



## Physical Safety Manual



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## Introduction

The safety and well-being of every member of our college community is our highest priority. This Physical Safety Manual is designed to provide clear guidance on recognizing and preventing hazards that may be encountered not just in laboratories and workshops, but across campus. A safe environment allows us to learn, teach, and conduct research effectively while minimizing risk of injury to ourselves and others.

On a college campus, physical hazards can take many forms. In shops and laboratories, risks may include rotating machinery, sharp tools, electrical equipment, hazardous materials, hot surfaces, and high-pressure systems. In academic and residential areas, hazards may involve slips, trips, and falls, poor housekeeping, ergonomic strain, and unsafe lifting practices. Outdoor spaces and maintenance areas may also present risks such as uneven ground, adverse weather conditions, and vehicle traffic.

This manual outlines the standards, expectations, and procedures necessary to work safely in all these environments. It covers shop and lab safety rules, personal protective equipment (PPE), emergency protocols, safe equipment use, and hazard reporting procedures. Following these guidelines is a shared responsibility: each student, faculty member, and staff member is accountable for contributing to a culture of safety. This manual cannot possibly address every scenario; as such, it is intended to be used as a guide to be used in conjunction with the, *Laboratory Safety and Performing Arts, Venues and Shop Safety Manuals*. These should prepare you to recognize hazards as they are encountered. The second portion of this manual is designed as a quick reference guide, broken up by tools and the various hazards and procedures associated. Every lab and shop space should have site-specific training on tools, hazards and specific policies/procedures and this training should be logged when completed by users.

By familiarizing yourself with the information in this manual and applying it consistently, you are helping create a safer campus for everyone. Safety is not just a rule, it is a mindset and a habit that protects lives.

## Responsible Parties

Well-defined roles and responsibilities ensure clear communication and decision making.

### Upper Management

Deans, Directors and department chairs are responsible for ensuring an effective safety program is implemented in all areas under their scope of responsibility. For shops, this includes all facilities where employees and students or outside guests, work or are involved with production activities. Upper management must assign and authorize designated individuals to establish and support the key processes and procedures of the safety plan.

### Supervisors, Faculty and Staff

Supervisors, faculty and staff play a critical role in the execution of the safety plan and are authorized to:

- develop safe work practices and procedures,
- enforce health and safety rules,
- stop work activities that pose imminent danger,
- ensure routine documented safety inspections occur,
- provide or coordinate safety training,
- make available and ensure proper use of personal, protective equipment (PPE),
- report and investigate injuries and incidents,
- maintain health and safety documentation associated with the safety plan,
- work with CWRU EHS to ensure programs are audited and remain current.

### Employees, Students, and Guests

Employees and students have an obligation to:

- obtain appropriate training for designated activities,
- use PPE as required and directed,
- report unsafe conditions, malfunctioning equipment and other safety concerns,
- report all work-related injuries and incidents,
- understand what to do in the event of an emergency,
- follow and understand all aspects of the safety program,

- not deviate from procedures without authorization from a faculty or staff member.

## **Environmental Health and Safety (EHS)**

EHS is responsible for:

- providing health and safety consultations to all levels of individuals within the CWRU organization,
- assisting with the implementation of safety programs,
- developing and providing safety training,
- performing safety inspections,
- conducting job or task hazard evaluations,
- overseeing incident investigations,
- monitoring compliance.

## **Campus Risk Management**

Campus Risk Management is required to:

- provide risk mitigation and injury management services,
- identify and evaluate emerging risks in cooperation with EHS,
- monitor the Enterprise Risk Management (ERM) program's standards and effectiveness,
- manage incident and injury claims, including workers' compensation claims,
- coordinate transitional return-to-work activities, and
- review contractual agreements.

## **Hazard Identification and Correction**

Identifying and correcting hazards is crucial for an effective safety program. Campus safety programs include regular safety inspections with the EHS office for documenting hazards and corrective actions. Self-inspections must also be conducted. Using the provided checklists, they should include general quarterly or annual facility checks (housekeeping, electrical safety, etc.).

Specialized systems like CNC routers, water jets, laser cutters, or milling machines should be inspected based on the frequency of use, manufacturer guidelines, and recommended industry best practice. These systems are typically not inspected or maintained by your campus facilities staff but may be by shop managers or EHS specialists. At a minimum these systems should receive a thorough and documented inspection by a qualified person annually. This can be performed by an in-house staff member provided they have sufficient experience and training

Hazard identification also involves process-related safety evaluations for activities like welding, paint spraying, laser cutting, and 3D printing.

Reporting unsafe conditions is also vital and employees should know how to report hazards anonymously without fear of reprisal. Overall, safety inspections, hazard evaluations, and reporting are key to maintaining a safe work environment in performing arts.

### **Communication and Training**

Supervisors serve as the primary contact for health and safety information related to your work areas and activities. This information can be disseminated through various channels, including emails, newsletters, posters, or during meetings. Supervisors are responsible for providing essential EHS resources and references relevant to an individual's role. This includes safety training, safety data sheets (SDS), warning labels, job hazard analysis (JHA) details, emergency response procedures, and safe work practices.

On-the-job training is another vital aspect of the training process. It involves direct instruction and guidance during the execution of tasks at the workplace, complementing the foundational safety training obtained through reading materials, videos, instructor-led sessions, or online content. All training must be documented and kept with this plan in each location.

The safety plan mandates that training needs to be identified for each individual and operation, with appropriate training provided based on the task's complexity and hazards. All new employees, or those undertaking new tasks or operations, must receive training, *especially when new hazards are introduced* into the workplace. Supervisors need training to recognize potential hazards faced by their employees and students must be experienced and knowledgeable about regulations and safe work practices to mitigate these risks.

EHS can help in identifying specific training requirements for different tasks within a production facility.

The act of documenting training includes regular reviews of the safety manual, a general safety awareness training record, and site-specific safety training.

## Accident Investigation and Injury Reporting

Two critical situations that require thorough investigation to pinpoint and address their causes are:

**An accident;** defined as an unexpected event causing injury, illness, or property damage.

**A near miss;** which holds potential for harm but does not cause significant damage, are both critical situations requiring a thorough investigation to pinpoint and address their causes.

In case of an accident, it is imperative for employees and students to immediately report to their supervisors to ensure swift medical attention and follow-up actions. Life-threatening injuries necessitate an urgent call to 216-368-3333. This will activate the communication chain required per the CWRU *University Emergency Response Handbook*.

For serious injuries, such as death, amputations, or hospitalizations exceeding 24 hours, the Occupational Safety and Health Administration (OSHA) must be notified within eight hours, underscoring the importance of prompt communication with Campus EHS, even during off-hours or weekends.

Employees, including staff and faculty, who suffer injuries requiring medical attention should be referred to the office of Risk Management and Insurance for processing workers' compensation claims within 24 hours of the incident. Prompt reporting of any injury or suspected illness to a supervisor is crucial.

Following the initial medical response and notifications, EHS or Risk Management may guide supervisors through the accident investigation process, offering the necessary documentation and advice. While they may lead investigations in severe cases, trained supervisors are typically responsible for examining near misses or minor accidents and communicating their findings to their teams. The process following the completion of these investigations involves determining the root cause of the accident and employing preventative measures to reduce the chances of a similar incident happening in the future. Additionally, it is important to document the investigation's findings for future reference.

Accidents causing injuries and illnesses are, by definition, unplanned and unexpected. Thankfully they don't occur frequently, but being well versed in campus procedures is critical. Trained supervisors, who understand these procedures before accidents occur, ensure a quick response and follow up with proper documentation and notification.

## **Summary**

Machine shops, wood shops, makerspaces and labs with shop equipment can be found in a variety of locations on campus. The *CWRU Physical Safety Manual* can provide faculty, staff, and students with a general overview of hazards and related safe work practices. To review safety programs, training, or emergency plans, you can check with supervisors, shop/lab managers, or the EHS office.

## **Chemical Hazards**

Shop users should be aware of and become familiar with the physical and health hazards associated with chemicals like paints, adhesives, dyes, glues, and solvents. Some materials may be impregnated with chemicals that react when cut or heated. Consider this when choosing and handling materials. Every chemical container must retain its original manufacturer's label displaying names, hazard warnings and manufacturer details. If chemicals are transferred to other containers, then these containers must be clearly labeled with the corresponding information

All workers are required to obtain and understand the SDS for each product, which includes details on physical properties, flammability, health hazards, and emergency procedures. An inventory of chemicals and associated SDS shall be kept and all employees and students should be trained on understanding the information and where it is located. Workers must also complete the hazard communication training through the EHS office. In addition, supervisors will discuss the specific products used in set construction or costume design including storage and disposal.

Keep in mind, there are specific product guidelines in areas such as ventilation, consumption prevention, container management, fire safety and aerosol cans as indicated below.

### **Ventilation**

Know the ventilation needs for products used, especially in enclosed spaces.

### **Consumption Prevention**

Do not eat or drink near work areas to prevent ingestion of hazardous materials. Wash hands thoroughly before breaks.

### **Container Management**

Keep chemical containers closed when not in use.

## Fire Safety

Manage ignition sources carefully, particularly around flammable liquids and always store flammable materials, paints and solvents, in a flammable liquid cabinet.

## Aerosol Cans

Do not puncture or expose aerosol cans to high heat. All used aerosol cans, unwanted paints, glues, dyes, solvents, oils, etc., must be sent off as hazardous waste.

## Disposal

Generating hazardous waste is often a byproduct of chemical use and unavoidable when working with such a wide variety of materials. Use the **CWRU Hazardous Waste Information Form** to request the pickup and removal of these materials. You can contact the EHS department for more information and guidance regarding proper storage until collection, proper labeling of waste containers and any special handling requirements.



## Cold and Heat Stress

### Cold Stress

Cold stress is a general definition for cold overexposure in which the heat loss rate of the body is higher than the heat generated by metabolism. This prevents the body from maintaining core temperature. The human body loses heat to the environment in a number of ways:

1. **Radiation heat loss** will occur when the temperature gradient causes exposure to temperatures below 98.6 F
2. **Conduction heat loss** occurs by direct contact with objects or liquids. The greater the surface area in contact and greater density, the faster the conduction occurs. For example, water conducts heat away from the body 25 times faster than air.
3. **Convection** occurs because heated air molecules against skin move away and are continually replaced by new cold air molecules which absorb more heat and continue the cycle.
4. **Evaporation** of sweat and exhalation of moisture is also a leading cause of heat loss. Dehydrated individuals are more susceptible to cold stress and cold injuries.

## Potential Hazards

- **Hypothermia:** Hypothermia occurs when the body cannot tolerate the internal core temperature and heat loss is significantly greater than heat replacement. Based on core temperature, hypothermia has 3 different stages:
  - A. Mild: Core temperature between 90-95 F
  - B. Moderate: Core temperature between 82-90 F
  - C. Severe or Fatal: Core temperature 75-82 F

The most important conditions leading to hypothermia are:

- A. Improper clothing
- B. Low air temperature
- C. Age (The ability to control body temperature lessens with age. Older people tend to expend less energy which generates heat. Young children use energy faster than adults and may use up reserves. Infants lose heat more easily than adults and don't have the energy reserves to shiver to increase heat.)
- D. Humidity and wetness
- E. Pre-existing health problems



Occupational hypothermia almost always occurs as a result of an accidental exposure such as failure to escape from low temperature areas or immersion in low temperature water.

**Mild Symptoms:** Alert but shivering

**Moderate/Severe Symptoms:** Shivery stops, slurred speech, heart rate/breathing slow, loss of consciousness.

## Cold Injuries

- **Frostbite:** is an injury to the body that is caused by freezing of the skin and underlying tissues. The lower the temperature, the more quickly frostbite will occur. Frostbite typically affects the extremities, particularly the feet and hands. Amputation may be required in severe cases.
- **Chilblains:** are painful inflammation of small blood vessels in the skin, caused by the repeated exposure of skin to temperatures just above freezing to as high as 60°F.

- **Trench Foot:** or immersion foot is caused by prolonged exposure to wet and cold temperatures. It can occur at temperatures as high as 60°F if the feet are constantly wet. Non-freezing injury occurs because wet feet lose heat 25 times faster than dry feet. To prevent heat loss, the body constricts the blood vessels to shut down circulation in the feet. The skin tissue begins to die because of a lack of oxygen and nutrients and due to the buildup of toxic products.

**Symptoms:** Redness, swelling, numbness, and blisters

THRESHOLD LIMIT VALUES WORK/WARM-UP SCHEDULE FOR FOUR-HOUR SHIFT*											
Air Temperature Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
° C (approx)	° F (approx)	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
-26° to -28°	-15° to -19°	(Norm breaks) 1	(Norm breaks) 1	75 min.	2	55 min.	3	40 min.	4	40 min.	4
-29° to -31°	-20° to -24°	(Norm breaks) 1	75 min.	2	55 min.	3	40 min.	4	30 min.	5	
-32° to -34°	-25° to -29°	75 min.	2	55 min.	3	40 min.	4	30 min.	5		
-35° to -37°	-30° to -34°	55 min.	3	40 min.	4	30 min.	5				Non-emergency work should cease
-38° to -39°	-35° to -39°	40 min.	4	30 min.	5						Non-emergency work should cease
-40° to -42°	-40° to -44°	30 min.	5								Non-emergency work should cease
-43° to below	-45° & below	Non-emergency work should cease									

## Safety Measures

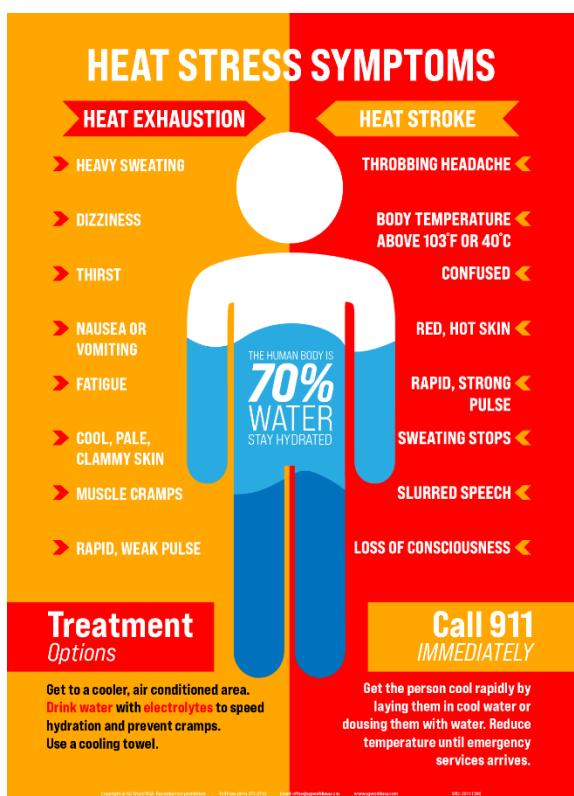
### Prevention:

- If work is performed in temperatures below 40 F, adequate, dry, insulating clothing shall be provided
- At air temperatures below 60.8 F, workers whose clothing becomes wet shall be immediately provided a change of clothing and be treated for hypothermia.
- If fine work is being performed with bare hands for more than 10-20 minutes in an air temperature below 60.8 F, special procedures must be

applied to keep hands warm. If fine work isn't being performed, anticontact gloves can be used.

- D. Warning signs are necessary if exposure to cold surfaces below 19.4 F are likely on a job site.
- E. When work is being performed in air temperature of 0 F or less, mittens shall protect hands.
- F. For work being performed at 39.2 F or less, cold protective clothing must be chosen based on level of cold, wind and physical activity.
- G. Employees handling evaporative liquids (alcohol or cleaning fluids) at temperatures below 39.2 F should take additional precautions to prevent soaking of the clothing or gloves in order to avoid increasing the risk of cold injuries.
- H. In cold rooms, air velocity should be minimized as much as possible and should not exceed 200 fpm at the job site.
  - I. Warm sweet drinks during breaks are required, but the intake of coffee should be limited because of its diuretic and circulatory effects.
  - J. Suitable thermometry should be arranged when the work environment temperatures are below 60 F
- K. The equivalent chill temperature should be considered when an air movement measurement is required.

## Heat Stress



The human body produces heat through metabolism. To tolerate internal body temperature, the body releases heat. The main means of heat release are convection, conduction, radiation, and evaporation (sweat). When the temperature increase rate is faster than the body can acclimate, disorders such as heat stress (shock) can occur.

Body temperature must be maintained at 98.6 F with a maximum change of 1.8 F. As little as a 6.5 degree increase in body temperature can result in death. In heat stress, not only temperature, but also environmental factors such as humidity, air movement and radiant heat exchange can affect body temperature tolerance. To evaluate actual heat exposure conditions, these factors are combined and stated as the WBGT factor (Wet Bulb, Globe Temperature).

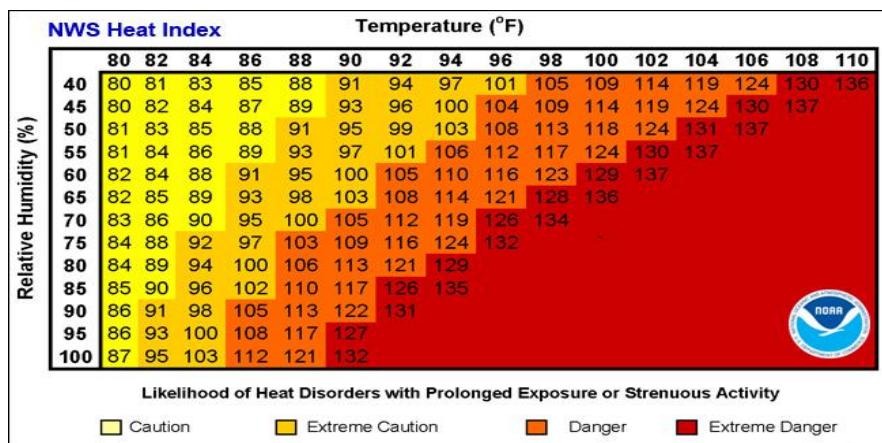
WBGT can be measured with special instruments or can be calculated based on the following formula:

- With direct exposure to sunlight:  $WBGT = 0.7T_{nwb} + 0.2T_g + 0.1T_{db}$
- Without direct exposure to sunlight:  $WBGT = 0.7 T_{nwb} + 0.3 T_g$

Where:  $T_{nwb}$  = Natural wet bulb temperature

$T_g$  = Globe temperature

$T_{db}$  = Dry bulb (air) temperature



## *Potential Hazards*

### **-Skin Disorders**

- Heat Rash: Heat rash is the early signal of potential heat stress and occurs when skin remains damp due to unevaporated sweat.
- Prickly Heat: This skin disorder is a dysfunction of sweat glands in which the sweat can't reach the skin surface. The patient suffers from distressing sensation of prickling, tingling and burning over the skin surface. Red and itchy rashes appear on parts of the body that are usually covered by clothing.

### **-Systemic Disorders**

- Heat Cramps: After hard work in hot environments, this painful muscle spasm happens because of a temporary fluid and salt imbalance.
- Heat Syncope: Heat syncope is fainting when a person stands still for an extended period in a hot environment. Syncope happens because blood pools in the skin and lower part of the body (to release heat) and the brain does not have enough blood flow.
- Heat Exhaustion: Heat exhaustion occurs when the body has lost a large amount of fluid and salt. Symptoms include fatigue, dizziness, nausea and vomiting.
- Heat Stroke: This is the worst effect of heat stress. Heat stroke occurs if the body temperature reaches 105 F. Persons in this stage of heat stress have a rapid heartbeat, red skin and are usually unconscious. Only prompt medical treatment can prevent death.

## **Safety Measures**

- Adequate training and written instruction shall be provided to inform employees about heat hazards
- Engineering controls to reduce temperature (air movement, shielding) shall be provided.
- PPE for specific work situations shall be provided.
- Administrative controls, consisting of break periods and exposure time limitation shall be considered.
- For work in hot areas, cool water should be provided.
- Loose, light and bright color clothing is recommended, except when the temperature is more than 95 F or when work is being conducted near heat sources in which protective clothing will be necessary.

