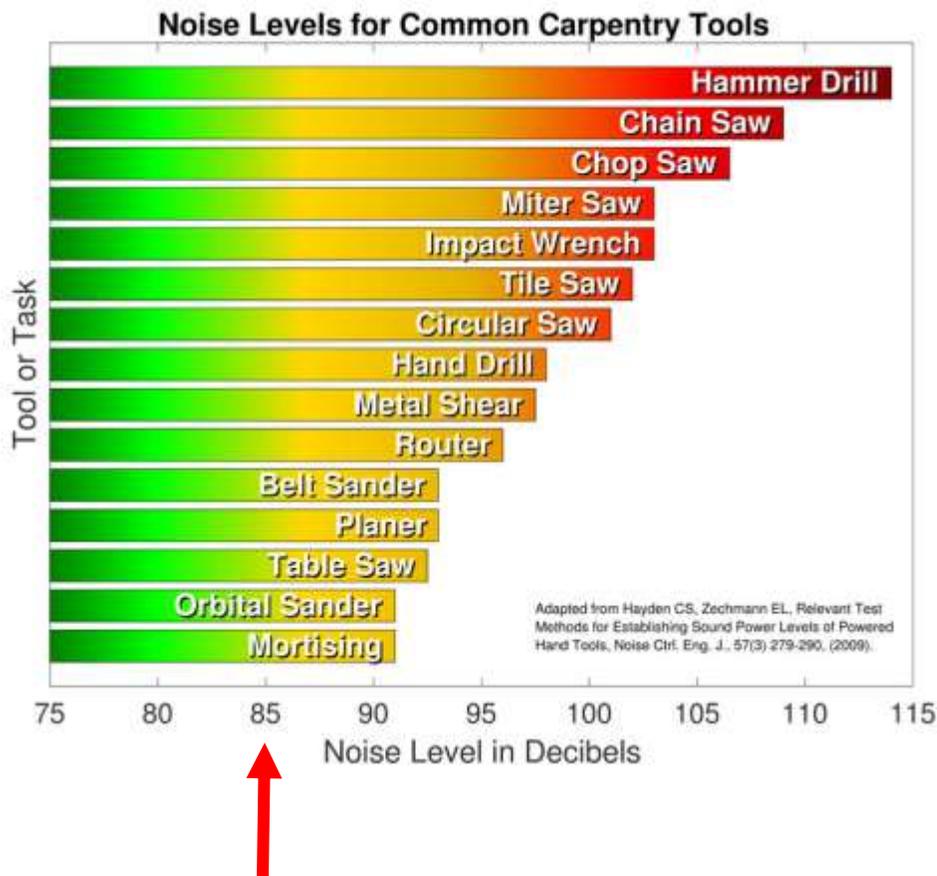
Some earplugs are disposable, to be used one time and then thrown away. The non-disposable type should be cleaned after each use for proper protection. Plain cotton is **ineffective** as protection against hazardous noise.

✓ **Earmuffs**

Earmuffs need to make a perfect seal around the ear to be effective. Glasses, long sideburns, long hair, and facial movements, such as chewing, can reduce protection.

**Remember:**

Care should be used to make sure you are not working in noise levels that will affect your ability to hear later in life. If you must work in noisy areas, use a high Noise Reduction Rated (NRR) hearing protector, and follow the instructions for its use.



Reference: 29CFR 1910.95

## WORK LOCATION EGRESS HAZARDS

Because of the nature of the work, the performing arts are known to store, stack, collect, move, change, and alter all the spaces they are provided in their workspace. This means many of the areas originally designed for egress, (that's simply an unobstructed way of exit) are blocked. Quite simply, you want to have a way out if needed. How can this be achieved?

- ✓ Store **STUFF** somewhere else.
- ✓ Keeping the emergency exits and walking paths clear will always be a challenge, but realizing the importance is an even greater challenge.
- ✓ Mentally imagine yourself trying to escape from the area in the event of an emergency or fire. Then move materials to a location that allows that to happen. **Note:** this doesn't mean stack from floor to ceiling.

### Remember:

In every building or structure, exits shall be so arranged and maintained as to provide free and unobstructed egress from all parts of the building or structure at all times when it is occupied.

*Reference:  
29 CFR 1910.35 Means of Egress NFPA 101 Life  
Safety Code Uniform Building Code Chapter 10*

## **WELDING and CUTTING HAZARDS**

When welding or cutting operations need to take place it is important to take safety precautions. From fire hazards to inhalation hazards, you need to know the safe steps to follow and the hazards to avoid.

### **Hazards**

Chemical agents released from the welding or cutting operation. Several are: Zinc, cadmium, beryllium, iron oxide, mercury, lead, and fluorides. Other hazards include: burns, ultraviolet radiation and potential fires.

Cylinder Hazards: Compressed gases are stores of potential energy.

### **Effects**

Chemical agent effects: Headaches, dizziness, nausea, cramps, change in skin color, irritation to respiratory tract.

Effects include but are not limited to: asphyxiating properties, flammable characteristics, and some compressed gases can augment or compound fire hazards (oxygen).

### **How can I protect myself?**

- ✓ Use adequate ventilation.
- ✓ Wear PPE designed for welding and cutting (welding-hood, gloves, leathers, etc.).
- ✓ Handle cylinders with care. Always secure them. Check for damaged hoses, valves and gauges.
- ✓ Check out your area before you weld or cut. Make sure all flammable materials are removed from the area.
- ✓ Have a suitable fire extinguisher nearby.
- ✓ Store full oxygen and acetylene (fuel) cylinders separately. Uniform Fire Code requires fuel and oxygen cylinders to be separated by a minimum of 20 feet or a 5-foot high wall with a ½ hour fire rating.

### **Ask yourself?**

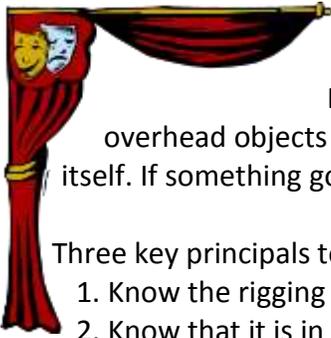
Do I know where the nearest fire extinguisher is located?



### *Reference:*

*CFR 1926.350, 1910.250 Subpart Q*

*Uniform Fire Code*



## STAGE RIGGING SYSTEM

Rigging is a tool used in the theatre. It supports and provides movement of overhead objects that are part of the production. If it works as it should, it rarely calls attention to itself. If something goes wrong, it may not only be noticeable but life threatening as well.

Three key principals to rigging safety are:

1. Know the rigging system you are working with.
2. Know that it is in safe working order.
3. Know how to use it.

As a Stagecraft/Drama teacher you will be asked conduct routine rigging inspections and coordinate with the Maintenance Department to have periodic maintenance performed. *The Multi-Line program also recommends that an outside professional be used to perform annual inspections.*

Common rigging systems used are:

- Block and tackle rigging
- Hemp rigging
- Counterweight rigging
- Motorized rigging

A typical rigging system is made up of individual line sets. Each line set is made up of individual components, such as rope, a head block, loft blocks and so on. Each line set is a separate subsystem, that is, a group of components interrelated and working together. Knowing the rigging system means knowing:

1. ***The capacity of the equipment.*** You must know how much weight each line set is designed to hold, the maximum speed that motorized line sets are designed to travel, the maximum weight that all of the line sets together can hold, and the maximum additional weight that the grid steel can support.
2. ***The capacity of the components.*** You should know the maximum load that each component is designed to carry. A 6-line counterweight set may be designed with a total capacity of 1,500 lb. The individual loft blocks may be designed to support only a load of 250 lb. each. The head block support steel may or may not be designed to support all of the line sets at the full load of 1,500 lb. each.

3. ***The operating characteristics of the system.*** Each line set is unique. It has its own sound and feel. In order to know the system, the operator should know the individual peculiarities of each line set in the system. By knowing how a line set is operated normally, the operator can detect abnormal operation and possible problems.

The most commonly used rigging systems in schools are counterweight and motorized. We will now discuss these systems in more detail.

### **COUNTERWEIGHT RIGGING**

Knowing the rigging system includes knowing the capacity of every part of a system. When using hardware for rigging applications, you should use only hardware with a manufacturer's name and load, or application rating on it and, if possible, a Product Identification Code (PIC). The companies that manufacture this type of hardware have engineering departments that are willing to answer your questions about the use and application of their products.

The counterweight systems most often used are the Single-purchase counterweight system and a Double-Purchase Counterweight system.