## Compressed Gas and Air<sup>1</sup>

### **Potential Hazards:**

- Flying projectiles (the cylinder itself).
- Pressure explosion and flying debris.
- Flash explosion and/or fire from undesired/uncontrolled release of flammable gas.
- Undesired/uncontrolled release of asphyxiant and/or toxic gases.
- Frostbite and/or chemical burns from exposure to extremely cold gases.



### **Safety Measures:**

- The existing Laboratory Safety Manual contains extensive information on safe use and storage of compressed gas cylinders.
- A quick checklist of common recommended practices is also attached.
- Consult EHS if you use an air compressor and/or have unusual situations not covered by the information provided.

### **Training:**

- Any employee who handles or uses compressed gas cylinders must be trained in general procedures and in specific procedures for the gas(es) they use.
  - Can be classroom, on the job, or a combination of both.
  - Train in accordance with the Laboratory Safety Manual.

### **Labeling:**

- All compressed gas cylinders must be marked to identify the gas content.
  - It must be legible and not easily removed.
  - Marking on slanted area below cap per ANSI Standard Z48.1
- Temporary labeling may be necessary or desirable.
  - Tag to indicate cylinder status: full, empty, etc.
  - Tag to indicate when placed in service.
  - Signage in area(s) where gas cylinders are stored.
- Do not accept or use improperly marked cylinders.

### **PPE:**

- PPE Required is determined by the gas(es) being used.
  - Eye protection is generally needed.

<sup>1</sup> OSHA 1910.165-171, 1910.101-105, and 1926.350

- Gloves and possibly other outerwear needed for “cold” gases.
- Respirators are needed for highly toxic gases and users must also be respirator trained.
- See Chapter 5-II of the Chemical Safety Manual for additional information and list of “restricted” gases.

## Cranes/Hoists/Rigging



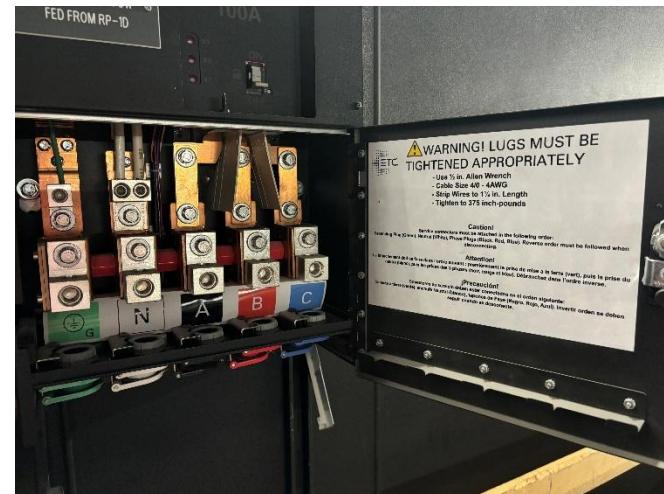
Cranes and chain hoists must have documented annual inspections; EHS coordinates those inspections. When a new hoist comes into service the department must be notified so that the location and other pertinent details can be added to the catalog of assets to maintain compliance. The full requirements and responsibilities can be found in the ***crane, hoist and rigging program*** on the EHS website.

## Electrical<sup>2</sup>

OSHA standard 1910.331-.335 and much of its content was derived from NFPA #70, the National Electric Code. It is intended to protect employees who work with, on, or near electrical equipment and is the focus of this section.

### Potential Hazards:

- Electrical shocks whereby electrical current passes through the body. The standard primarily addresses systems operating from 50 to 600 volts, as this is the voltage area in which most accidents occur. Higher voltages are even more hazardous. Voltages less than 50 are not likely to be a shock hazard but can cause burns and fires. Currents as low as 30mA (.03 ampere) can be lethal.
- Burns
- Explosions and/or fires can occur when electricity provides a source of ignition.



<sup>2</sup> OSHA 1910.331-335, 1910.147, and NFPA 70 National Electric Code



### Safety Measures:

- Learn to recognize electrical hazards and unsafe conditions and follow recommended practices to deal with them.
- A list of the most common hazards and recommended practices is attached.
- If there are any questions regarding an electrical situation, consult with your supervisor and/or EHS
- Take any electrical situation seriously, there is no truly “safe” voltage.
- Heed warning signs
- Use PPE when necessary

### Training:

This standard has many training requirements which vary according to the employee's risk of an electrical accident. OSHA has classified employees into two broad categories relative to requirements.

- **Unqualified Person:** ALL employees who face a risk of electrical shock are classified as unqualified persons. They list a group of occupational categories that they feel face a higher than normal risk. See the attached table. NOTE: There could be others. The unqualified person's training must include:
  - Any safety related work practices that pertain to the employee's work assignments
  - Any safe practices not specifically addressed in the standard but that would be necessary for the employee's safety.
- **Qualified Person:** One who is familiar with the construction and operation of the equipment and the hazards involved. The qualified person's training must include the same as an unqualified person IN ADDITION TO:
  - The ability to distinguish live (energized) parts.
  - The ability to determine nominal voltage.
  - Knowledge of clearance distances.
  - The ability to work on energized parts with the proper use of special precautionary techniques, PPE, insulating and shielding materials, and insulated tools.

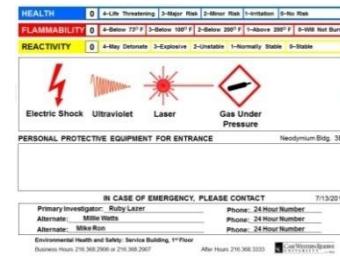
**29 CFR 1926.1408**  
**Table A**

<b>Voltage</b>	<b>Minimum Clearance Distance</b>
Up to 50 kV	10 feet
Above 50-200 kV	15 feet
Above 200-350 kV	20 feet
Above 350-500 kV	25 feet
Above 500-750 kV	35 feet
Above 750-1000 kV	45 feet
Above 1000 kV	(As established by the utility owner/operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution)

Figure 1. OSHA's minimum clearance distances.

### **Labeling:**

Safety signs, safety symbols, or accident prevention tags shall be used where necessary to warn employees about electrical hazards which may endanger them. In some extreme cases, barricades and/or attendants may be required. Electrical equipment, appliances, portable tools, etc. come with factory installed labels which contain specifications and warnings. These must be intact and readable.



### **PPE:**

Electrical protective equipment appropriate for the parts of the body that need protection from electrical hazards must be provided and used. An assessment of the task(s) and hazard(s) must be done to determine what is needed. This PPE would include but is not limited to:

- Non-conductive head protection.
- Eye and face protection.
- Gloves and sleeves.
- Insulated tools and handling equipment.
- Insulating blankets and matting.
- Protective shields and barriers.
- Rubber-soled footwear.

Most electrical protective equipment must meet certain standards as manufactured and must be regularly inspected and tested to ensure they remain within specifications.

### **Electrical Hazards / Recommended Practices List**

- Be on the lookout for exposed wires, terminals and any energized electrical equipment; do NOT come into contact with it.
- Do not use portable metal ladders around exposed, energized electrical equipment.
- Do not wear any metal objects, watches, rings, bracelets, etc. when working around electricity.
- Only “qualified persons” can install or repair electrical systems and equipment.
- Do follow LOTO procedures if you are an authorized employee (doing the work) or an affected employee (the work is being done in your area and/or on your equipment).
- Regularly inspect your work area(s) to identify electrical hazards and/or unsafe conditions that may be present.
  - Missing/Broken electrical box covers including outlets and switches.



- Light fixtures and/or other appliances hanging by their wires and not securely fastened.
- Wires protruding from holes in the wall, ceiling or floor.
- Any situation you suspect might be a hazard or unsafe condition.

Promptly report any of the above to Customer Service and your supervisor. Avoid the situation and post warnings if necessary until it is checked and repaired as necessary by a qualified person.

- Regularly inspect any appliances, portable electric tools and devices that you use to identify any defects.
  - Cables and cords are not frayed, kinked, cut or torn.
  - Plug ends in good condition and ground connection intact where applicable.
  - Switches and other control and safety devices are in good condition and functioning.
  - No signs of arcing or excessive heating.
  - Housings not cracked or broken, no missing pieces.

Do not use any defective or suspected defective equipment until it is checked and repaired as necessary by a qualified person.

- If you use portable electric tools in wet/damp areas, the tools must be made and approved for wet locations and you must wear approved rubber gloves and rubber-soled footwear.
- If you must work with or near flammable gases or vapors, any electrical equipment used MUST be approved for the area.

## Ergonomics-General Duty Clause

According to OSHA, ergonomics is the science of fitting the job to the worker. When a job's physical requirements and the worker's physical capacity are mismatched, muscular skeletal disorders (MSDs) can result. A properly designed work environment improves efficiency, productivity, and worker satisfaction. It decreases absenteeism, workers compensation costs, and a large number of injuries and illnesses.

An MSD is an injury of the muscles, tendons, nerves, ligaments, joints, cartilage, or spinal discs. Some examples include tendonitis, carpal tunnel syndrome, muscle strains, herniated discs, and lower back pain.

## Potential Hazards

- General
  - **Repetitive motion:** As the frequency of a task increases, more muscle effort is required to perform the same task. Repetitive tasks contribute to MSDs especially if they are performed without adequate rest or breaks.

- **Posture:** Proper posture is the position that creates the least amount of stress on the body and allows the maximum amount of blood flow and is referred to as the “neutral” position. Posture that is not neutral causes undue stress on the nerves and tendons. This increases the risk of friction and rubbing between connective tissues.

***High risk postures include:***

- Working with hands above the head for prolonged periods.
- Working with neck bent more than 45 degrees without support or posture changes.
- Working with the back bent forward without support.
- Squatting or kneeling to work repetitively or for prolonged periods.



- **Force:** There is a limit to the amount of force workers can safely exert. Upper extremity exertions that are overly forceful, particularly with repetitive motion, can cause illnesses such as tendonitis or carpal tunnel syndrome. Pinch grips, heavy tools, or low friction between the tool and the hand increase the required amount of force to operate the tools and place undue strain on the muscles and tendons. Whole body exertions such as lifting, pushing, and pulling, can cause lower back pain and other back disorders.
- **Contact stress:** Contact stresses occur when pressure is applied to body tissues by an object, surface, or tool. Nerve injury could result from contact stress depending on the degree of compression. For example, the ulnar nerve could be affected if the forearm is pressed against the side of an uncushioned bench for prolonged periods. Contact stresses may also effect blood flow or circulation. If there is localized pressure on the thigh while seated there may be discomfort or swelling in the ankles due to poor circulation. For example, using the hand, heel or base of palm as a hammer more than once per minute creates contact stress.
- **Static loading:** Static work occurs when a muscle is contracted for an extended period of time. It is most common among awkward postures and tasks requiring lots of strength or while carrying heavy objects. Blood vessels are compressed when a muscle contracts and the blood supply to the muscle decreases. If the muscle cannot rest, the need for metabolic nutrients is unmet and wastes accumulate. Short-term effects may include pain, tremor, or a reduced ability to produce tension.
- **Vibration:** There are two types of vibration. Whole-body vibration is vibration transmitted through the entire body usually originating from the

feet or seat and is often encountered with moving vehicles in shipping, construction, or transportation. Hand and arm vibration is limited to the extremities and results from the usage of power hand tools and vehicle controls. Vibration can disturb muscular control and leads to excessive grip exertions increasing the risk of carpal tunnel.

- **In Lab Situations:** Labs have a number of ergonomic issues which may need addressed depending on the individual's technique, work station design, equipment design, and work duration. The following is a list of potential ergonomic hazards found in labs.
  - **Repetitive pipetting:** Some labs require many hours of pipetting. Tasks such as mixing or dispensing need evaluated since they require frequent repetitions. Any pipette work lasting more than 2 hours/day should be closely supervised. Symptoms such as pain in the forearm, thumb, neck, shoulder, or elbow should not be ignored.
  - **Microscopy:** A microscope that is too low or not positioned correctly puts undue stress on the neck and causes the shoulders and upper back to be rounded forward. Bad posture compromises blood flow, compresses nerves to the arms, and increases muscle strain. The arms should also be properly supported so that contact stresses are avoided.
  - **Keyboarding and mouse use:** Many researchers spend hours entering data into the computer and generating reports. Desks, keyboards, mouse pads, and chairs should be at proper heights, computers should be placed directly in front of the worker, and proper wrist support should be available.
  - **Biosafety cabinets, work benches and fume hoods:** Factors such as a workers posture, heights of cabinets and hoods, leg room, adjustability, metal edges, and technique such as working with arms outstretched all affect the worker's health and safety.
  - **Micromanipulation and fine motor skills:** Frequent pinching, dissecting, twisting, or unscrewing caps and stoppers require the repetitive use of the small muscle groups of the fingers and wrist.
  - **Microtome work and cryostat:** Microtome work predominantly affects histology technicians. Some ergonomic hazards may include unsuitable seat and microtome heights; the use of a manual rotary microtome requiring repetitive flexion and extension of the wrist, elbow and shoulder; pinch grips for slicing or cover slip applications and contact stress on the bench.



- **Lifting centrifuge rotors:** Some rotors weigh up to 35 pounds. Rotors are in the bottom of the centrifuge so the worker has to bend over and reach inside to lift it leading to lower back strain.
- **Overhead lifting:** Many labs store supplies on overhead shelves. Lifting items overhead creates an awkward lifting posture and depending on the frequency and load, results in back pain.
- **Standing in place:** Static loading may be experienced while standing in place for long periods of time (especially if the floors are not padded) resulting in back and foot pain.
- **Flow cytometers:** The worker must sit or stand in awkward positions to see the controls since the receiving port is on the bottom of the flow cytometer. This could require frequent bending of the neck and back as well as arm reaching.
- **In Material Handling Operations**
  - Low back pain and injuries attributed to manual material handling (lifting, pushing, pulling) are still one of the leading causes of occupational injuries. According to the Department of Labor's Bureau of labor statistics, back injuries account for nearly 20% of all injuries in the workplace and nearly 25% of annual workers compensation payments.
  - The main cause of back injuries is over-exertion causing the vertebral discs to be worn down. Various positions of the load, body postures, load weights, and angles of lifting all create different pressures on the vertebral discs. Compression forces increase with the weight and distance of the load. It is also generally preferred to keep the load positioned close to the body and with spine in a relatively straight position while bending at the legs.
- **In Offices**

Potential hazards in an office include furniture that is poorly arranged or designed, lack of wrist support, and repetitive motion such as mouse clicking or typing. Furniture that is poorly arranged or designed can decrease circulation and lead to neck and back pain and/or swelling of the feet.

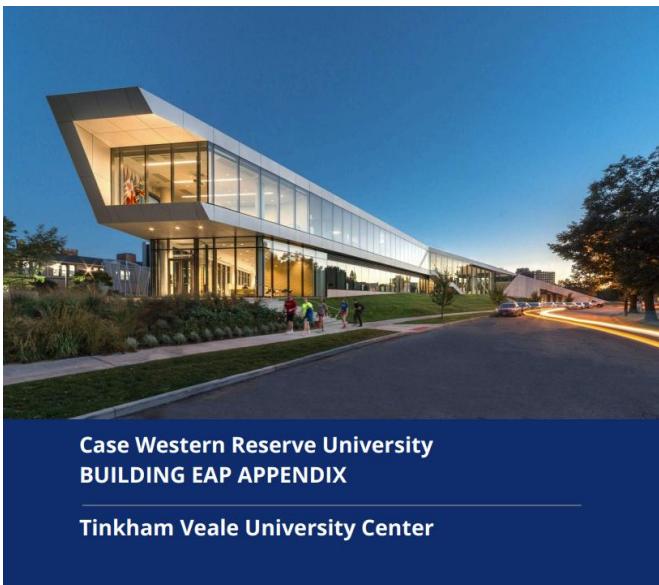
### **Safety Measures:**

- Work positions must be systematically analyzed to proactively identify hazards and prevent occupational injuries and illnesses. Reviewing company job descriptions and accident reports are a good place to start. The employees in the identified work positions should be identified, interviewed, and observed. These employees should then be assessed for the ergonomic risk factors. Any risk factors must be eliminated or minimized and the employee's progress tracked.
- **Use mechanical lifting devices:** Hand trucks, push carts and forklifts are great engineering controls that reduce exposure to lifting hazards.
- **Repetitive motion:** Persons performing repetitive tasks should keep the body in the neutral position, use automated equipment whenever possible, take plenty of

breaks to rest muscles, and rotate the work among a number of people to decrease exposure time.

- **Poor posture:** Furniture and equipment should be arranged to accommodate the worker's neutral posture. This involves the placement of furniture and adjusting it to appropriate heights.
- **Force:** To minimize force, substitute power tools for manual tools, provide friction on tools that are slippery and use torque control devices.
- **Contact stresses:** To deter contact stress, provide padding or round sharp edges. Providing proper support and furniture heights also reduces stresses.
- **Vibration:** When evaluating vibration exposure, the magnitude, frequency and duration must be assessed. Whole body vibration can be minimized by isolation and suspension systems inserted between the worker and source. Hand/arm vibration is encountered frequently with power hand tools and is more difficult to control. The closer the equipment vibration frequency is to the natural or resonant vibration frequency of the affected body part, the more damaging the vibration. Vibration levels depend on the tool's size, weight, propulsion method, power source, attachments, and drive mechanisms. Redesigning work procedures to eliminate the need for power tools, rotating workers, using tools with lower vibration levels or antivibration gloves help to reduce exposure.
- **Repetitive pipetting:** Use ergonomically designed electronic pipettors. Electronic pipettors are generally lighter than manual pipettors, require less force to operate, and have improved grip designs. Rotating tasks between workers to decrease exposure time also helps.
- **Microscopy:** There are many ergonomic factors to consider when using a microscope, and more and more companies are making microscopes that are ergonomically designed. Microscope stations should not be cramped or inflexible. The researchers should sit in a neutral position with the ears above the shoulders and shoulders above the hips. Arms should rest comfortably on the desk at a right angle
- **Biosafety cabinets, work benches and fume hoods:** Make sure there is ample legroom under the bench and an adjustable chair is provided. If bench heights are high, provide a sit/stand stool. Floors should be padded with mats. Edges of benches need to be rounded or padded.
- If an unsafe load is lifted by a worker, the first approach is to eliminate the job's manual requirements by using engineering controls such as hoists, conveyors, lift trucks, lift tables, or other automated equipment. If this is not feasible, stress on the worker should be minimized. Minimization can be achieved by modifying the physical layout of the job, reducing the frequency or duration of the lifting, dividing the load among multiple people, or changing the properties of the load such as its size and weight. Whenever possible, a handcart or lifting ramp should be used.

## Emergency Action Plans



Building Coordinators are responsible for writing and updating building Emergency Action Plans. These plans can be found on the Public Safety division's website. In the event of campus wide emergencies or severe weather, the university notifies the community through the Spartan Safe app. In the app you can receive real time announcements and instruction as well as find campus maps and emergency plans. Spartan Safe is an opt out system. In the event that an emergency does not impact the entirety of campus, the development of venue specific response plans is required for the safety of students, staff, performers, crew and patrons. Assistance in creating these plans and conducting training for staff, performers, and crew can be provided by EHS, Risk Management and the Public Safety Division.

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### Assign Duties

Emergency plans need to be specific and thorough, assign duties based on skill sets and the authority to carry out assigned tasks. Consider building conditions throughout the day. Will what is happening change based on who is present and the response needed? What events might occur during performances, rehearsals, during classes or a typical workday? How do you evacuate patrons with mobility issues? And how might those events occur differently under those conditions. Personnel that are assigned emergency response duties should have those duties clearly detailed in action plans and should receive initial and recurring training. Ensure that venue specific site plans are compatible with campus response plans found online and in the Spartan Safe app.

### In the Event of Illness or Injury

For minor injuries, provide first aid immediately. Ensure that universal precautions are used and stocked in first aid kits to reduce the risk of bloodborne pathogen exposure. These include CPR safety masks, latex gloves, and materials to clean, bandage and if needed apply pressure to wounds.

## Serious Injuries

For non-minor injuries such as head injuries, loss of consciousness, stroke, heart attack or symptoms, loss of breathing or deep wounds. Call medical services immediately by calling 216.368.3333 or 911 and be sure that you know where you are. Unless the call comes from a landline, dispatchers may not be able to determine precise locations. 1 caller with clear, concise information saves vital response time. Notify superiors of injuries immediately and post personnel at entry points and along the route to assist in directing emergency responders to the injured person's location.

## Automated External Defibrillators

are available around campus, if you have received CPR training you should have also had AED training. That said, because of their automated nature and diagrams, they are designed so that anybody can use them, regardless of training. Announcements will be made, and instructions will be given. Follow the instructions given by the device and any training you have received.



## Investigation

As soon as an injured or ill person's needs have been met, begin gathering information for an incident investigation. Obtain information from the individual and any patrons with them and any witnesses to the event, including:

- Names
- Address
- Phone number
- Medical conditions or medications (first responders will also need this information)
- What was seen or heard

Document this information and report the event to EHS and risk management.

## Evacuation

In the event of an emergency that requires evacuating patrons and staff, announcement procedures must be defined. There must be clarity on how the need to evacuate is communicated to students, building staff, and guests. In class settings, instructors are responsible for students. These requirements apply to all EAP's regardless of location.

All site-specific plans should have a primary evacuation route and a secondary route in the event that the first is blocked. Included in this planning should be an assessment of accessible routes and areas of refuge where evacuees who are unable to exit can

shelter until help arrives. It is important to use stairs, not elevators, take ONLY essential items and to move quickly but in an orderly manner.

## Assembly Points

An assembly point is an area outside of a building for evacuees to gather and regroup. It should be far enough removed (at least 300 feet) that any building hazards are no longer a threat and out of the anticipated path of first responders.

## Training

Everyone in a building that assists others with evacuating should be familiar and comfortable with these routes, refuge areas and assembly points. Maps documenting routes and refuge should be posted and visible at all times.

## Shelter in Place

There are times when the university may issue a shelter in place order. This could be due to weather events, power outages or active threats. Determine how a show stoppage occurs and is communicated and how action is to resume after an all clear. How will the facility be secured and where will occupants shelter to be protected?

## Fire

### Before a fire:

- Know where the fire alarm pull stations are in your area and how to use them.
- Know how to get help. Call the emergency line at x3333.
- Know where the exits from your area are and where stairs are located.
- Know the location of fire extinguishers in your area.
- If you need special assistance during an evacuation, notify and discuss it with your Evacuation Coordinator, supervisor, and notify Public Safety of the details.
- Teaching faculty should advise their students how to respond to alarms and their evacuation routes. They should participate in planning required to provide assistance for any students who may have difficulty evacuating. This should be done in the first two weeks of class.

### When a fire is discovered:

- Activate the building fire alarm.
- Call the campus emergency line at 216-368-3333, be specific about where the fire is.
- Evacuate the building, closing doors after each area or room is cleared.
- Immediately go to the assembly area and remain there for further instruction, never reenter the building. Do NOT use elevators.

- Before opening doors, feel the knob/hardware. If hot, do not open it. If heavy/obscuring smoke or heat is present, seek alternate routes.
- Keep low to the floor if smoke and/or heat is encountered.
- Attempt to extinguish a fire ONLY if you have been trained, feel comfortable, the fire is small, can be extinguished in less than 10 seconds or if you have no other choice.
- If for any reason you cannot evacuate, move as far away as possible from the fire area. Seek a room with a door. Close the door, seal any cracks along the door with towels or other materials and notify Public Safety of your location. Signal from a window.



## Chemical Spills and Exposure

Hazardous materials can put people in immediate danger from exposure, contact, inhalation or ingestion. If there is a danger or noxious fumes, evacuate the area. As soon as possible, call the emergency line at 216-368-3333. After the emergency has ended, report all chemical spills to EHS. All personnel who work with hazardous chemicals or in an area where they are used or stored need to be trained in the response procedures.

### Contact with eyes and skin

- Flush the skin immediately with running water. For eyes, keep them in contact with water from an eye wash station for at least 15 minutes and do not wait to remove contact lenses.
- Seek immediate medical attention for eye contact and for any chemical burns.
- Provide a Safety Data Sheet for the specific chemical exposure to medical personnel when they arrive.

### Inhalation

- Immediately seek fresh air.
- Remove anybody that is unresponsive to fresh air.
- As you exit, turn on any exhaust ventilation and leave the door open
- Provide first aid as needed and if symptoms don't subside or a person remains unconscious, seek medical attention.
- Provide any applicable SDS to medical personnel

## Ingestion

- Follow safety guidelines prohibiting eating, drinking, or serving food where chemicals are used or stored.
- Seek medical attention for incidents of ingestion and provide SDS to medical personnel.

## Power Outage

Many buildings on campus have backup power generators to cope with power loss situations. Be aware that generators can take a few minutes to initiate and restore power and that trip and fall incidents greatly increase during power losses from people trying to move in the dark.

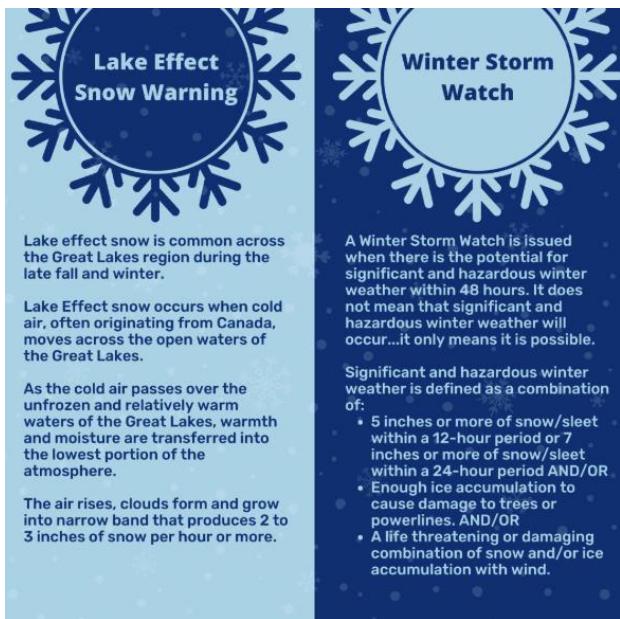
- If there is no immediate danger, stay where you are and wait for directions from managers.
- Report the power outage to the CWRU Non-Emergency line at 216-368-3300
- If after 5 minutes you are still in the dark, the building may not have a generator, or it may not be functioning properly. At that point proceed with caution to an area lit with emergency lighting.
- If asked to evacuate, proceed cautiously to the nearest exit and move to the assembly point or at least 300 feet away from the structure.

## Medical

A medical emergency is an injury or illness that poses an immediate risk to a person's life or health.

- Immediately call CWRU Public Safety at 216-368-3333 or 911
- Unless you are trained, do not render assistance above basic first aid.
- Utilize universal precautions while delivering aid. If the injured person is able, allow them to clean, bandage or apply pressure to the wound themselves. Be sure to wear gloves, use a CPR mask if giving CPR and wash hands immediately after removing gloves.
- AEDs and Stop the Bleed kits are located in wall mounted cabinets in buildings and populated areas.
- Clear the area of unnecessary people
- Have someone meet and escort the medical team to the injured person.
- Notify supervisors or the person in charge for any non-minor injuries
- Remain after the person's needs are met to assist the incident investigation.

## Weather



Severe weather events include high winds, tornadoes, and hail. Determine how a building closure decision will be made and when that decision will occur if it differs from campus closure policies. Continuous monitoring is required as severe weather approaches.

- Seek shelter away from windows, doors, skylights, or other objects that could cause injury if knocked or blown over.
- Have established locations that you can move patrons to if you need to shelter a large number of people
- Do not use elevators

## Training

Emergency response training should be conducted and documented for all students and staff. It is imperative that people understand the procedures and any responsibilities they have during anticipated emergency situations. Shop managers should also receive first aid, CPR and AED training. This training should be conducted annually, when response plans change, or as needed when new employees or students join.

## Drills

Part of the annual training should include documented practice drills. Track and record the time it takes to fully evacuate a building, find and retrieve AEDs or how to move a group to an area of refuge. Review safety plans afterwards to identify areas of improvement. EHS, risk management and Public Safety are here to assist and can provide guidance. There may be times throughout the year when these departments conduct drills that may be unannounced.

As the distance between training or instruction grows your memories and skills may fade. Being vigilant every day and aware of hazards as you encounter them is important to keeping response times fast and your knowledge in the foreground even during the chaos of productions, teaching classes and managing students. Report issues as you see them to the appropriate departments and continue to examine spaces critically for hazards as they develop.

## Eyewash Stations<sup>3</sup>

Eyewash stations are designed to provide immediate decontamination to the eyes following exposure to hazardous substances such as chemicals, biological agents, or particulate matter. These stations deliver a controlled flow of clean water or saline solution to the eyes, helping to flush out irritants, minimize injury, and prevent further contamination. Eyewash stations are a critical component of workplace safety systems in environments where workers handle or are exposed to potentially harmful materials, including laboratories, manufacturing plants, construction sites, and healthcare facilities.



Eyewash stations are generally classified into two main categories: plumbed units and self-contained (portable) units. Plumbed units are permanently connected to a facility's water supply and drainage system, ensuring a continuous source of flushing fluid. Self-contained units, by contrast, contain a fixed volume of sterile water or buffered saline solution and are often used in areas lacking access to plumbing. Combination units, which integrate both an eyewash and an emergency shower, are commonly installed in areas where there is risk of exposure to corrosive or toxic substances that can affect both the eyes and body.

The standard requires that eyewash stations deliver a minimum flow of 0.4 gallons (1.5 liters) per minute for at least 15 minutes, with fluid temperature maintained within a tepid range (16–38°C or 60–100°F). Stations must be located within 10 seconds' travel time from potential hazards, be clearly identified, and always remain unobstructed.

Routine maintenance is essential to ensure the proper functioning of eyewash stations. Plumbed units should be activated weekly to flush the system and verify operational readiness, while self-contained units must be inspected and the flushing fluid replaced according to manufacturer instructions and expiration dates, typically every three to six months. Annual comprehensive inspections are recommended to confirm compliance with performance standards. Neglecting maintenance can result in stagnant or contaminated water, reduced flow, or mechanical failure, rendering the equipment ineffective in an emergency.

<sup>3</sup> The design and operation of eyewash stations are governed by standards such as ANSI/ISEA Z358.1

## Fire Safety and Fire Systems and Sprinklers<sup>4</sup>

EHS ensures that exit signs, emergency lighting systems, and fire suppression systems are inspected regularly and are functioning properly. Additionally, EHS verifies that fire extinguishers are inspected, replaced annually, that fire alarm control panels are free of faults with up to date inspections. Although these occur on a regular basis, there are times between these inspections where situations may change. You should not rely solely on the knowledge that these checks occur and should maintain your own system of periodic checks of the areas in which you work. Should you encounter burnt out exit signs, alarm faults, or out-of-date inspections please contact EHS with the details, for the issue to be rectified.



“Fire Safety” is a broad term and comprised of three major components: fire prevention, fire protection, and response to a fire situation. “Fire Prevention” consists of measures taken to reduce the possibility of a fire occurring. “Fire Protection” consists of systems and devices in place to warn occupants if a fire situation happens and to control the fire. “Response” consists of the actions to be taken by the occupants of an area in a fire situation.

### **Potential Hazards**

- Burns; can be fatal.
- Smoke inhalation; can be fatal.

### **Safety Measures**

- Eliminate/control sources of ignition.
  - Avoid the use of open flames; if they must be used, NEVER leave them unattended.
  - Be sure all heating devices/appliances are in good condition with all safeguards intact and working. Do not leave any heating operation unattended.
  - Inspect all electrical equipment. Look for worn or frayed insulation, broken plugs or housings, exposed wires/terminals, signs of excess heating. Take anything that is defective or questionable out of service until it is checked and repaired by a qualified person.
- Develop and practice good housekeeping habits.

<sup>4</sup> OSHA 1910.155-165, 1910.35-40, 1926.150, 1926.352, NFPA 1, 10, 30, 45, 72, 96, 101

- Avoid accumulations of ordinary combustible materials, including paper, cardboard, wood, and plastics.
- Keep combustibles away from heat producing appliances/devices.
- Do not place glass bottles of flammable/combustible liquids on the floor, lab worktop or any place where they could be kicked/knocked over and broken.
- Provide a fire resistant, covered container for oily rags and/or any materials that are saturated with flammable/combustible materials.
- Remove ordinary trash on a timely basis.
- Store and handle flammable liquids properly; see Chemical Safety Manual.

## Fire Protection

- All University buildings have fire alarm systems in place.
  - Most systems have automatic and manual activation capability and provide audible and visual alarm indication.
  - These systems are put in place and maintained by the University.
  - All occupants **must** evacuate the area if a system activates.
  - Do not block or impede access to any components of the system. Including fire extinguishers.
  - Do report any obvious and/or suspected defects or problems to customer service and/or EHS.
- Some “special hazards” operations (i.e. flammable liquid storage rooms, commercial cooking facilities, hazardous waste storage facilities, etc.) have automatic fixed station fire suppression systems.
  - These systems are put in place and maintained by the University.
  - Report any obvious and/or suspected defects/problems to customer service and/or EHS.
- A few buildings have automatic sprinkler systems and/or standpipes with hose connections.
  - These systems are put in place and maintained by the University.
  - Keep all items, storage, equipment, etc. **at least 18 inches below** the sprinkler head in the ceiling.
  - Do not block or impede access to hose stations or hose connections.



- Report any obvious or suspected defects or problems to customer service and/or EHS.
- Fire hoses are for use by trained responders, not the general building population.
- Buildings are equipped with fire-rated doors. These are part of a passive protection system that provides compartmentalization of fire and smoke and enables safe egress.
  - These doors provide a fire barrier for an amount of time identified by a tag on the door edge.
  - The fire rating label must not be painted over.
  - Most fire doors are designed to be kept closed at all times. They are NOT to be propped open. This defeats the fire barrier. Some doors are designed to stay open under normal circumstances and close automatically in the event of a fire. These are often held open by electromagnetic door holders that de-energize when an alarm triggers, allowing the door to close.
  - Report any obvious or suspected defects or damage to customer service and/or EHS.
- All buildings are equipped with portable fire extinguishers.
  - Fire extinguishers are put in place and maintained by the University.
  - Fire extinguishers are primarily used by properly trained responders and not by the general building population.
  - Report any obvious or suspected defects/problems to customer service and/or EHS.

### **Response**

- The University neither expects nor does it want its general employee population to fight fires and it does not have a fire brigade.
- If a fire situation, alarm activation, or actual fire observation occurs, evacuate to a safe area of refuge immediately.
- Become familiar with your building's evacuation plan before a fire situation happens. Plans can be found on the Public Safety website.

### ***Training and Labeling:***

- No specific training requirements; however, all employees should be familiar with their building's evacuation plans. Anyone expected to fight fires would have to be trained in basic firefighting techniques.
- Some labeling could be needed in certain situations (i.e. “open flames and lights prohibited”, “CAUTION: Hot Surface”, etc.) and of course exit signage. Signage to indicate the location of fire extinguishers, hose stations/connections, if the location is not obviously apparent.

## Extinguishers

- Fire extinguishers must be inspected annually and must have a tag marking when that inspection occurred.
- Direct and clear access to extinguishers shall be maintained at all times. Nothing should block physical access.
- Extinguishers should not be on the floor. They must be mounted or secured in a labeled enclosure. This prevents the potential that they are covered, blocked, hard to find, and keeps them from being knocked over and possibly damaged.
- It is vital that the proper classification of extinguishers is used for the types of exposure in a given area. ABC types are the most often recommended.
- Do not mistake an ABC inspection tag (an extinguisher servicing company) as a label for the TYPE of extinguisher.
- Consider requirements for fire watches, outdoor events and other situations where hazards or gathered crowds may necessitate extinguishers beyond the permanently installed options already in a building.

**There are 5 classes of extinguisher, based on what type of fires they extinguish**

**Class A:** Combustible materials

**Class B:** Flammable liquids

**Class C:** Electrical

**Class D:** Combustible metals (magnesium, sodium, lithium, and potassium)

**Class K:** Cooking media

### Using a Fire Extinguisher

Remember the “PASS” acronym when operating an extinguisher:

**P – Pull the pin**

**A – Aim at the base of the fire**

**S – Squeeze the trigger**

**S – Sweep from side to side**

Contact EH&S to get further information on signing up for fire extinguisher training.



## Housekeeping



During work shifts and heavy use times, aisles and work areas can become particularly congested, elevating the risk of accidents. To ensure safety and efficiency certain protocols must be followed.

Post-session cleaning is an important protocol that should become routine. Workers need to maintain a habit of cleaning up after every work session. As a result, hazards are minimized, and the space is kept well organized.

Dispose of trash and waste materials in designated receptacles immediately after use. Clutter is a major problem in workspaces. With this in mind, avoid accumulation. It is neither safe, nor appealing and can be a dangerous eyesore.

Remove scrap lumber, unused materials, and other debris on a regular basis. Accumulated clutter not only poses a tripping hazard but can also become a fire risk. At all times, store materials and equipment properly when they are not in use. In addition to being out of the way, this practice preserves their condition and makes them easy to locate.

All tools must be returned to their designated storage area. This prevents them from becoming tripping hazards and helps maintain an organized and efficient workspace. Make sure you remain alert and **ALWAYS** be aware of your surroundings, especially in areas where students and outside guests may be present. If you notice a potential hazard, inform your colleagues and take immediate steps to rectify it. The risk of fire is significantly reduced by keeping the area clear of unnecessary debris, especially flammable materials like scrap wood and paper.

Workspaces should be “made safe” every day. When a space is shared with multiple groups, personal responsibility should take precedence and spaces should be left clean and clear. Debris and equipment should be cleared, stored and tidied; any construction hazards marked and guarded. Any hazards that cannot be mitigated should be communicated supervisors or managers. Similarly, anytime there is a work stoppage (shift changes, breaks, end of workday) current tasks should be made safe before a worker steps away leaving anything unattended.

## Ladders

Every ladder should be inspected on a frequent and regular basis to ensure they are maintained in good working order. Ladders should be free of grease, oils, or other slippery conditions and every component should be free of damage. Defective ladders should immediately be removed from service and the defect should be reported to your supervisor. Place ladders only on stable surfaces. Boxes, tables, chairs or other secondary platforms should never be used to prop up or change the height of any ladder. For more information on ladder safety read the **CWRU Ladder Safety Written Program**. It is important to remember, anyone who uses a ladder must be trained; ladders over 4' that are stored against a wall should be secured to prevent tipping; ladders must only be used to the weight loading listed on the ladder.



## Lasers<sup>5</sup>

Laser stands for “Light Amplification by the Stimulated Emission Radiation”. An energy source is needed to supply the energy needed to cause stimulated emissions of atoms over and over again. This energy source could be as simple as a light source, an electrical discharge or many more complicated systems. The next major component is the medium. The energy source



stimulates atoms in the medium. Some examples of mediums are helium-neon, carbon dioxide, and neodymium: yttrium aluminum garnet. The medium can be liquid, gas, or solid. The photons then collide with the medium and spread in multiple directions, which leads to the last component, the resonator. This optical feedback device directs photons back and forth through the medium, amplifying the amount of photons present. The basic resonator is a pair of curved mirrors on either end of the medium along the optical axis. One of these mirrors is not 100% reflective, allowing some of the photons to pass through it. This produces the beam that is emitted from the laser.

<sup>5</sup> ANSI Z136.1 and 136.3 and 21 CFR 1040.10 & 1040.11

### Potential Hazards:

- Beam Hazards
  - Lasers are divided into 4 main classes, 1, 2, 3, and 4 which are classified by the ability of the primary beam to cause damage to the eye or skin. Depending on the intensity and exposure time, laser radiation can cause permanent damage to the eye and skin. Tissues may be damaged by a rise in temperature from the absorption of laser energy.
    - Class 1 lasers: (0.4 uwatts) Do not emit radiation at hazardous levels. And are exempt from the requirements of most programs.
    - Class 2 lasers: (<1 mW) are low power visible lasers. They may be viewed directly under carefully controlled exposure conditions. Eye protection is usually afforded by aversion response and blink reflex.
    - Class 3R lasers: (1-5 mW) Normally not a hazard if viewed momentarily. May present a hazard if viewed using collecting optics. Do not view the direct or reflected beams. Some controls are recommended.
    - Class 3B lasers: (5-500 mW) are not fire hazards but there is some hazard associated with direct exposure to the beam. This includes intrabeam viewing and specular reflections. Some controls are required for Class 3 lasers.
    - Class 4 lasers: (500 mW) are high powered lasers and are hazardous to view under any condition, direct or scattered. They are also potential fire and skin hazards. Controls are required for Class 4 lasers.