A Single-Purchase Counterweight system consists of:

1. Head blocks for lift line and hand line
2. Loft blocks for line lift
3. Wire-rope lift lines
4. Batten
5. Hand line
6. Counterweight arbor
7. Lock rail
8. Tension block
9. T-bar guide rails
10. Loading bridge

A Double-Purchase Counterweight system consists of:

1. Head blocks for lift line and hand line
2. Loft blocks for line lift
3. Wire-rope lift lines
4. Batten
5. Hand line
6. Counterweight arbor
7. Lock rail
8. Tension block
9. T-bar guide rails
10. Loading bridge
11. Arbor Blocks
12. Hand line tie-off
13. Hand line and lift line tie-off

## **Wire Ropes**

Wire rope is the material used for lift lines. Lift lines attach to the counterweight arbor and travel up around the head block, around and down the loft blocks where they are attached to the batten. The wire ropes should be inspected periodically for signs of fraying. If you need to purchase new wire rope, talk to a stage equipment company. Hardware store personnel will not know or understand theatrical requirements.

When attaching wire ropes to the batten and arbor, the load will cause it to stretch. This will usually cause the batten to be uneven. Therefore, when terminating the lift lines at the batten, a method of adjustment must be provided. A trimming device is usually attached to the batten. A trimming device can be a turnbuckle, trim chain, or wire rope with clips. Whatever trim device is used, it should be inspected for wear and tightness (particularly if cable clips are used).

## **Arbor**

The arbor is the rack that holds the counterweights. It consists of a top plate, a bottom plate, a steel back plate, two guide shoe assemblies, and two steel rods  $\frac{3}{4}$  inch in diameter. Steel plates, called spreader plates or spreader bars, slide on the rods. Top plates have collars and thumbscrews and are called lock plates. As weights are stacked on the arbor, the spreader bars should be distributed every 2 to 3 feet. In the event the counterweight set moves too fast and the arbor slams into the top or bottom stops, the spreader plates keep the rods from bending so the counterweights do not fall out.

The lock plate should always be used on the top of the counterweights. Its function is to keep the counterweights from falling out of the arbor in case of a crash. If the arbor becomes hard to move, check the guide and T-bars for proper alignment. The guide shoes may need replacement. Never grease the T-bar. The grease will attract dust and dirt, and it will ultimately make the arbor harder to move.

## **Lock Rail**

The lock rail is a metal rail with a rope lock for the hand line of each counterweight set. The rope lock is intended to keep the batten in a given position under a nearly balanced load condition. The rope lock is never intended to hold a heavily unbalanced load while loading or unloading.

## **Hand Line**

Typically hand lines are made of rope that is tied to the top plate and to the bottom plate of the arbor. The ropes and knots should be inspected periodically.

### **Loading and Unloading Weights**

Counterweight sets are designed to be used in a balanced condition. This means that the load on the batten is equally balanced with the counterweights on the arbors. During the loading and unloading process, an unbalanced condition exists. The basic rule for working with an unbalanced load is keeping the weight down. Never depend on the lock or the lock rail to hold weight in the air. When loading or unloading always have a safety wrap on the hand line.

### **Safety Inspections**

The following components should be inspected:

1. Hand lines
2. Arbor:
  - a. nuts on rods
  - b. spreader bars and lock plates
  - c. hand line knots
  - d. casting and weld cracks
  - e. guide system
3. Head and loft blocks:
  - a. mounting clamps
  - b. support steel
  - c. bearings
4. Tension pulley:
  - a. travel
  - b. bearings
  - c. guides
5. Lock rail:
  - a. mounting bolts that hold the rail
  - b. rope lock mounting bolts
  - c. lock rings
  - d. lock adjustment
6. Rope locks:
  - a. tension adjustment
  - b. mounting bolts
  - c. self-locking feature

7. Wire rope:
  - a. abrasion
  - b. broken wires
  - c. terminations at both ends
8. Battens:
  - a. splices
  - b. level
  - c. straight

## **MOTORIZED RIGGING**

Stage rigging manufacturers combine industrial-grade motors, speed reducers, brakes, controls, and special components to produce motorized rigging equipment for the entertainment industry. A motorized system must be properly designed for its application by a competent engineer. Because motorized rigging equipment is used to suspend objects over people, it requires operational safety devices not found on winches used in industry. Truck winches, industrial hoists, and boat winches are extremely dangerous to use in stage rigging, as are homemade systems. Don't use them.