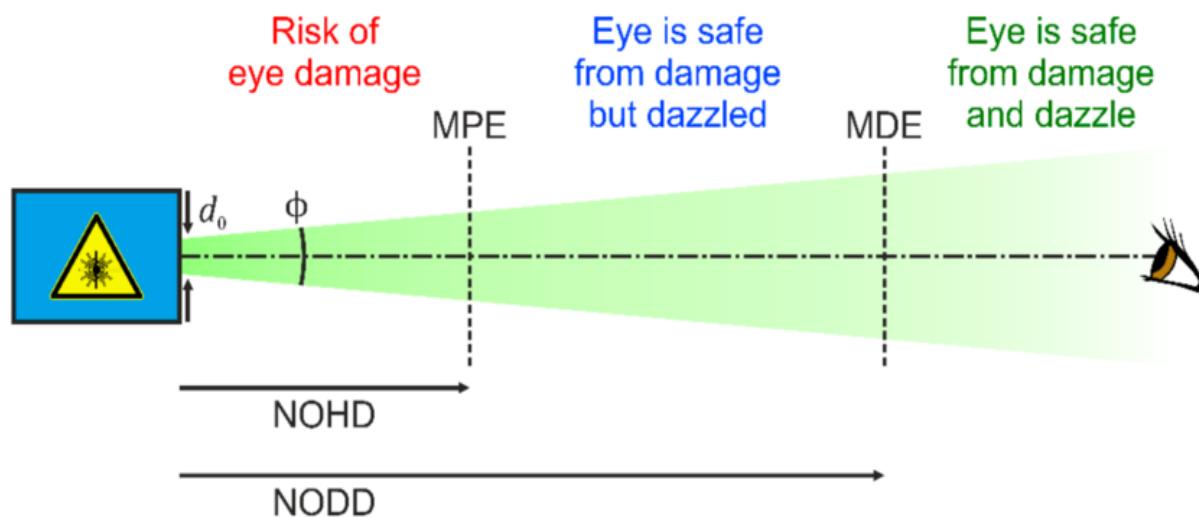
Laser Classification <sup>6</sup>			
Laser Class	Hazard Risk	Common Uses	Safe Use Considerations
Class 1	None	Scanners/DVD players	Safe under all conditions
Class 1M (no special FDA class)	None to low	Laser diodes, speed meters	Safe unless view with optical instruments
Class 2 (Class II)	Low (unless stared into)	Laser pointers, laser levels	Avoid direct eye exposure
Class 2M (no special FDA class)	Low to moderate	Projection laser (light shows)	Safe unless view with optical instruments
Class 3R/3B (Class IIIa/Class IIIb)	Moderate to high	Laser scanner, 3d printer	Can damage naked eye and skin
Class 4 (Class IV)	Very high	Cutting, surgery, cleaning	Requires eye protection and strict controls

<sup>6</sup> Newer ANSI/IEC number classes are now preferred over older FDA Roman numeral classes.

- Non-Beam Hazards
  - Industrial Hygiene Issues: Hazards associated with the compressed gasses in lasers, cryogenic materials and noise need consideration. Cryogenic gasses can damage skin upon contact.
  - Explosion Hazards: High-pressure arc lamps or filament lamps could explode or disintegrate. The buildup of high pressures in the lamp when it is fired could create an explosion
  - Other Radiation Hazards: Radiation emitted, such as UV light, x-rays, and radio frequency (RF) energy, may create a hazard.
  - Flammable Hazards: Certain enclosures and terminations for Class 4 and B lasers may be flammable if they are exposed to irradiances exceeding 10 W/cm<sup>2</sup>. Flame-resistant materials designed for lasers should be used.

### **Safety Measures:**

- Follow Maximum Permissible Exposure Limits
- **Design Requirements/Engineering Controls – Beam Hazards**
  - A hazard zone of potential laser exposure must be defined for the area. This could be exposure from direct, reflected, or scattered radiation. To define the hazard zone, the following information is required: laser power, beam diameter, beam divergence, pulse repetition frequency, wavelength, beam optics and path, and the maximum anticipated exposure duration. Lasers may have to be totally or partially enclosed.



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<sup>7</sup> **NOHD:** Nominal Ocular Hazard Distance. **NODD:** Nominal Ocular Dazzle Distance  
**MPE:** Maximum Permissible Exposure. **MDE:** Maximum Dazzle Exposure.

- Windows may not be present if they allow either direct or reflected beams to leave the lab area.
- An area for donning PPE before entering the lab must be provided, unless the laser is completely contained with a proper enclosure. (curtains are not beam enclosures.)
- Beams must be permanently terminated or enclosed through use of attached beam stops or attenuators. All lasers must have some form of enclosure around the laser; however, the enclosure level depends on the hazard class of the laser and exposure potential.
- Materials such as curtains, where Class 4 lasers are used must be fire resistant to direct beam contact.
- Class 4 lasers must have a labeled emergency stop that terminates power to the laser. They also require a master switch control (key or code) which disables the laser. NOTE: This is not an on/off switch.

- **Design Requirements/Engineering Controls- Non Beam Hazards**
  - To correct for the industrial hygiene issues listed above, laser welding or cutting must have adequate ventilation to reduce any exposures to gases or fumes produced.
  - High-pressure arc lamps, filament lamps, or laser welding equipment must be enclosed in housing that can withstand pressures resulting from the lamps exploding or disintegrating. Anything that could shatter during an explosion should also be enclosed.
  - UV light, x-rays, and radio frequency (RF) energy must be kept below recommended guidelines.
  - All electrical equipment must be installed in accordance with the National Electrical Code and OSHA guidelines.
  - Flame-resistant materials designed for lasers must be used.
- **Work Practices**
  - Every lab must have a written program for laser safety, including safe operating procedures, and it must be included in the lab's Physical Safety Plan. This should include a designation of a Laser Safety Officer (LSO). The LSO is in charge of administering laser safety issues.
  - Initial and routine eye exams are recommended. Consult Health Services.
  - Consult Safety Services before disposing of lasers
  - All personnel working with Class III and IV lasers must be trained by the LSO.

- There must be some form of entryway control measure implemented for labs with Class IV lasers. Doorway interlocks are one option.

### **Training**

- All employees working with and around lasers must be able to identify the hazards and be able to protect themselves from them.
  - Must be trained to follow established work practices.
  - Must be trained to select and use appropriate PPE.

### **Labeling**

- All Class 1 and 2 lasers should have a caution sign on the door with a laser label. If a lab contains more than one laser, the sign must convey the information for the laser of the highest power. All Class 3B and 4 lasers must have laser signs posted on the lab door and include the following information.
  - “DANGER”
  - Class 3B “Laser Radiation – Avoid direct exposure to beam”
  - Class 4 “Laser Radiation – Avoid eye or skin exposure to direct or scattered radiation.”
  - Type of radiation or emitted wavelength
  - Pulse duration (where appropriate)
  - Maximum output
  - Laser Class Designation

### **PPE**

- With Excimer lasers and UV sources, complete skin protection is recommended with long sleeves, pants, and gloves.
- Appropriate eyewear must be worn in all areas where lasers are used. Eyewear must have a certain Optical Density and protect the worker from specific wavelengths of lasers in use.

## **Lifting and Handling**

Strain and back pain from lifting and material handling are some of the most frequent types of injuries. Sheet goods, large materials and objects are often awkward, heavy, or oddly shaped, or not built with ease of handling in mind, which makes them difficult to lift properly.

### **Preparation**

Assess the load before lifting, evaluating the weight, size, and shape of the object. Consider if it is bulky or has uneven distribution of weight, which may affect how you handle it or if you need a second person. Plan your route ensuring there are no

obstructions or hazards along your path. Be aware of the space required to navigate through doorways, turns, and any inclines or declines.

### **Lifting Techniques**

Keep your feet shoulder-width apart, providing a stable base for lifting. This stance helps maintain balance and distributes the load evenly. Always bend at the knees, not the waist, to engage the strength of your leg muscles. Keep your back straight but not rigid. This position protects your spine and helps in engaging the core muscles.

### **Carrying the Load**

Keep the load as close to your waist as possible. The further away from the body, the more strain it puts on your back. Avoid twisting by turning your whole body in the direction you want to go, rather than twisting at the waist while carrying a load.

### **Team Lifting**

When lifting with a partner, communicate clearly. Decide who will lead and coordinate movements to ensure a synchronized lift and walk. Ensure the weight is evenly distributed between the lifters. Adjust positions if one person is taking more load than the other.

### **Mechanical Aids**

For heavy or awkward objects, utilize tools like dollies, hand trucks, or forklifts. Understand and follow the safety guidelines for each tool. If you use mechanical aids, make certain you are trained or certified as required. Improper use can lead to accidents.

### **PPE**

Wear shoes with good grip and adequate support. Depending on the environment, steel-toed boots or other safety shoes may be necessary. Use gloves that provide a good grip and protect your hands, especially when handling rough or sharp objects.

### **Posture and Rest**

Take regular breaks to help prevent fatigue. Fatigue can lead to a decrease in concentration and an increase in the risk of injury. Gentle stretching before and after lifting can help reduce muscle stiffness and injury risk.

## Lighting<sup>8</sup>

Adequate lighting differs depending on the task being performed. Too little light will result in the individual not being able to see well enough to comfortably accomplish a task. On the other hand, too much light may cause the same problem because of glare, brightness, or contrast and may also cause eye fatigue or strain over a period of time. Light is measured in units called a lux. Units of lux are equal to 1 lumen per square meter.

Lighting guidelines are concerned with the amount of light needed to carry out job functions. Lighting issues surface if there is not enough light, too much light, improperly positioned light, excessive levels of contrast/shadows. Harmful wavelengths of light may cause eye damage to the worker.

### **Potential Hazards**

- Increased risk of injury from other hazards
  - Slips, trips, and falls; can't see where you are going.
  - Impact and/or puncture wounds; bump into objects, unable to see moving parts
- Makes the task at hand more difficult.
  - Increased risk of mistakes
  - Leads to eye strain/fatigue
  - Can cause undue stress

### **Safety Measures:**

- Be sure lighting is adequate and placed properly.
- Ensure that lighting is adequate for the task at hand.
- Use protective glasses to filter out harmful wavelengths.
- Do not have light sources aimed at workers' eyes.
- Position light sources to the sides and above the work.
- Position lights so that shadows are not created.
- Ensure that background surfaces will not reflect or refract indirect light sources adversely on to the work area.
- See the following examples and guidelines to evaluate your workplace lighting and to make improvements as needed.
  - Typical output from incandescent bulbs is
    - 15 watt = 110 lumens
    - 40 watt = 435 lumens
    - 60 watt = 840 lumens
    - 100 watt = 1630 lumens

<sup>8</sup> OSHA 29 CFR 1926.56

- LED bulbs use less power but are equivalent based on incandescent standards

Illuminance (lux)	Activity	Area
100	Casual seeing	Corridors, changing rooms, stores
150	Some perception of detail	Loading bays, switch rooms, plant rooms
200	Continuously occupied	Foyers, entrance halls, dining rooms
300	Visual tasks moderately easy	Libraries, sports halls, lecture theatres
500	Visual tasks moderately difficult	General offices, kitchens, laboratories, retail shops
750	Visual tasks difficult	Drawing offices, meat inspection, chain stores
1000	Visual tasks very difficult	General inspection, electronic assembly, paintwork, supermarkets
1500	Visual tasks extremely difficult	Fine work and inspection, precision assembly
2000	Visual tasks exceptionally difficult	Assembly of minute items, finished fabric inspection

### ***Light source placement guidelines:***

- Workstations should be placed at right angles to the available light.
- Overhead lights should be set to the sides and above workstations
- Light should be set at a comfortable level for the worker and provide adequate light for the task at hand.
- Fine work may be done more comfortably in a lower light setting that will increase the contrast of the objects and background. A light that is too bright will reduce depth perception.
- Light should be placed to diffuse through the work area.
- Light should not shine directly in workers' eyes. Illumination from the sides or behind is often more effective.

## **Liquid Fuel Tools/Equipment**

The use of gas powered tools and equipment indoors or in semi-enclosed areas can lead to a dangerous buildup of carbon monoxide. These could include power washers, lawn mowers, leaf blowers, generators, golf carts and forklifts. Even in areas that appear to be well ventilated CO can build up to dangerous concentrations within minutes.

It is important to recognize the symptoms and signs of CO exposure: headache, nausea, weakness, dizziness, visual disturbances, changes in personality, and loss of consciousness. Any of these symptoms and signs can occur within minutes of exposure. Be aware that gas powered tools can also present noise and ergonomic hazards depending on the length of exposure.

Using electric tools and equipment is one effective method of reducing exposure risk. If that is not possible, place the pump or power unit outdoors away from any air intakes, Limiting the amount of time gas powered tools operate, and increasing the rate at which air cycles are also important parts of preventing carbon monoxide incidents. There are many areas on campus that are labeled as “confined spaces” these areas have specific requirements that must be followed for work to occur. However, there are many less obvious areas that may not be labeled. Be aware that a confined **space has limited or restricted means for entry or exit and is not designed for continuous occupancy**. See the CWRU confined space policy, and the procedures it requires, if you find yourself needing to work in a space with tight quarters and inadequate ventilation.



## Lockout/Tagout



Lockout/tagout (LOTO) is a method of preventing equipment from being set in motion and endangering workers. Failure to properly isolate and de-energize energy sources can be fatal. CWRU has extensively documented LOTO procedures; these sheets and associated tags are found physically attached to the equipment and machinery documented in the program. Compliance with the University's LOTO policy is mandatory for your protection and the protection of others. Although the application of LOTO is often limited to electrical energy, you should understand that other power sources, including mechanical, hydraulic, pneumatic, chemical, and thermal energies, require similar procedures and care to ensure your safety.

Another source of energy that must be dissipated is often stored energy, such as in electrical batteries, capacitors, and springs. Even gravity is a potential energy source.

### Training:

Training may be required for LOTO procedures. These procedures are contained in 1910.333 (b)(2) for electrical energy and in 1910.147 for all types of energy. LOTO identifies three classes of employees based on risk and specifies training needs for each.

- **Affected Employee:**

An employee whose job requires them to operate or use equipment. May or may not be a qualified person for other tasks and not authorized to perform LOTO procedures. Must be trained to:

- Recognize tags and locks.
- Not violate tags.

- **Authorized Employee:**

One who is authorized to perform LOTO procedures. May or may not be a qualified person for other tasks. Must be trained to:

- Recognize energy sources.
- Know type and magnitude of sources.
- Know methods and means of LOTO.

- **Other Employees:**

All employees who are or may be in the area. Must be trained to recognize the procedures and prohibitions.

Any training necessary can be done in the classroom, on the job, or in a combination of both. The degree of training provided shall be determined by the risk to the employee(s) being trained.

**See the CWRU LOTO Safety Program for details.**

## Machine Guarding<sup>9</sup>

Machine guarding is one of OSHA's most frequently cited regulations. The primary application is for manufacturing and/or process operations and there are specific requirements for guarding many named types of machinery. The standard says that if it can move and cause injury, guard it.

Therefore, machine-guarding hazards can be found in almost any operation.



### Potential Hazards:

- Contact with moving parts can cause injury to or loss of fingers, hands, arms, legs and fatalities.
- Flying debris also poses additional hazard

<sup>9</sup> OSHA 1910.211-222, 1926.300 (guarding), 1910.147, 1926.417 (LOTO), and 1910.241-247 (handheld tools)

**Safety Measures:**

- Survey the workplace to determine if any machine guarding hazards are present.
  - A comprehensive checklist is attached.
  - NOTE: the most common violation observed around the university is the belt guard missing from vacuum pumps, air compressors, mixers, etc.
  - If the hazard is at least 7 feet above the work floor and the operator never comes in contact with it during normal operations, then no other guarding is required. (guarded by location)
  - Consults with EHS if there are any questions as to whether or not a hazard exists
- Abate all hazards identified.
  - In addition to general requirements, the standard contains specific requirements for some equipment (woodworking machines, abrasive wheels, milling machines, mechanical power presses, forging machines and mechanical power-transmission devices)
  - A guard (physical barrier) is the preferred method to abate moving machinery hazards.
  - In some situations fixed guards cannot be used, so other devices are utilized. These would include limit switches, sensors, pullback and holdback restraints, two-hand operating controls, etc.
  - Consult with EHS if there are any questions regarding the best way to abate.

**Training and Labeling Requirements:**

- This standard has training requirements for power press operators, maintenance personnel, and for forging machinery maintenance personnel. It is recommended that **all** employees be made aware of the potential hazards involved.
- There are no specific labeling requirements; however, some signage or labeling is recommended. This would include signs to identify the hazards and warnings on removable guards (i.e. “Do Not Operate With Guard Removed”).

## Noise and Hearing Protection<sup>10</sup>

Noise, often described simply as an undesired sound, is a combination of different frequencies. From a safety point of view, frequency and sound pressure level (intensity) are the two most important characteristics of noise that lead to hazardous exposure. Frequency is the number of variations per unit of time, defined as Hertz or cycle per

<sup>10</sup> OSHA 29 CFR 1910.95, 1926.52, and ANSI S3.6-2025

second. The human ear can detect sounds in frequencies ranging from 16 to 16,000 hertz.

The sound pressure level (SPL) is measured in decibels (dB). Based on its occurrence, noise can be categorized as:

- **Steady State:** Continuous (unvarying) noise or noise with negligible level fluctuations, less than 6dBA of variation. This could be engine noise, factory noise, and heating or ventilation noise.
- **Intermittent:** With notable level variation. Intermittent noise can increase and decrease rapidly. This could be trains passing by, planes overhead, landscaping equipment, or factories that operate on a cycle.
- **Impulse/Impact:** Extremely short bursts of loud noise. This noise could be explosions, gunshots, balloons popping, or construction equipment like pile drivers.

Sound level meters usually have three different settings to weight the measurements that are being taken. These weights are A, C, and Z. The most common weighting used in noise measurement is A-weighting, notated as dBA. A-weighted measurements correlate well with perceived noise level because like the human ear, it effectively cuts off the lower and higher frequencies that the average person cannot hear.

The human ear responds differently with higher sound pressure levels. At higher levels, 100 dB and above, the ear's response is flatter which the C-weighted scale correlates to. C-weighting is usually used for Peak measurements and in some entertainment noise measurement where the transmission of bass noise can be problematic, it also better correlates to noise induced hearing loss.

Z-weighting is a flat response, usually 10Hz to 20kHz +/- 1.5dB. This response replaces the older "Linear" and "Unweighted" responses as these did not define the range over which the meter would be linear. The Z scale is the actual noise being made, without weighting for the human ear.

### ***Potential Hazards:***

- Auditory Effects  
The auditory effect of occupational noise exposure is the most important effect of noise, and its biological effects can be manifested in hearing loss. Work related hearing loss is one of the most common occupational diseases in the United States.

- Acute Exposure: Acute forms of noise exposure occur from high levels of noise within a short period of time. This type of occupational exposure occurs during high noise level explosions and often affects only one ear. Noise level is the most important factor in this type of exposure. Acute exposure can lead to temporary hearing loss, permanent hearing loss, or even deafness.
- Chronic Exposure: Long term exposure to noise levels higher than those shown in table N-1 can cause permanent irreversible hearing loss or deafness. During the first phases of disorder development, hearing loss can be recognized just by audiometric examinations but not the person. Usually once hearing loss has been recognized by the person, it is the last phase of the disorder and may develop more to deafness, unless exposure to noise is completely stopped.

Time to reach 100% noise dose	Exposure level per NIOSH REL	Exposure level per OSHA PEL
8 hours	85 dBA	90 dBA
4 hours	88 dBA	95 dBA
2 hours	91 dBA	100 dBA
1 hour	94 dBA	105 dBA
30 minutes	97 dBA	110 dBA
15 minutes	100 dBA	115 dBA

Noise level, frequency, exposure duration, personal susceptibility, and age are all important factors, which influence noise exposure effect from chronic exposure. According to the OSHA standard for occupational noise exposure, the maximum permissible noise level for 8 hours per day is 90dBA. When daily exposure is composed of different noise levels, their combination effect should be considered as a TWA (time weighted average). The 8 hour TWA should not exceed the limit value of 90 dBA. Further, for each noise level, exposure time should not exceed the permissible level shown in the table. Note that the **OSHA permissible exposure limits** are \*higher\* thresholds than the **recommended exposure limits** from other organizations like NIOSH (National Institute for Occupational Safety and health) and ACGIH (American Conference of Governmental Industrial Hygienists).

For example. The OSHA 8 hour threshold is 90 dBA, the NIOSH/ACGIH threshold for 8 hours is 85 dBA. The OSHA permissible exposure time for noise at 115 dBA is 15 minutes/8 hours.

<b>PAINFUL &amp; DANGEROUS</b>		
Use hearing protection or avoid	140	• Fireworks • Gun shots • Custom car stereos (at full volume)
	130	• Jackhammers • Ambulances
<b>UNCOMFORTABLE</b>		
Dangerous over 30 seconds	120	• Jet planes (during take off)
<b>VERY LOUD</b>		
Dangerous over 30 minutes	110	• Concerts (any genre of music) • Car horns • Sporting events
	100	• Snowmobiles • MP3 players (at full volume)
	90	• Lawnmowers • Power tools • Blenders • Hair dryers
Over 85 dB for extended periods can cause permanent hearing loss.		
<b>LOUD</b>		
	80	• Alarm clocks
	70	• Traffic • Vacuums
<b>MODERATE</b>		
	60	• Normal conversation • Dishwashers
	50	• Moderate rainfall
<b>SOFT</b>		
	40	• Quiet library
	30	• Whisper
<b>FAINT</b>		
	20	• Leaves rustling

In a work area, if you need to raise your voice to talk to someone who is an arm's length away, your noise exposure is likely to be hazardous. Regardless of exposure time, hearing protection is needed when the noise level is 85 dBA or more. Usually after first exposure to high level noise, Tinnitus (a ringing or roaring) occurs. Tinnitus can be a good indication of high-level noise exposure.

- Non-Auditory Effects
  - The most important non-auditory effects of noise are physiological effects. These consist of stress reactions, an increase in blood pressure, annoyance, reductions in efficiency, and an increase in fatigue. It has been proven that working in high noise environments can increase job related accidents.

### **Safety Measures:**

- Engineering control:
  - Noise reduction with engineering control, can be achieved by different methods such as source reduction (vibration dampers, etc), source

surrounding (noise enclosures), employee isolation, and using noise absorbent materials (noise distributing control).

- Administrative control:
  - Reduction of exposure time and job reassignment are two major administrative controls.
- Work practices:
  - When the SPL exceeds the standard levels, administrative/engineering controls shall be conducted to standardize the exposure.
  - If all other controls failed to reduce sound level, adequate PPE shall be used to reduce noise to standard levels.
  - When the employee noise exposure is equal or exceeds an 8 hour TWA of 85 dBA, a continuing, effective hearing conservation program shall be administered. An effective conservation program not only prevents hearing loss, but also decreases work-related stress, improves employee morale, and increases efficiency. This program can be summarized as the following:
    - Noise measurement, engineering/administrative control, audiometric testing, hearing protection, training and education, record keeping and program evaluation. [The CWRU Hearing Conservation Program](#) provides details on procedures and policies.
  - For employees exposed to 85 dBA or more, a baseline audiogram and annual audiogram shall be obtained and filed.
  - Adequate safety signs shall be posted on the entrances to the high-level noise areas to notify employees to use PPE.
  - A training program shall be conducted for employees subject to action level noise or more.

#### ***Training:***

If employees are exposed to noise at or above the action level (85dBA), then there are training requirements which are part of a total program. Consult EHS and the ***hearing conservation program*** for additional information.

#### ***Personal Protection Equipment:***

When all methods of prevention fail to reduce the sound level below the action level, PPE must be used. The most usual PPE for hearing protection are:

- Ear plugs: Flexible plugs are used for low over level noises.
- Earmuffs: These are more effective than ear plugs and can be chosen based on existing sound pressure levels and frequency.
- Canal caps: Caps often resemble ear plugs on a flexible plastic or metal band.

## Non Ionizing Radiation (UV and IR)

**Ultraviolet radiation** is a part of the electromagnetic spectrum with wavelengths of 200-400 nanometers. Under ordinary circumstances, airborne energy UV is insufficient to produce ionization in the atoms of the absorbing molecules. The major sources of UV are solar radiation, the arc welding process, and fluorescent and discharge types of lighting. The main component of solar radiation from the sun is absorbed by the ozone layer. UV radiation can be divided into three major components.

- Long-wave UV-A (near wave): 315-400 nm
- Middle-wave UV-B (sunburn radiation): 280-315 nm
- Short-wave UV-C (germicide radiation): 100-280 nm

UV with wavelengths less than 200 nm are called vacuum ultraviolet and exist only in a vacuum or inert gas enclosure. The most important sources of UV in laboratories are germicidal and black light lamps, which are found in tissue culture rooms, biosafety cabinets, and operation rooms. Other significant hazards are UV emitted from certain laser beams and UV light boxes used in molecular biology labs.



### **Potential Hazards:**

The most important biological hazards of occupational exposure of UV are skin and eye disorders. ACGIH has published an occupational exposure TLV. These values may be used as a guide in the control of exposure, but not as a fine line between safe and dangerous levels. Permissible occupational UV is listed in table (number). The exposure incident for unprotected skin or eye should not exceed the values in the above mentioned table. The major determinants of severity and types of damage are wavelength, intensity, and exposure duration. The following types of damage can occur:

- Skin burn: Wavelengths below 320 nm are primarily responsible for reddening and burning. These symptoms may vary from a simple reddening at the site of exposure to severe blistering or desquamation.
- Carcinogenic effects: Skin cancer related to long-term exposure to direct wavelengths between 254 and 320 can have significant carcinogenic effects. The probability of skin cancer development also depends on other contributing factors.

- Cataract: Cataracts are highly probable outcome as a result of chronic exposure of eyes to UV.
- Conjunctivitis and keratitis (the inflammation of the cornea): Exposure to UV above TLV (30J/m<sup>2</sup> at 270 nm) will produce inflammation of conjunctiva and cornea, which can be painful.
- Hypersensitivity: Exposure to UV concurrently with some chemicals and drugs can lead to skin erythema at sub TLV doses.
- Indirect effects: UV below 250 nm can dissociate molecular oxygen or nitrogen, the recombination of these atoms forms toxic gases, ozone, and nitrogen oxides. Interaction between UV and chlorinated hydrocarbon vapor can also form toxic gases, hydrogen chloride and phosgene.

**Safety Measures (general):**

- All employees should be informed about hazards and protection methods.
- Suitable safety signs shall be posted at the entrance of hazardous areas.
- Proper ventilation shall be provided to evacuate gases generated from UV producing process (such as arc welding).
- A written safe operating procedure shall be kept in the lab at all times.
- Control measures such as the use of enclosures and shielding shall be considered to reduce/eliminate UV exposure.
- Employees using UV will be cautioned to pay attention to any change in skin color or vision.

**Safety Measures (outdoor work areas):**

- Long-term exposure of unprotected skin to sunlight increases the risk of skin cancer. The sun's rays are brightest between 10am and 3pm.
- 20-30 minutes prior to going outside, apply sunscreen with a minimum SPF of 15, even if it is a cloudy day (the sun can penetrate a thin cloud layer). Sunscreen should be labeled as protecting against UV A, B and C light.
- Protective clothing can be chosen based on its' Sun Protective Factor (SPF). The higher protection factors indicate higher protection levels. SPF is equal to the minutes spent in the sun / minutes before skin reddens.
- Try to wear white or bright color clothing. Dark colors tend to absorb more sunlight.
- A hat with 4-inch brim all around, provides adequate facial protection.
- Sunglasses should be used to protect the eyes.

**Safety Measures (exposure limits):**

UV Index	Time to exceed ACGIH TLV (minutes)	Time to sunburn for fair skin (minutes)
3	26.4	44.4
4	19.8	33.3
6	13.2	22.2
8	9.9	16.7
10	7.9	13.3
12	6.6	11.1
14	5.7	9.5

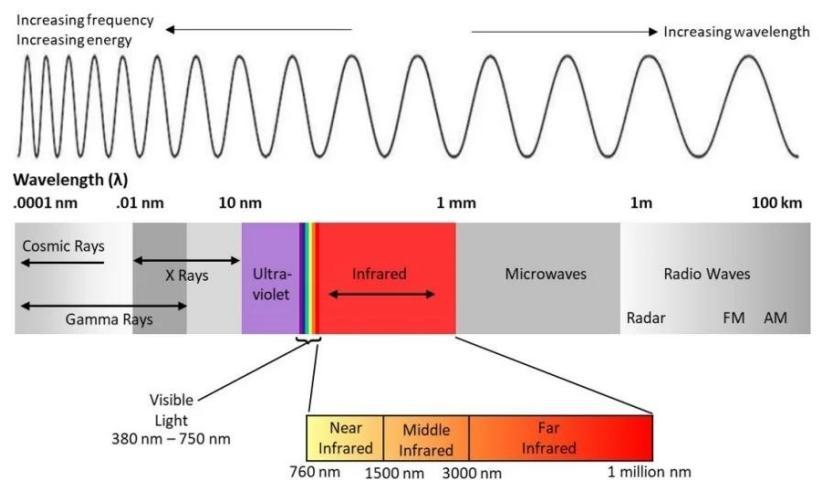
**Labels:**

Sources of UV hazards must have warning signage posted. Items used as PPE must be labeled to indicate their applications and limitations.

**PPE:**

- When there is a potential exposure hazard, eye/face protection with proper filters (glasses) must be used.
- To protect the skin, use full coverage clothing and gloves with a minimum SPF of 15.

**Infrared Radiation (IR)** under ordinary conditions, has insufficient energy to produce ionization in atoms of the absorbing molecules. This non-visible radiation is mainly emitted from the sun, with wavelengths between 0.75 micrometer to 1.0 nanometer. The most important sources for IR are sun, melted metal or glass, the arc producing process, hot furnaces and other heat sources.

**Potential Hazards:**

The severity and type of injury depends on the wavelength, source intensity, and duration of exposure.

- Thermal effects on skin: Effects on skin from short-wave absorbed IR are the same as a thermal burn.
- High intensity exposure will affect the cornea, iris, lens, and retina of the eye.

- In chronic forms of exposure, the lens of the eye can be affected, causing cataracts.
- Short-term high intensity exposure can cause severe injuries.

**Safety Measures:**

- A written safe operating procedure (SOP) should be provided and kept in the work area.
- If there is a risk of overdose IR exposure, suitable eye protection is necessary, especially when direct exposure of eye to heat sources is part of the task being performed.
- Using normal clothing will protect the skin.
- Employees shall be fully informed about relevant hazards/safety measures.
- Adequate safety signs shall be posted to show potential hazards.

**Labeling:**

Sources of this hazard must have warning signs posted. Items used as PPE must be labeled to indicate their applications and limitations.

**PPE:**

Eye and skin protection is required in many situations.

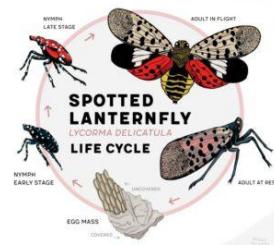
## Outdoor Pests

Outdoor workers can face a variety of bug and pest hazards that can affect their health and safety. Common risks include bites and stings from insects such as ants, ticks, bees, wasps, and spiders. These can cause allergic reactions, painful irritation, or in some cases, serious medical conditions. Some pests also carry diseases that can be transmitted to humans, such as Lyme disease from ticks or West Nile virus from mosquitoes. In addition, contact with certain pests, like fire ants or biting flies, can lead to infection if the skin is broken or not properly cleaned. Because these hazards are common in fields such as construction, landscaping, forestry, and agriculture, outdoor workers need to use proper protective clothing, insect repellent, and awareness of their surroundings to reduce the risk of exposure.



**Ticks** are active year-round and can survive in freezing temperatures, but they are at their peak in warmer months, typically April-September. Ticks are most likely encountered in leaf and wood piles, tall grassy areas, areas planted with ground cover such as pachysandra, and lawn perimeters where they meet forest or garden edges. When working in tall grass or brush, wear long sleeves, pants and socks. To keep your skin covered, tuck shirts into pants, pants into socks, and check yourself every day. Ticks will instinctively migrate to the warmest parts of your body. Knees, groin, armpits, hair and waist. An additional layer of defense to prevent bites is to treat clothing with a tick repellent such as Permethrin. Unlike DEET, it prevents ticks from climbing onto your clothing, but **do not** apply it directly to skin. To remove an embedded tick, grab it firmly by the head with tweezers and slowly twist it out of your skin and wash the affected area with soap and water.

**Bees/Wasps/Hornets** are most active and abundant in warm months. Their nests and hives can be found in trees, under roof eaves, and behind siding. Avoid wearing perfumes or colognes and if a single bee is flying around you, remain calm and don't swat at it. In the event you are stung, remove the stinger by scraping the area with a fingernail. Do not squeeze it or use tweezers. Once removed wash the area with soap and water and apply ice to reduce swelling.



## Personal Protective Equipment



PPE is equipment used to prevent or minimize exposure to hazards. It may include eye, face, head, foot, hand, or respiratory protection, and the use of other equipment to help protect you against injury or illness. It is the last line of defense and effective use of PPE relies on the user.

Your supervisor will identify the necessary PPE for work areas and the tasks at hand and training will be provided as needed. Every individual needs to understand and follow the requirements provided during training and should also communicate with supervisors if additional needs arise through other hazards. Remember to ask questions and consult with the EHS department for more information.

When working with tools, it is imperative to wear eye and face protection as flying debris and other materials can cause temporary or permanent eye damage, and in some cases, even blindness. Chemical splashes, sparks, hanging or swinging objects, and glare are all dangerous and require the use of appropriate PPE for the eye and face. Overhead work and bump hazards require considering hard hats.

It is necessary to follow a multistep process when using a respirator. Also, keep in mind, if you need a respirator, then more than likely, everyone around you needs one as well. Consult with EHS and your supervisor before considering using a respirator so that engineering controls and other methods can be used initially, thereby eliminating the need for a respirator. See the Codes of Safety for procedures.

Regarding the instructions and protocol for using paint, when possible, all painting, staining and chemical work should occur in the spray booth. Wear gloves to keep chemicals, paints, and glues off your skin and refer to the **EHS Lab Safety Manual** and the **Respiratory Protection Program** for more details.

## PIT Equipment



Powered Industrial Trucks (PIT) are industrial vehicles, used to carry, push, pull, lift, stack or tier materials. They are powered by an electric motor or an internal combustion engine and can be ridden or controlled by a walking operator.

Commonly known as forklifts, pallet trucks, rider trucks, fork trucks or lift trucks. Not all PITs are forklifts, but all forklifts are PITs. OSHA requires operators to be evaluated and certified every three years. Contact EHS to discuss training new operators,

recertifying current operators or whenever a new piece of PIT equipment comes into service. More details about the program and procedures are available on the EHS website.

## Pneumatic Tools

Pneumatic tools have become essential and ubiquitous in wood shops; powered by compressed air, they provide both speed and precision. This increased efficiency shortens build times and allows for a variety of fasteners to be used. The most common air powered tools found in a shop are staplers and nailers. Higher end shops may also have pneumatic sanders or sprayers, but their higher rate of airflow requires larger capacity compressors and tanks. While pneumatic tools are favored for their speed, reliability and ease of use, they do present some hazards that can lead to serious injury. Such as:

### Air Pressure Hazards

- Compressed air can penetrate skin, resulting in air injection. It is vital that pressure levels are regulated. Air exhausts on tools can also vent directly into the operator's face or eyes if improperly positioned. Pneumatic tools can produce high noise levels. Over time, some carpenters experience hearing loss on their dominant side from tool noise.

### Flying Objects

- Pneumatic tools like nail guns or staplers can misfire or send fasteners flying at high speeds if not handled properly. Another risk is ejected material such as dust or debris from fasteners exiting material.

### Hose-Related Hazards

- Air hoses, which supply power to pneumatic tools, can tangle, creating a trip hazard in workspaces, especially in busy environments. If a hose becomes

disconnected or damaged, the sudden release of air pressure can cause the hose to whip around violently, potentially hitting/injuring bystanders.

### Repetitive Stress Injuries

- Using pneumatic tools for long periods can lead to ergonomic issues. Tools that vibrate excessively can cause hand-arm vibration syndrome (HAVS), leading to numbness, pain, and decreased grip strength over time.

Lack of maintenance or improper storage can lead to malfunctioning tools. Before use, always inspect tools and hoses for damage or broken mechanisms. If found, take them out of service until they can be repaired.

## Power and Hand Tools

Employees must be trained in the proper use of power and hand tools, including applicable safety features, guards, and the required personal PPE. Each tool has specific guidelines (many of which can be found in the Codes of Safety), the following are general safety procedures for all tools.

- Receive in person training and be observed using the tools for the first time by a supervisor.
- Complete general shop training/orientation.
- Follow all manufacturers' instructions on the use and care of the tools.
- Inspect tools before use to check for any defects such as frayed wires or damaged hand tools. Remove defective tools from service and report findings to your supervisor.
- Never carry or hoist a power tool by the power cord.
- Unplug power tools before loading them, changing blades or bits, making adjustments, or cleaning them.
- Never use power tools on wet surfaces or in wet weather.
- Never alter or remove any machine or blade guards.

## Safe Storage

Proper storage of materials is crucial for the safety of employees, students and guests in any facility. To ensure a safe environment, observe the following storage procedures.

### Flammable Materials

- Always store flammable and combustible materials in designated flammable storage cabinets. This reduces the risk of fire hazards.

### Sprinkler System Compliance

- Vertical clearance: Store materials *at least 18 inches below* all sprinkler heads to ensure effective operation in case of a fire.

- Horizontal clearance: Maintain a *minimum distance of 36 inches* horizontally from sprinkler heads to prevent obstruction.

## Ceiling Clearance

- In areas without sprinkler heads, keep materials stored at least 24 inches below the ceiling. This helps in maintaining clear air circulation and reduces fire risks.

## Exit Accessibility

- Never block exits with stored materials. Clear pathways are essential for safe evacuation during emergencies.

## Access to Firefighting Equipment

- Ensure that firefighting equipment like extinguishers, hose stations, and alarm pull stations are always accessible and not obstructed by stored materials.

## Electrical Equipment Safety

- Maintain an *unobstructed space of at least 36 inches in all directions* from electrical service equipment. This is important to prevent electrical hazards and to allow safe access for maintenance and emergencies.

## Shop Maintenance

Maintenance is not glamorous, but it is vital in preventing injuries and ensuring machines and tools operate under their best conditions. Much like emergency response plans, if everyone assumes someone else is responsible, you'll be faced with inaction in the name of "deferred maintenance".<sup>11</sup> Clear, proactive plans prevent damage, injuries and prolong the life of equipment and facilities.

Routine inspections are the primary method of determining what systems need repaired and evaluating needs. Beginning with observations and evaluations allows for simple problems to be corrected quickly and, over time, reveals patterns if issues are recurring. As inspection cycles progress and corrective plans are implemented you may find your actions are effective, that the outcome wasn't as intended, or that there are deeper root causes than your initial observation revealed. If the latter outcomes occur, reevaluate, and continue developing new plans until you reach the desired outcome. Campus shops and labs are dynamic and fast changing, minor problems and simple wear and tear can quickly evolve into hazardous conditions. Recognizing these moments and correcting them leads to a safer environment for everyone involved.