### **Electric Winch Components**

**Motor.** The motor is the device that converts electrical energy into mechanical energy. The motor is either AC or DC.

**Gear Reducer.** The gear reducer converts a high number of revolutions with low torque into a lower number of revolutions with high torque (or lifting power).

**Brakes.** Most electric winches use a motor brake, which is electrically held open when the winch is running. When the power is turned off, the brake closes and holds the load in place.

**Drum.** On most electric winches, the lift lines wind on a grooved drum. The drum's grooves match the size of the cable being used. A minimum of two dead wraps of cable should be maintained on the drum.

**Controls.** Motorized rigging can be controlled in a number of different ways. Some typical components and methods include:

- Limit switches - usually set to control the maximum high and low trims. There should also be a set of overtravel switches, which serve as backups for the limit switches. Should the limit switch fail, the overtravel switch will stop the movement of the winch.

- Movement controls – there are two types: 1. Hold to run, which requires constant pressure (safest to operate). 2. Latching, which requires only the control to be activated to start the action. The control then is latched in and the winch will run until a preset limit is reached.
- Emergency stop button - all motorized winch systems should have this. This should be a large easy to find button.
- Speed controls - with variable speed systems, you can select the speed of the winches.
- Position control - many systems have some sort of device to allow for stopping the batten at a particular position.

The rigging components of motorized systems (the head and loft blocks, cables, battens, etc.) are the same as those used in counterweight rigging. The same inspection procedures should be followed.

### **Operation of Motorized Rigging**

It is absolutely necessary that the operator know the motorized equipment thoroughly. Answers to the following questions are essential before using a motorized system safely.

- What is the capacity of each winch?
- Are the overtravel switches on the limit switches?
- How do the controls work? (Hold to run? Latching?)
- How does the emergency stop switch work? (Disconnect the power to the winches or only to the controls?)

### **Safety Inspection**

As with any rigging system, motorized sets must be periodically inspected. In addition to inspecting the normal rigging components, check the following:

1. Be sure the correct fuse size is installed.
2. Check all limit and overtravel switches.
3. Maintain oil in the gear reducer according to the manufacturer's instructions. Change the oil when necessary.
4. Test all controls for proper function.
5. Inspect winch mounting devices. They can pull loose.
6. Check the brake. If it chatters or the drum continues to turn after the winch has stopped, the brake may need adjustment.

#### *Reference:*

*Stage Rigging Handbook, Jay O. Glerum*

## **SET PRODUCTION SAFETY RECOMMENDATIONS**

The following risk control recommendations can help your schools control the hazards and resulting losses associated with theatre set productions.

### **RECOMMENDATIONS**

- Require a vocationally knowledgeable teacher to supervise students using powered machinery.
- Suggest teachers have demonstrable proficiency in safety.
- Recommend a staff member have a valid CPR/First Aid card.
- Require students to take written safety tests and skills tests. Require students to score 100% before using powered machinery (See shop teachers for examples of tests).
- If your school has a shop, coordinate with shop teacher to have shop students perform powered tool functions.
- Provide appropriate guards for all powered machinery.
- Install non-slip surfacing around all powered machinery.
- Anchor all fixed power machinery to the floor or counter to prevent walking or tipping of the equipment.
- Post safety-warning signs on or in close proximity to all powered machinery.
- Provide and require to be worn personal protective equipment (PPE) for all processes requiring them. Examples: Eye protection, hearing protection, gloves, hard hats (for overhead hazards), and foot protection (appropriate foot wear, no open toed shoes or sandals). Contact your school's shop or the district warehouse for examples.
- Reduce build-up of flammable materials through good housekeeping practices.
- Store all flammable products appropriately in a flammable storage cabinet.
- Mount fire extinguishers in highly visible locations for use in case of emergency.
- Have first aid kits and other emergency supplies readily available in case of emergency.
- Store all potentially hazardous products appropriately (check the Safety Data Sheet).
- Dispose of all hazardous wastes, such as paint thinner, etc., in compliance with state and local regulations.
- Inspect all shops on a regular basis; document the results.
- Perform preventative maintenance on all powered machinery annually.

**In you have any further questions regarding theatre and stagecraft safety,  
please call the VSBIT Multi-line Program – 1-802-223-6132.**