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<sup>11</sup> Deferred maintenance may seem like an enticing method of saving budget, but often results in higher long term costs, inopportune failures, and possibly catastrophic health and safety repercussions.

To be effective, this cycle of inspection should identify some key points.

- Who is responsible for inspections
- When they occur
- How will they be managed and documented and how corrective actions are applied.

## Preventative

Scheduled preventative maintenance ensures facilities continue to function over their lifespan with all their parts operating as intended. Depending on the type of maintenance, the responsibilities may be to the departments operating the shop, some may be performed by Facilities or EHS and others may be external contractors. Every department and manager should be clear on what needs to be inspected or serviced, who will do the work and the timeline on which it must be completed. Scheduled maintenance often occurs on a similar timeline as inspections so that they coincide or can be completed shortly after if inspections reveal the need for corrective measures. Some examples have clear delineation of responsibility and others are overlapping; they include but are not limited to:

- **Elevators**- The Facilities Department takes responsibility for elevator inspection and repairs; this typically occurs during the summer break. Current inspection certificates should be posted in each elevator.
- **Backup Generators**- Generators should be tested monthly and serviced yearly. The facilities department conducts this work. Follow manufacturers guidelines for routine maintenance.
- **HVAC Systems**- The Facilities Department will replace air filters on a regular schedule, a log should be maintained that records filter changes.
- **Aerial lifts (MEWPS)**- Are inspected annually by the Facilities Department, any damage that is discovered should be reported and documented. Follow Manufacturers guidelines on servicing pumps, hydraulic systems and batteries.
- **Shop Tools and Machines**- Shop managers should follow maintenance schedules laid out by the owner's manuals for each machine. At times this may require outside contracted services.
- **Spray Booths and Hoods**- OSHA requires yearly testing of ventilation hoods and after any repairs. Contact EHS to arrange these inspections. Work with Facilities to determine how often replacement or cleaning of filters should occur and who will be responsible for that work. Maintain a log of inspections, filter changes and maintenance.
- **PIT equipment and MEWPS**- Inspected annually. Follow manufacturers maintenance schedule.
- **Asbestos**- There are many buildings on campus that were built prior to 1982 and could have asbestos. It was a common fireproofing material found in fire curtains and even as artificial snow. It can be found in pipe wraps, “popcorn” ceilings,

sprayed on coatings, electrical insulation in lighting. Even after 1982<sup>12</sup> items in buildings could contain asbestos. If you're doing work and suspect an area could contain asbestos contact EHS.

- **Cranes and Hoists**- Inspected annually by EHS.

*EHS and Facilities can aid in developing an inspection and maintenance program*

## Routine

Routine maintenance is a key to good housekeeping and a robust process often uncovers potential issues before they can become hazards. It keeps your facility clean and sanitary for students, staff and patrons. CWRU has cleaning crews that help empty trash and maintain floors, surfaces and bathrooms. If you notice a specific need for cleaning or attention, contact customer service at 216.368.2580 or submit a work request. Complete an event notification/ service request 2 weeks prior to your event if you are hosting an event on campus that requires support from Facilities Services such as custodial, trash removal, sprinkler shut off, or electrical services.

## Cleaning

There are times when shops may need to undertake additional cleaning. Whether it is cleaning up material debris or salt and snow that have been tracked into hallways or workspaces.

Many contracted cleaning responsibilities do not extend to the whole building. Shops, labs and areas of restricted access may need specialized cleaning procedures or cleaning that is more in depth than contracted personnel may provide. Regular cleaning schedules help build a culture of proactive safety. Combined with clear responsibilities, signage, and instructor oversight, it reinforces accountability, protects equipment, and models industry-standard housekeeping practices expected in professional shops and laboratories. Cleaning up workstations at the end of a shift, putting away tools and materials, and gathering trash are all simple acts that ensure clutter and hazards don't build up.

<sup>12</sup> 1982 marked the first bankruptcy due to legal issues regarding asbestos followed by a ban on all new asbestos in 1989

## Steam Safety



Steam has many applications and can travel over long distances. It can sterilize, heat, and do work.

At an industrial level, power and heating/cooling are our most common uses of steam, but on a basic level, something as simple as ironing a shirt can present steam hazards.

Simply put, steam is water that has been boiled into a vapor. Generally, when water is boiled into vapor, the volume increases by 1,600 times. Condensate is generated as the steam cools back into liquid. In these steam systems, condensate can cause cracks, ruptures, collapse/failure of components, valve failures, and overstressed gauges.

Most steam system failures are caused by water hammer where condensate exists with steam and causes:

- Hydraulic shock – Often occurs because of sudden stopping of flow.
- Thermal shock – As steam collapses, condensate rapidly rushing in to fill the void.
- Flow shock – A consequence of steam rushing down a cold pipe and producing a large quantity of condensate at a high velocity.
- Differential shock – Occurs whenever steam and condensate flow in the same line, but at different velocities ultimately resulting in a slug of condensate impacting components which changes direction (tees, elbows, valves, etc.).

### Safety Reminders

Before starting up a cold system, ensure that traps and pipes are inspected for sagging or other damage. Follow a slow, gradual, sequence at low pressure which promotes less condensation formation during the start up procedure. In this process, include monitoring points, proper PPE and review emergency procedures beforehand. Steam and condensate lines should all be properly labeled and LOTO procedures should be followed to control hazardous energy before any work is started on any steam system.

## Walking/Working Surfaces and Ladders<sup>13</sup>

Walking and working surfaces are regulated by OSHA in 29 CFR 1910.21-30. This includes floor openings, railings, toe boards, risers, stairs, treads, ladders, and scaffolds. Good housekeeping practices are essential. Slips, trips, and falls, can lead to

<sup>13</sup> OSHA 29 CFR 1910.21, 1910.23, and 1926.501

bruises, strains, breaks, and even fatalities if walking and working surfaces are not maintained in good condition and if fall protection is not provided as needed.

**Safety Measures:**

1. Follow good housekeeping practices:
  - All rooms and hallways must be kept clean, orderly and in good condition.
  - Floors must be kept clean and dry. If wet processes are used, drainage must be installed and platforms/mats used.
  - Floors must be kept free of nails, splinters, holes and loose boards.
  - Aisles and halls must be kept clear of obstructions
  - Large spills must be cleaned up promptly.
  - Surfaces of stairs must be slip resistant.
2. Protect floor openings:
  - A railing meeting 29 CFR 1910.23(e) requirements must guard every stairway or ladderway floor opening.
  - Every floor hole must be guarded by someone or have a railing when the cover is not in place.
  - Every open-sided floor or platform 4' above another floor must be guarded by a railing.
  - There must be adequate lighting around all floor openings.
3. Protect stairways:
  - All stairs having 4 or more risers must be equipped with railings as specified in 29 CFR 1910 Subpart D
4. Provide railings and toe boards when needed:
  - Standard railing: includes a top rail, intermediate rail, and posts. Vertical height must be 42" from the top rail to the floor. Intermediate rail is halfway between the top rail and floor. Railings should be used whenever there is a change in elevation.
  - Stair railing: similar to the standard railing except vertical height should be 30-34"
  - Hand rails: must be attached to the wall by brackets, rounded handle, height should be 30-34" with 1.5-2" diameter, and able to withstand a load of 200 pounds.
  - Toe boards should be 4" in vertical height and securely fastened.
  - All scaffolds require toe boards.
5. Maintain portable ladders properly:
  - No sharp edges and splinters (wooden ladders are prohibited from use)
  - Tight joints between step and side rail.

- Fittings securely attached.
- Moveable parts must operate freely.
- Safety feet must be present and in good condition.
- Rungs must be free of grease and oil.
- Ladders must be inspected on a routine basis. All defective ladders will be removed from service and labeled “Dangerous Do Not Use”.
- Ladder should be taken out of service if the capacity label is damaged or unreadable.

6. Use portable ladders properly:

- Ladders must be placed at proper angles depending on dimensions.
- The top of the ladder should extend 3' beyond what it is leaning against.
- Ladders should not be used as platforms or runways.
- Ladders should not be placed in front of doors, on boxes, or barrels
- Climber must face the ladder.
- Do not stand higher than the rung below the top rung.
- Use nonconductive (fiberglass) ladders around electrical equipment. Do not use metal ladders.
- Do not use chairs with wheels, boxes, crates etc as a step stool.



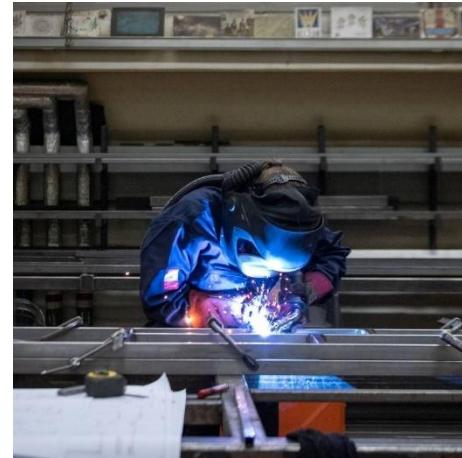
See the **CWRU Ladder Safety Written Program** for more details

## Welding

Welding involves the use of high heat to join metals together and, in some processes, to add a filler material to make a secure joint. It's a skill used across various industries, including manufacturing, construction, and automotive repair. Given the inherent risks associated with the intense heat, bright light, and potentially toxic fumes produced during welding, adhering to safety and training protocols is paramount.

### PPE

Wearing an auto-darkening welding helmet protects your eyes from the intense light and UV radiation and your face from sparks and hot metal. Long-sleeved jackets and trousers made from durable, flame-resistant materials protects against sparks, spatter, and heat. Use insulated gloves designed for welding to protect your hands from heat, sparks, and electric shock. Wear safety glasses with side shields under your welding helmet for additional eye protection. Utilize earplugs or earmuffs to protect against noise and prevent hot sparks from entering the ear canal. Wear dry, insulated gloves to protect against electric shock. When working in poorly ventilated areas or with materials that produce hazardous fumes, use an appropriate respirator. Check with EHS and your supervisor to ensure proper ventilation devices are in place.



### Workplace Safety

Ensure adequate ventilation in the welding area to disperse harmful fumes and gasses. Use local exhaust ventilation systems for indoor welding or weld outdoors if possible. Be sure to keep a fire extinguisher nearby and remove flammable materials from the welding area to prevent fire hazards. Inspect welding equipment for damaged cords or connectors before use. Position yourself so that you are not directly inhaling fumes and ensure your welding approach does not expose your body to sparks and spatter.

### Health Hazards

Be aware of the specific metals you are welding and the potential fumes they may emit. Certain materials, such as galvanized steel, can release toxic zinc fumes. Protect your skin from UV radiation by covering exposed skin with protective clothing. Prolonged exposure to noise from welding can lead to hearing loss. Use adequate ear protection, especially in confined spaces.

### Equipment and Maintenance

Routinely inspect welding machines, cables, clamps, and protective gear for wear or damage.

Use the correct settings for your welding machine based on the material and thickness to minimize hazards. Perform regular maintenance on welding equipment as recommended by the manufacturer to ensure safe operation.

## Physical Safety Part 2 - Quick Reference Guide



The following section of this manual is designed as a quick reference guide for when you're seeking details or fast information. The material is similar to the first half of this manual, but distilled down into the "need to know" basics. Keep in mind that training is site specific and that every shop, lab, or workspace may have additional policies or procedures beyond what is covered in this document.

## Batteries



Rechargeable batteries provide power to many kinds of devices including power tools, phones, laptops, scooters, RC vehicles, power banks, emergency lighting and fire systems. In rare cases, Lithium-Ion (Li-ion) and Lithium-Polymer (LiPo) can cause a fire or explode when over charged. The following safety guidelines apply to rechargeable batteries:

- Never attempt to modify batteries.
- Do NOT use batteries that are damaged or bulging.
- Never mix battery types or use new batteries with old ones.
- Avoid using or installing conductive materials near battery terminals. Remove jewelry and use nonconductive or insulated tools when working on or near the terminals.
- Immediately disconnect batteries during operation or during charging if they emit an unusual smell, develop heat or are bulging. If the battery starts to smoke or catches fire, call 911 and activate the fire alarm pull station in the building you are in.

### Charging and Storing

- Follow the manufacturer instructions and only use approved charging methods and equipment (preferably automatic chargers that prevent overcharging). Charging voltage and amps are specific to each battery.
- Place batteries on non-conductive and non-combustible surfaces.
- Store batteries in a cool, dry, and well-ventilated room away from flammable and combustible materials.
- Never discard rechargeable batteries, including lead acid, lithium-ion, and button batteries into the general trash, they are universal waste and should be properly recycled.
- Sand buckets, fire blankets, and fire gloves are all tools (in addition to fire extinguishers) that can help control a fire in the case of an incident. Review the fire policies of the building where you will be charging batteries for any additional procedures or requirements.



# Dust Collection



Dust collection systems are crucial in various work environments for maintaining air quality and reducing the risk of respiratory problems, fires, and explosions caused by airborne particles. Proper use and maintenance of these systems is essential to ensure their effectiveness and longevity. Here is a guide on the use and maintenance of dust collection systems.

## Proper Operation

Always operate the dust collection system when using equipment that generates dust, such as saws, sanders, and routers. Ensure that the system is adjusted to the correct settings for the type of dust being collected.

## Adequate Ventilation

Using dust collection systems in well-ventilated areas further increases their efficiency in removing airborne particles.

## Training

Train all personnel in the proper use of the dust collection system, including how to adjust settings and what to do in case of a malfunction.

## Maintenance of Dust Collection Systems

Inspect systems regularly for signs of wear or damage, especially in hoses, filters, and dust collection bags. Check for any leaks in the ductwork and seals.

## Cleaning and Replacing Filters

Clean or replace filters as recommended by the manufacturer or more frequently if the system is used heavily. Clogged filters reduce the efficiency of the system and can cause it to malfunction.

## Dust Removal

Regularly empty the dust collection bags or bins. Overfilled containers can hinder the system's performance and pose a fire hazard.

## Checking Airflow

Monitor the airflow of the system. Reduced airflow can indicate clogged filters, full dust bags, or other issues that need addressing.

## Hose and Duct Maintenance

Check hoses and ducts for clogs and clean them out. Clogged hoses can reduce the efficiency of the system and potentially cause overheating.

## **Motor and Fan Maintenance**

Ensure that the motor and fan are functioning correctly. Listen for any unusual noises that might indicate a problem.

## **Record Keeping**

Keep a log of all maintenance activities, including dates, actions taken, and any parts replaced. This record can help track the system's performance and identify recurring issues.

## **Safety Considerations**

### **Fire Hazards**

Be aware of the potential for fire hazards, especially when collecting dust from materials like wood. Regular cleaning and maintenance are crucial. Assure that the system is equipped with appropriate fire suppression features if necessary.

### **Explosion Risk with Combustible Dust**

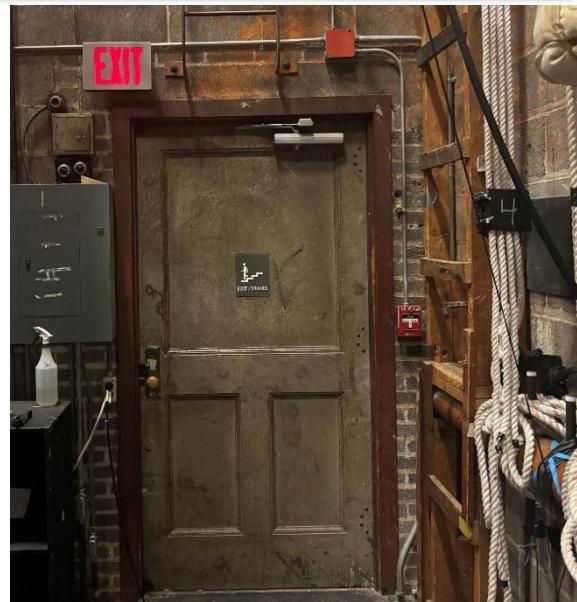
When handling combustible dust (like sawdust or metal powders), ensure the dust collection system is designed to handle such materials safely and complies with NFPA standards.

### **Electrical Safety**

Ensure that all electrical components of the system are in good condition and that the system is properly grounded.

## Egress

OSHA defines a means of egress as “a continuous and unobstructed way of exit... in a building or structure to a public way and consists of 3 separate parts: the way of exit access, the exit and the way of exit discharge.” This includes rooms, doorways, hallways, balconies, ramps, stairs, escalators, courts, and yards. Companies must have Emergency Action Plans to ensure the safety of employees during fires or other emergencies. “Means of egress” and “emergency escape routes” must be included in these plans, see the sections on fire safety for additional information.



### **Potential Hazards**

Trapped in a burning building or by some other emergency situation that could cause injuries or fatalities.

### **Safety Measures**

- Exit Access
  - Egress routes must be unobstructed at all times. Access to exits may not be through a bathroom or any room subject to locking.
  - Locks (such as locked doors) which prevent free escape from the inside of the building cannot be used. (29 CFR 1910.36(b)(4))
  - Exit routes and exits must be clearly marked and visible so people know the direction of escape from any point in the building. (1910.36.(b)(5)) Illumination must be continuous and emergency lighting must be periodically tested.
  - Egress routes must be adequately illuminated.
  - Depending on the number of occupants, more than one egress route should be provided in case one route is blocked by fire.
  - Fire detection, sprinklers, and alarm systems must be provided continuously in prop working condition.
  - A minimum width of any way of exit access cannot be less than 36" however, the width must be compatible with the required capacity or the number of people it must accommodate.

- Exits
  - Exits must be provided in the appropriate numbers and locations to provide prompt escape of the building's occupant load. The occupant load is the maximum number of people that may be in that space at one time.
  - Buildings should not be occupied until all exits are completed and ready for use.
  - All exits must discharge to a street, yard, court, or other open space that gives access to a public way. The space must be of adequate dimensions to accommodate the occupant load.
  - Ceiling height cannot be less than 7'6"
  - Exits must be marked by a visible sign. Wherever the exit is not visible to occupants, signs must also mark access to exits.
  - Any door or passage that is likely to be mistaken for an exit or egress route must be marked "Not An Exit".
  - "A sign reading "Exit" with an arrow indicating the directions must be placed in every location where the direction of travel to reach the nearest exit is not immediately apparent" (1910.37(q)(3))
  - Every exit sign shall be illuminated by a light source.
  - Every exit sign must have letters not less than 6" high and 0.75" wide.
  - Hangings or draperies shall not be placed over exit doors or conceal exits.
  - Internally illuminated signs must be legible from a distance of 100 feet.

### ***Training***

- Training requirements vary depending upon occupancy. Some high hazard occupancies require very detailed action plans and specific training. Most do not. All employees should be familiar with emergency evacuation procedures.
  - Know where the exits for their workplace are.
  - Know the path from their work area to an exit; two routes if possible.
  - Remember: an activation of the fire alarm system is a university order to evacuate immediately.
  - See the fire safety sections for additional information.

## Emergency Action Plans

This code outlines the specific actions and responses required during various emergency situations, including fires, chemical spills, shelter-in-place scenarios, medical emergencies, power outages, and severe weather. These procedures are designed to protect the safety of all personnel and ensure a swift and effective response. Building specific plans and procedures should be developed and submitted to campus safety, but these aspects are consistent for almost every eventuality. You can find outlines of plans and procedures under the Division of Emergency Management on CWRU's Public Safety website.

### General Preparedness

- **Emergency Action Plan (EAP):** Develop and maintain a comprehensive EAP that addresses all potential emergencies. Ensure that the plan is accessible to all employees and regularly updated.
- **Training:** Provide regular training to all employees on emergency procedures, including specific actions for each type of emergency.
- **Drills:** Conduct regular emergency drills (e.g., fire drills, shelter-in-place drills) to ensure that all personnel are familiar with procedures and can respond effectively.
- **Emergency Contact Information:** Post emergency contact numbers and instructions prominently throughout the facility. Ensure that all employees know how to quickly reach emergency services.
- **Reporting:** know how to report emergencies and damaged equipment and how to submit incident reports.

### Fire Emergency Actions and Responses

- **Alert:** If you see a fire, immediately activate the nearest fire alarm and notify others in the vicinity.
- **Evacuate:** Follow the designated evacuation routes. Do not use elevators. Close doors behind you to contain the fire. Activate the fire curtain.
- **Assist:** Help those who need assistance, but do not delay your own evacuation. Guide them to the nearest safe exit if possible.
- **Assemble:** Proceed to the designated assembly point outside the building. Do not re-enter the building until instructed by emergency personnel.
- **Fire Extinguishing:** Only attempt to extinguish the fire if the fire is small, you are trained, and you have a clear escape route. Use the appropriate fire extinguisher.

## Chemical Spill Emergency Actions and Responses

- **Alert:** If a chemical spill occurs, immediately alert those in the area and evacuate if necessary. Notify your supervisor or the designated emergency contact and the emergency line **216.368.3333**
- **Isolate:** If safe to do so, isolate the spill by closing doors and using PPE and spill containment materials. Avoid direct contact with the chemical.
- **Ventilate:** Increase ventilation in the area, but only if it can be done safely (e.g., turning on exhaust fans or opening windows without risking exposure).
- **Flush:** Use eyewash stations or sinks to immediately flush eyes and skin if they have been exposed.
- **Evacuate:** Evacuate the area if the chemical is hazardous or the spill is large. Ensure that everyone is moved to a safe distance.

## Shelter-in-Place Emergency Actions and Responses

- **Alert:** If a shelter-in-place order is given, immediately notify all personnel and direct them to designated shelter areas.
- **Seal:** Close all windows, doors, and ventilation systems to prevent outside air from entering if the emergency involves airborne hazards.
- **Supplies:** Gather emergency supplies, such as water, food, first aid kits, and communication devices, in the shelter area.
- **Stay Calm:** Keep all personnel calm and informed.
- **Monitor:** Continue to monitor the situation via official channels (e.g., weather reports, public safety announcements) and remain in the shelter until the all-clear signal is given.

## Medical Emergency Actions and Responses

- **Assess:** Quickly assess the situation to determine the severity of the medical emergency. If the person is unresponsive or not breathing, call emergency services immediately and administer first aid to the extent you are trained and comfortable with and observe universal precautions.<sup>14</sup>
- **CPR/AED:** If trained, begin CPR or use an Automated External Defibrillator (AED) if necessary.
- **First Aid:** Follow first aid procedures based on the type of injury or illness.
- **Stay with the Victim:** Remain with the injured or ill person until help arrives. Keep them calm and provide reassurance.

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<sup>14</sup> Universal precautions are a standard set of guidelines to prevent the transmission of bloodborne pathogens from exposure to blood and other potentially infectious materials by means of wearing nonporous articles such as medical gloves, goggles, and face shields.

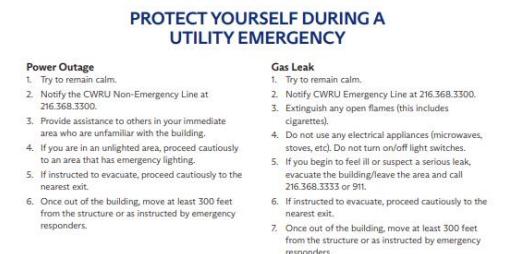
- **Emergency Services:** When calling emergency services, provide clear and accurate information about the location, nature of the emergency, and any first aid that is being administered. Stay with the injured person and post personnel along the route to escort responders.

## Power Outage Emergency Actions and Responses

- **Shelter:** Shelter in place until backup power turns on; or after a few minutes of darkness, carefully navigate to an area with emergency lighting. Wait for power restoration or further instruction.
- **Shut Down Equipment:** Determine the extent of the power outage and shut down non-essential equipment to prevent damage when power is restored.

## Severe Weather Emergency Actions and Responses

- **Alert:** Monitor weather alerts and notify all personnel of the approaching severe weather. Provide specific instructions based on the type of weather event (e.g., tornado, hurricane, flood).
- **Shelter:** Move all personnel to the designated shelter area if the weather poses an immediate threat. For tornadoes, seek shelter in a basement or interior room without windows. Wait till an all-clear signal is given.
- **Secure Property:** Secure outdoor equipment and close all windows and doors to protect against wind or flying debris.



# Ergonomics

This code of safety outlines the ergonomic risk factors that can lead to discomfort, injury, or long-term health issues in the workplace. By identifying and addressing these risk factors, organizations can create a safer and more comfortable work environment, reducing the likelihood of musculoskeletal disorders (MSDs) and other ergonomic-related injuries.

Recognizing these factors can help reduce ergonomic injuries.



**Forceful Exertions:** Tasks that require significant physical effort, such as lifting, pushing, pulling, or gripping with excessive force, can lead to musculoskeletal injuries.

**Static Postures:** Holding the same position for an extended period, whether sitting or standing, can lead to muscle fatigue and discomfort, particularly in the back, neck, and legs.

**Contact Stress:** Continuous contact between sensitive body parts (e.g., wrists, elbows, knees) and hard or sharp surfaces can lead to localized pressure and discomfort.

**Vibration Exposure:** Prolonged exposure to vibrations from tools, machinery, or vehicles can increase the risk of injuries.

**Environmental Factors:** Poor lighting, extreme temperatures, and noise can contribute to ergonomic stress, leading to increased risk of injury or discomfort.

**Work Pace and Workload:** High work pace and excessive workload can increase the risk of ergonomic injuries by forcing employees to rush or skip proper techniques.

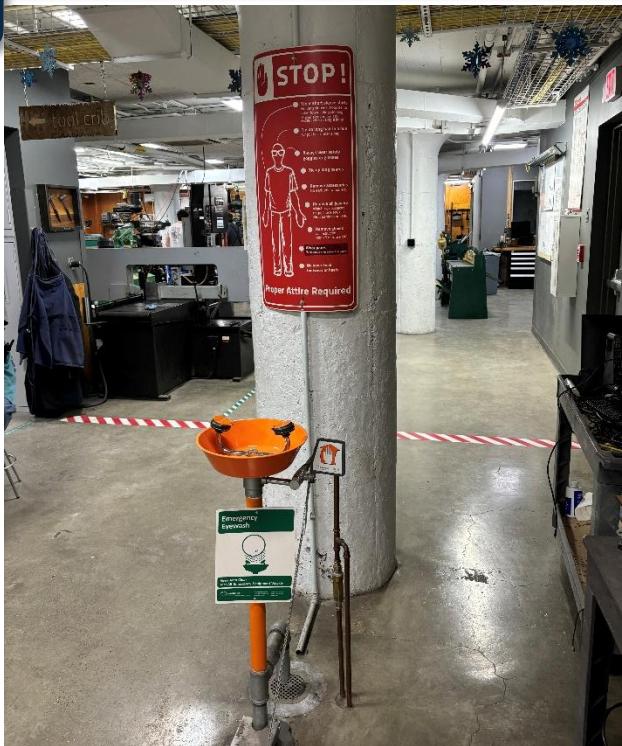
Avoid these risks by taking frequent breaks and alternating tasks, maintaining comfortable body positions, using the correct tools, and arranging workstations at the right height to eliminate awkward postures. Contact EHS for more training and ergonomic resources.

## Repetitive Movements:

Performing the same motion or series of motions repeatedly can lead to strain and injury over time, particularly in joints, tendons, and muscles.

**Awkward Postures:** Working in awkward or unnatural positions (e.g., twisting, reaching overhead, bending at the waist) can increase the risk of strain and injury.

## Eyewash Stations



Clear procedures for the use of eyewash stations ensures effective and immediate response in the event of eye exposure to harmful substances. Proper usage of eyewash stations is crucial for preventing serious eye injuries and maintaining workplace safety.

Emergency eyewash stations should be regularly inspected. However, they must also be operated monthly to ensure that the water lines are clean and clear. Routine flushing of the water in the pipes ensures that any rust or debris is removed. It is good practice for shop managers to develop a schedule for flushing, where stations are operated until the water is clean, and keeping a log to verify it is ready for use in an emergency.

### Accessibility and Location

- **Immediate access:** Ensure that eyewash stations are installed in all areas where hazardous chemicals, irritants, or particles are present. They should be easily accessible within 10 seconds (approximately 55 feet) of potential exposure areas. Time is critical and wasted seconds can result in irreparable eye damage, never hesitate to use safety equipment.
- **Clear pathways:** Always keep the path to the eyewash station clear of obstructions. Ensure that the station is well lit and clearly marked with signage.
- **Know your stations:** All employees working in areas where eyewash stations are required should be familiar with their locations and how to use them.

### Operation and Maintenance

- **Activation:** Eyewash stations should be designed for hands-free operation, allowing the user to activate the flow of water with a single motion, such as pushing a lever or stepping on a foot pedal.
- **Water Temperature:** The water delivered by the eyewash station should be tepid, typically between 60°F and 100°F (16°C and 38°C), to avoid further injury or discomfort.
- **Regular Maintenance:** Conduct weekly inspections and tests of eyewash stations to ensure proper operation. Flush the system to prevent the buildup of bacteria or sediment.
- **Service and Repairs:** Promptly address any malfunctions or damage to eyewash stations to ensure they are always operational when needed.

### Emergency Usage Procedure

- **Immediate Action:** Immediately go to the nearest eyewash station. If you wear contact lenses, do not delay removing them.
- **Activate Station:** Activate the eyewash station and position your face in the stream of water. Keep your eyes open, using your hands to hold your eyelids apart if necessary.
- **Flushing Duration:** Flush your eyes continuously for at least 15 minutes, ensuring that the water reaches all parts of the eyes. Roll your eyes around to facilitate this.
- **Seek Medical Attention:** After flushing, seek immediate medical attention, even if symptoms seem to improve. Inform the medical personnel about the substance involved.

## Fall Protection - Portable ladders



The list of forms that portable ladders come in is long. Most commonly you'll find step ladders, double sided step ladders, extension ladders, platform ladders, and rolling merchandise ladders. Reference the EHS ladder training documents for more information.

### General Guidelines

- **Authorized Use:** Only personnel trained in ladder safety are authorized to use portable ladders. Ensure that all users are familiar with this code of safety.
- **Inspection Before Use:** Inspect the ladder before each use for any signs of damage, such as cracks, corrosion, loose rungs, or missing parts. Do not use any ladder that is damaged or unstable. Immediately label and take damaged ladders out of service.

- **Ladder Selection:** Choose the right ladder for the job, considering the height, weight capacity, and type of work. Use ladders made of non-conductive materials, such as fiberglass, when working near electricity.
- **Drop Hazards:** Never stand, walk or work under ladders that are in use.
- **Weather Conditions:** Avoid using portable ladders in adverse weather conditions, such as strong winds, rain, or ice, which can make the ladder slippery and increase the risk of falls.

### Setting Up the Ladder

- **Stable Surface:** Place the ladder on a stable, level surface. If the ground is uneven or soft, use a ladder stabilizer or secure the feet to prevent slipping. Never use a folding ladder in an unfolded position.
- **Proper Angle:** Set the ladder at the correct angle. The base should be one foot away from the wall for every four feet of ladder height (the 4-to-1 rule).
- **Securing the Ladder:** If necessary, secure the ladder at the top or bottom to prevent it from moving. For extension ladders, ensure the locking mechanisms are engaged before climbing.

- **Extension Ladders:** Extend the ladder at least three feet above the landing point if using it to access a roof or platform. Ensure that the overlap between sections meets the manufacturer's specifications.

### Climbing and Descending

- **Three-Point Contact:** Maintain three points of contact (two hands and one foot, or two feet and one hand) with the ladder at all times while climbing or descending.
- **Face the Ladder:** Always face the ladder when climbing up or down. Do not climb with your back to the ladder.
- **Hands-Free Climbing:** Do not carry tools or materials in your hands while climbing. Use a tool belt, backpack, or hoist items up separately.
- **One Person at a Time:** Only one person should be on the ladder at a time unless the ladder is specifically designed for multiple users.

### Working from the Ladder

- **Safe Working Height:** Do not stand on the top two rungs of a stepladder or the top three rungs of an extension ladder. Ensure you have a stable base and enough ladder above your working position.
- **Avoid Overreaching:** Keep your body centered between the ladder rails. Do not lean or overreach to the side. Instead, move the ladder to a new position.
- **Tool and Equipment Management:** Secure tools and materials to prevent them from falling. Use tool belts or trays designed for ladders to keep your hands free.  
**Stable Positioning:** Do not move or shift the ladder while standing on it. Climb down and reposition the ladder if needed.

# First Aid

The university's shops, labs and workspaces can be a bustling environment with various potential hazards. First aid knowledge and preparedness are crucial to address injuries or health issues that may occur. Here's a guide highlighting common injuries and their immediate treatment:

## Treatment for Cuts and Abrasions

- Clean the wound with mild soap and water.
- Apply gentle pressure with a sterile bandage or clean cloth to stop bleeding.
- Once the bleeding has stopped, cover the wound with a sterile dressing.
- Change the dressing daily or as needed.

## Treatment for Splinters

- Use sterilized tweezers to gently remove the splinter. Do not squeeze the splinter out.
- Clean the area with soap and water after removal.
- Apply antiseptic cream and cover with a bandage.

## Treatment for Punctures

- *Stop the bleeding.* Apply gentle pressure with a clean bandage or cloth.
- Clean the area with soap and water after removal.
- Apply antiseptic cream and cover with a bandage.

## Treatment for Eye Injuries, e.g., Dust or Chemicals in the Eye

- Do not rub your eye.
- Seek the nearest eyewash station
- For dust, encourage blinking to promote tearing, which can help wash out the particle. If ineffective, flush the eye gently with clean water.
- For chemicals, immediately flush the eye with running water for at least 15 minutes and seek medical attention.

## Treatment for Burns (from Welding, Hot Surfaces or Chemicals)

- For minor burns, cool the burn under running cool water for at least 10 minutes.
- Apply burn gel in a thick layer to the injury. Do not apply ice or any other creams or ointments.
- Cover the burn with a sterile, non-fluffy dressing or cloth.
- Seek medical attention for more serious burns.

### Treatment for Falls and Sprains

- For falls resulting in minor injuries, rest and elevate the injured part.
- Apply an ice pack or a cold compress to reduce swelling.
- Use a bandage or support if necessary.
- Advise the injured person to seek medical attention if pain or swelling persists.

### Treatment of Inhalation of Fumes

- Move the person to fresh air immediately.
- Keep them calm and seated in a position that eases breathing.
- If they are having difficulty breathing, call emergency services.
- Monitor them closely until help arrives, or symptoms improve.

### Treatment for Heat Exhaustion

- Move the person to a cooler place.
- Have them lie down and elevate their legs.
- Make them drink water or a sports drink slowly.
- Cool their skin with water or damp cloths.

## First Aid Kits

A well-stocked first aid kit should be checked and restocked on a regular basis and should include:

- Sterile gauze and bandages of various sizes
- Adhesive tape
- Antiseptic wipes and cream
- Sterilized tweezers and scissors
- Disposable sterile gloves
- Burn gel and dressing
- Eye wash and eye bath
- Cold packs
- Pain relief medication (as permitted)
- Instructions for basic first aid procedures



### Additional Considerations

Ensure staff and volunteers are trained in basic first aid and CPR.

Have a clear, accessible emergency plan that includes locations of first aid kits, emergency exits, and contact information for local emergency services.

Regularly review emergency plans and first aid kits to update and remove out of date items.

## AED



An Automated External Defibrillator (AED) is a portable medical device used to treat sudden cardiac arrest by delivering an electric shock to the heart. The AED is designed to be simple to use, with voice and visual prompts guiding users through the process, making it an essential tool in emergency situations to help restore a normal heart rhythm before professional medical help arrives. There are more than 125 on campus. Nearly every building has at least one, find the nearest AED to where you are located. When they are properly charged there should be a green light that blinks.

## Stop the Bleed Kit

To prevent such unnecessary deaths, the Case Western Reserve University Department of Resiliency and CWRU EMS are working together to help the community “Stop the Bleed.” A campaign launched by the federal government, Stop the Bleed empowers bystanders to provide aid in the event of an emergency, similar to initiatives to train individuals to perform CPR and first aid. The campaign instructs individuals on how to apply a tourniquet and pack wounds to control bleeding. Through these methods, bystanders can give a victim crucial time.

These public access kits, which have enough supplies to save one or two lives each, have been co-located with AED kits across campus and placed in CWRU police and mobile security vehicles.

To participate in an upcoming Stop the Bleed, CPR, AED, and first aid training opportunities contact CWRU EMS

***These kits should be checked periodically for expired products.***

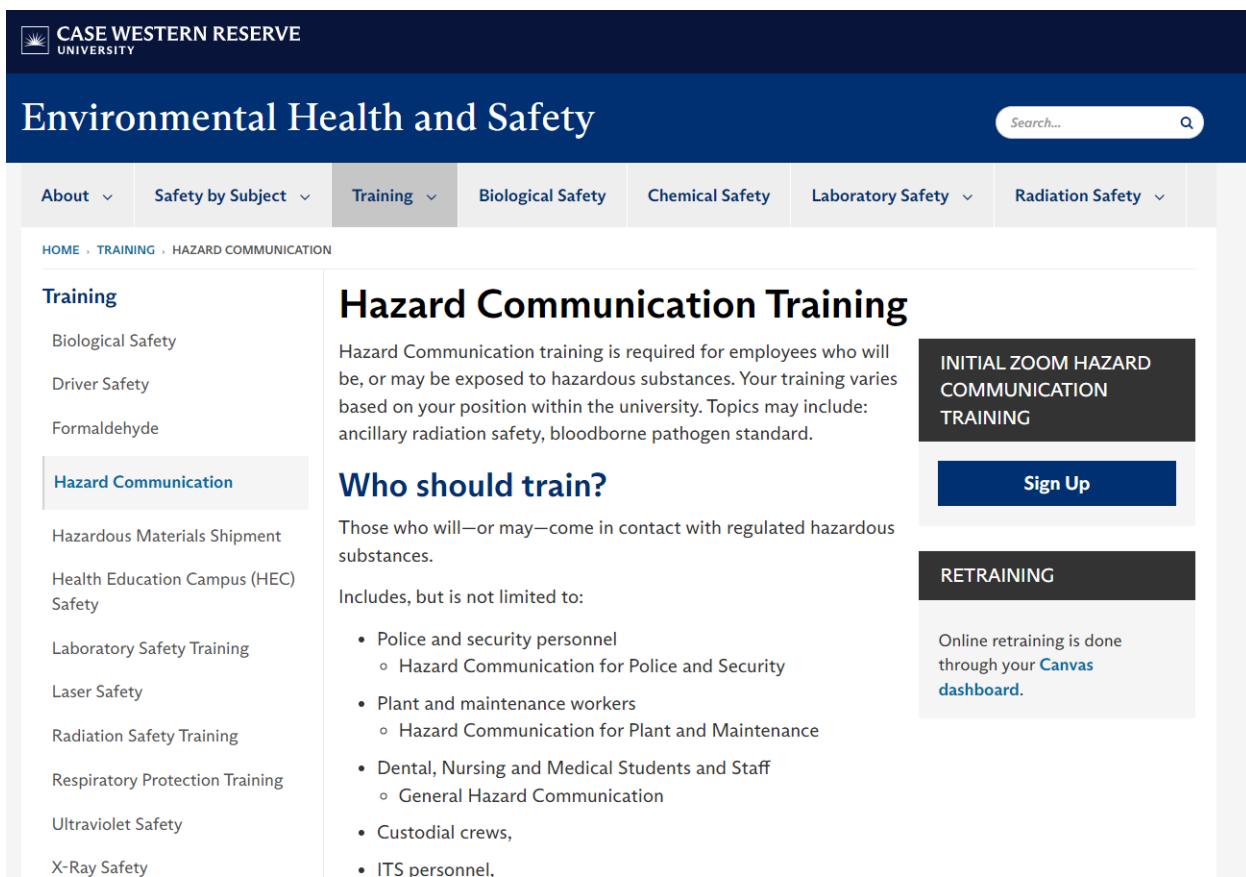
## Naloxone/Narcan

Naloxone is a medicine that rapidly reverses an opioid overdose. It is an opioid antagonist. This means that it attaches to opioid receptors and reverses and blocks the effects of other opioids. Naloxone can quickly restore normal breathing to a person if their breathing has slowed or stopped because of an opioid overdose. Naloxone has no effect on someone who does not have opioids in their system. University Health and Counseling services will provide naloxone for free with no prescription and will provide training. On Campus, each AED case should also have a dose of Naloxone for emergencies.

# Hazard Communication

All applicable personnel must be aware of hazardous substances in the workplace and trained to understand safety protocols. The goal is to protect workers from chemical, physical, and biological hazards by providing information about the risks and necessary precautions. Topics may include ancillary radiation safety, bloodborne pathogen standard, chemical inventories and labeling and PPE.

EHS offers this online training every Tuesday from 10:30am-12:00pm. The signup link is located on the EHS website in the Hazard Communication section of the training tab.



The screenshot shows the Case Western Reserve University Environmental Health and Safety website. The top navigation bar includes links for About, Safety by Subject, Training (which is the active tab), Biological Safety, Chemical Safety, Laboratory Safety, and Radiation Safety. The main content area is titled "Hazard Communication Training". It describes the required training for employees exposed to hazardous substances, mentioning topics like ancillary radiation safety and bloodborne pathogen standard. Below this, a section titled "Who should train?" lists various roles including Police and security personnel, Plant and maintenance workers, Dental, Nursing and Medical Students and Staff, Custodial crews, and ITS personnel. To the right, there are two call-to-action boxes: "INITIAL ZOOM HAZARD COMMUNICATION TRAINING" with a "Sign Up" button, and "RETRAINING" with text indicating online retraining is done through the Canvas dashboard.

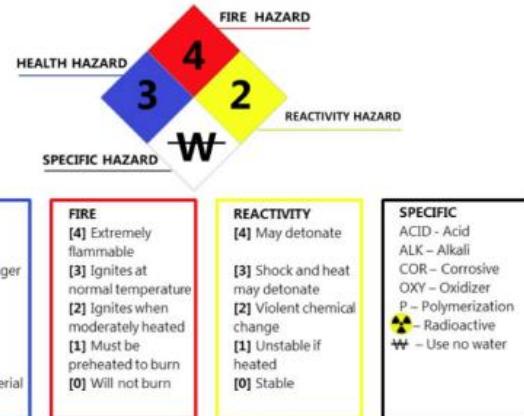
## Chemical Use

Before working with any chemical, you must be aware of the hazards associated with it, how to use and handle it with appropriate safety controls, and the proper storage and disposal of it. This can be accomplished through reviewing references such as Safety Data Sheets (SDS) and written procedures. Always ask questions if you are unsure of how to handle a chemical.

## SDS- How do I read an SDS?

The following information will be listed, in this order, for every chemical that you use:

- **Section 1, Identification:** includes product identifier; manufacturer or distributor name, address, phone number; emergency phone number; recommended use; restrictions on use.
- **Section 2, Hazard(s) identification:** includes all hazards regarding the chemical; required label elements.
- **Section 3, Composition/information on ingredients:** includes information on chemical ingredients; trade secret claims.
- **Section 4, First-aid measures:** includes important symptoms/effects, acute, delayed; required treatment.
- **Section 5, Fire-fighting measures:** lists suitable extinguishing techniques, equipment; chemical hazards from fire.
- **Section 6, Accidental release measures:** lists emergency procedures; protective equipment; proper methods of containment and cleanup.
- **Section 7, Handling and storage:** lists precautions for safe handling and storage, including incompatibilities.
- **Section 8, Exposure controls/personal protection:** lists OSHA's Permissible Exposure Limits (PELs); ACGIH Threshold Limit Values (TLVs); and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the SDS where available as well as appropriate engineering controls; personal protective equipment (PPE).
- **Section 9, Physical and chemical properties:** lists the chemical's characteristics.
- **Section 10, Stability and reactivity:** lists chemical stability and possibility of hazardous reactions.
- **Section 11, Toxicological information:** includes routes of exposure; related symptoms, acute and chronic effects; numerical measures of toxicity.
- **Section 12, Ecological information:** lists ecotoxicity persistence and degradability; bioaccumulative potential, mobility in the soil.
- **Section 13, Disposal considerations**
- **Section 14, Transport information:** lists UN number, UN proper shipping name, transport hazard class(es), packing group, if applicable, environmental hazards.
- **Section 15, Regulatory information:** includes safety, health and environmental regulations specific for the product in question.
- **Section 16, Other information:** includes the date of preparation or last revision.



# Housekeeping

The crunch of impending events or approaching deadlines often leads to an increase in clutter and mess. Maintaining a clean and organized environment on stage and in shops is essential for safety, efficiency, and overall workplace well-being. This code of safety provides guidelines for proper housekeeping practices to minimize hazards and create a safe working environment.



## General Housekeeping Guidelines

- **Clean Workspaces:** Keep work areas, including workbenches, floors, and storage spaces, clean and free of clutter. Regularly dispose of waste materials and keep tools and equipment stored properly when not in use.
- **Daily Cleanup:** Perform a thorough cleanup of work areas at the end of each shift and sweep at least daily, but more frequently when needed. Ensure all trash is removed, tools are returned to their proper places, and materials are stored safely.
- **Spill Management:** Immediately clean up any spills, including liquids, powders, or debris, to prevent slips, trips, and falls. Use appropriate cleaning materials for different substances and follow chemical safety guidelines when handling hazardous spills.
- **Ongoing Awareness:** Promote ongoing awareness of housekeeping practices through regular safety meetings, reminders, and signage. Encourage workers to take responsibility for maintaining a clean and safe workspace.
- **Reporting Hazards:** Encourage workers to report any hazards or unsafe conditions immediately. Address reported issues promptly to maintain a safe working environment.
- **Storage:** Store and secure ladders when not in use, secure stored materials in a manner that prevents them from falling, coil power tool cords when stored.

## Waste Management

- **Regular Disposal:** Dispose of waste materials, including scrap wood, fabric offcuts, and packaging, on a regular basis. Use appropriate containers for different types of waste, such as recycling bins and hazardous waste disposal units.

- **Chemical Waste:** Follow proper procedures for disposing of chemical waste, such as paints, solvents, and adhesives. Do not pour chemicals down drains or discard them in regular trash receptacles.
- **Sharp Waste:** Dispose of sharp objects, such as broken glass or used blades, in designated sharps containers to prevent injury.
- **Flammable Waste:** Do not allow combustible waste, such as paper, sawdust, or fabric scraps, to accumulate. Dispose of these materials in metal containers with lids to reduce the risk of fire.

### **Floor and Aisle Maintenance**

- **Clear Walkways:** Keep aisles and walkways clear of obstructions at all times. Ensure that materials, tools, and equipment are not left in areas where people walk, especially in emergency exit routes.
- **Trip Hazards:** Identify and remove trip hazards, such as loose cords, uneven flooring, and misplaced tools. Secure cords and cables with cable covers or tape, and repair damaged flooring promptly.
- **Regular Inspections:** Conduct regular inspections of floors, stairs, and ramps to identify and address potential hazards. Repair or report any damage, such as cracks or loose steps, immediately.

### **Record Keeping and Inspections**

- **Housekeeping Checklists:** Use housekeeping checklists to ensure that all areas are regularly cleaned and maintained. Supervisors should review checklists daily or weekly, depending on the area's use.



- **Routine Inspections:** Conduct routine inspections of the shop and theatre spaces to identify and correct any housekeeping issues. Document inspections and corrective actions taken.

## Inspections and Machine Repairs

Only **authorized individuals**, such as shop supervisors, managers, or approved vendors can repair machinery. User manuals or Standard Operating Procedures (SOPs) must be consulted and followed when maintaining or repairing equipment. Maintenance and repair records must be maintained for every piece of machinery, whether it is sent out or repaired in-house. These records must outline what was repaired, the date the repair occurred, and who completed it.

**What type of machinery must have routine inspections?** All heavy machinery that is continuously in use must have routine safety or maintenance inspections. Inspections must be documented using machine-specific checklists or general maintenance logs that demonstrate routine review and inspection of machine parts and performance. Some equipment (like cranes and hoists) fall into their own programs that outline inspection procedures. Other equipment should be routinely inspected for damage and maintained as part of a shop safety program for each space.

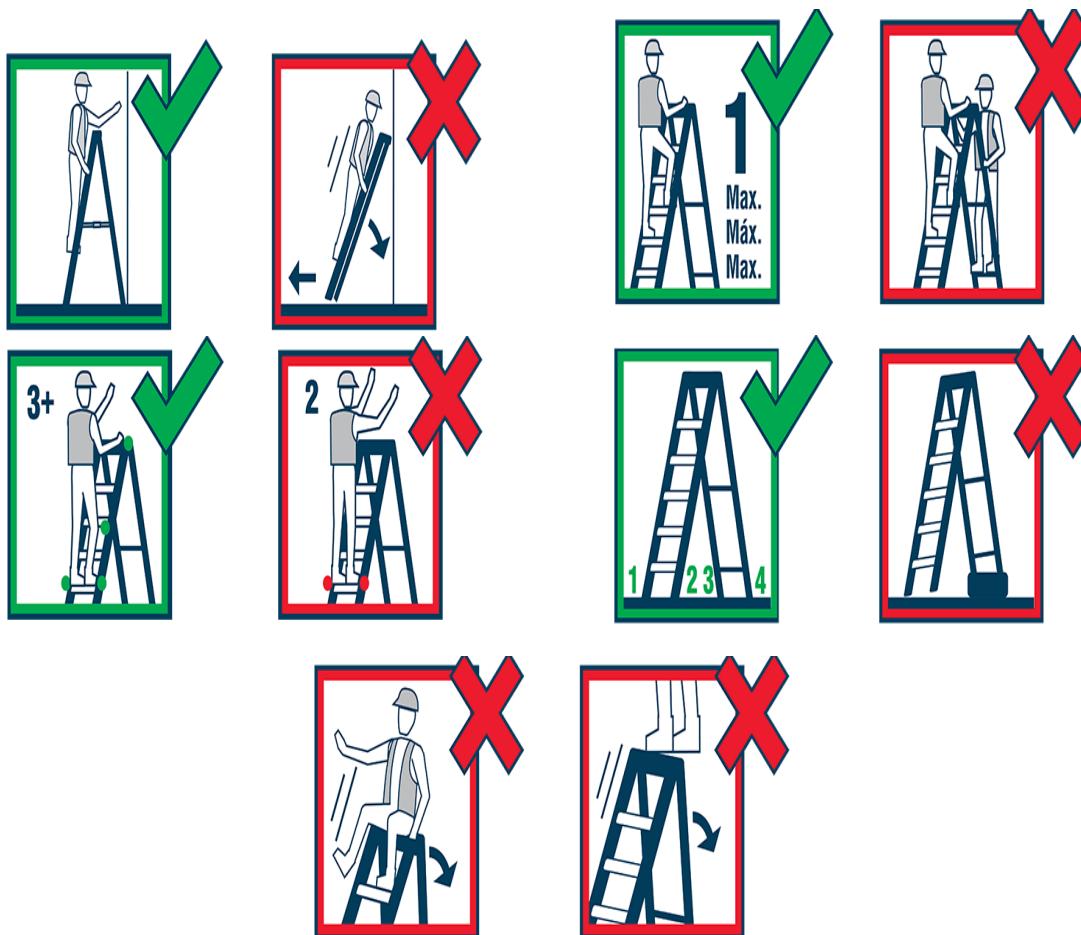
### Notice: Temporary Equipment Outage

- Waterjet: Currently undergoing maintenance and is unavailable until further notice.
- Paint Booth & Sand Blasters: Temporarily offline for renovations. Returning in Spring with exciting upgrades!

## Ladders

Every ladder should be inspected on a **frequent and regular** basis to ensure they are maintained in good working order. Ladders should be free of grease, oils, or other slippery conditions and every component should be free of damage. Defective ladders should immediately be removed from service and the defect should be reported to your supervisor.

Place ladders only on stable surfaces. Boxes, tables, chairs or other secondary platforms should never be used to prop up or change the height of any ladder. For more information on ladder safety read the **CWRU Ladder Safety Written Program**. It is important to remember, anyone who uses a ladder must be trained; ladders over 4' that are stored against a wall should be secured to prevent tipping; ladders must only be used to the weight loading listed on the ladder.



## Lockout/Tagout

Improper use of lockout/tagout procedures can be fatal. For full training and procedures contact EHS and review the LOTO program on the EHS website.<sup>15</sup> Examples of energy that must be controlled comes in the form of electrical, thermal, mechanical, hydraulic, and stored. This is not an all-encompassing list which is why identification of site specific LOTO hazards is vital.

- **Preparation:**
  - Apply LOTO whenever work on tools or machines occurs and any time when the unexpected activation of a device could cause injuries.
  - Notify affected employees about the shutdown and LOTO procedure.
- **Isolation:**
  - Disconnect or isolate the energy sources and dissipate or block stored energy. This may involve switching off breakers, closing valves.
- **Lockout:**
  - Apply locks to all energy-isolating devices to ensure they remain in the "off" position. Only authorized personnel should apply their personal lock.
- **Tagout:**
  - Attach a clearly visible tag to each lock indicating the name of the person who applied the lock, the date and reason for the lockout.
- **Verification:**
  - Attempt to start or operate the equipment to verify that all energy sources are isolated. Ensure there is no residual energy.
- **Maintenance or Repair:**
  - Perform the necessary maintenance or repair work safely.
- **Restoration:**
  - Ensure all tools and materials are removed, guards are reinstalled, and workers are clear.
  - Remove locks and tags after verifying that the work is complete.
  - Re-energize the equipment in accordance with standard operating procedures.
  - Notify affected employees that the equipment is back in service.



<sup>15</sup> <https://case.edu/ehs/sites/default/files/2018-02/LOTO-Written-Program.pdf>

### Important Reminders:

- **One Lock, One Key:** Each person working on the equipment should apply their own lock and keep the key.
- **Never Remove Another's Lock:** Only the person who applied the lock can remove it. If necessary, follow CWRU procedures for emergency lock removal.
- **No Shortcuts:** Follow the full LOTO procedure every time, even if the job seems quick or routine.
- **Communication:** Maintain clear communication with all affected employees throughout the LOTO process.



# Machine Guards

Machine guards are essential safety features designed to protect operators from direct contact with moving parts, flying debris, sparks, and other hazards associated with machinery operation.

Proper use and maintenance of machine guards are critical components of workplace safety in industries ranging from manufacturing to woodworking. Here is a general guide on the importance of guards on machines, encompassing various types of equipment. Machine guarding is one of OSHA's most frequently cited violations.

## Importance of Machine Guards

Machine guards serve as physical barriers between the operator and the moving parts of machinery, preventing accidental contact that could result in injuries such as cuts, abrasions, amputations, or worse. They help to contain or deflect flying debris, sparks, and other materials that could cause injury or fires. Guards contribute to a safer working environment, helping to reduce the risk of work-related accidents and injuries.

## Types of Guards

- **Fixed Guards**-These are permanent parts of the machine that do not move while the machine operates. They provide a solid barrier between the operator and the dangerous parts.
- **Interlocking Guards**-These guards automatically shut off or disengage the machine's power when opened or removed, ensuring the machine cannot operate when the guard is not in place.
- **Adjustable Guards**-These provide a barrier that can be adjusted to accommodate various sizes of material being processed.
- **Self-adjusting Guards**-These automatically adjust to the movement of the stock or the machine part, offering protection while allowing for the progress of work.

## Safety Measures:

- Survey the workplace to determine if any machine guarding hazards are present.
  - The most common violation observed around campus are belt guards that are missing on vacuum pumps, air compressors, mixers, etc.
  - NOTE: If the hazard is at least 7 feet above the work floor and the operator never comes into contact with it during normal operations, then no other guarding is required (guarded by location).
  - Consult with EHS if there are any questions as to whether or not a hazard exists.



- If a machine's guards are removed or not functioning, the machine should be immediately removed from service and locked out until such time that guards are replaced or repaired.
- Abate all hazards identified.
  - In addition to general requirements, the OSHA standards contain specific requirements for some equipment (woodworking machinery, abrasive wheel machines, rubber and plastic mills, mechanical power presses, forging machines, etc)
  - A guard (physical barrier) is the preferred method to abate moving machinery hazards.
  - In some situations, fixed guards cannot be used, so other devices are utilized. These would include limit switches, various sensors, pullback and holdback restraints, two-handed operating controls, etc.

### **General Safety Instructions for Machine Guards**

Machine guards should be inspected regularly for signs of damage or wear. Any issues should be addressed immediately to ensure the guard continues to provide effective protection. Guards should be properly installed and maintained according to the manufacturer's instructions. They should not be modified or removed without authorization.

Operators should receive training on the proper use of machine guards, including how to adjust them and what to do if a guard is damaged or missing. Ensure that guards do not create additional hazards by obstructing the operator's view or making it difficult to operate the machine safely. Follow all relevant workplace safety regulations and standards related to machine guarding to ensure compliance and protect workers.

### **Additional Guards Safety Tips**

Always use machine guards as intended. Never bypass or disable them to speed up production. When removing guards for maintenance or cleaning, follow lockout/tagout procedures to ensure the machine is not accidentally started. Educate all workers about the importance of machine guards and encourage a culture of safety that prioritizes the use of guards at all times.

#### ***Training and Labeling:***

The OSHA standards only have training requirements for power press operators, and maintenance personnel, however it is recommended that all employees be made aware of the potential hazards involved.

There are no specific labeling requirements; however, some signage is recommended. This would include signs to identify hazards and warnings on removable guards (i.e. "Do Not Operate With Guard Removed")

# Material Handling, Lifting, Loading and Unloading

Loading and unloading trucks and trailers may happen infrequently, which makes review procedures even more important so that crews are prepared when the situation arises.

## General Guidelines

- If PIT (powered industrial truck) equipment is employed, ensure all operators are trained and have current EHS certifications. Contact EHS if a forklift will be used inside a trailer.
- Prior to unloading, develop a plan outlining where offloaded items will be stored and who will manage the unloading.
- Ensure that truck wheels have been chocked or dock locks have been engaged, and that trailer jacks are engaged if the tractor has been removed.
- **Inspection:** Inspect the trailer, loading dock, and surrounding area for hazards such as uneven surfaces, debris, or insufficient lighting. Ensure the trailer is properly secured and stabilized before beginning.
- **Balanced Loading:** Load heavier items first and distribute weight evenly across the trailer to prevent tipping or shifting during transport.
- **Securing Equipment:** Use straps, ropes, load bars or other securing devices to prevent equipment from shifting during transport.
- **Clear Pathways:** Ensure that the area is clear of obstacles and designate a path for moving equipment from the trailer to the storage or staging area.
- **Spotters:** Use spotters to guide the process, especially when moving large or heavy items. Spotters should be positioned where they can see both the equipment and the workers.
- **Awareness:** Keep hands clear of crushing hazards (this can be exceptionally true if moving road cases).
- **Guarding:** Ensure edges of docks are marked, place barriers to control access, place signage to warn pedestrians away from the loading/unloading area.



Carrying heavy loads, positioning large pieces of scenery, moving rigging counterweights, transporting equipment cases, and traveling on ramps are just some examples where hazards exist. Improper lifting technique can lead to injury.

### **Before You Lift**

- Warm up and stretch muscles.
- Plan your path of travel.
- Utilize dollies and carts when possible
- Never lift a load you don't believe you can handle alone.

### **When You Lift**

- Bend at the knee, not your waist
- Keep the load close to your body
- Use handles if available
- Maintain a comfortable and natural body position.
- Lift with your legs
- Lift smoothly and move smoothly.
- Communicate with anybody assisting you.

### **When You Move**

- **Transport:** Do not “bite” the heels of people ahead of you during transport with objects you are pushing. Densely packed loads carry momentum, ensure that momentum is constantly controlled. If pushing up or down a ramp, ask for more hands if needed and keep the load in front of you.
- **Pushing:** Use a low center of gravity and push as low as you can on a load. Strange shapes or poorly balanced loads can tip when pushed from a higher center of gravity. Keep hands towards the outside edges of a load to improve turning leverage.
- **Thresholds:** When pushing cases, dollies, and heavy loads, rather than pushing squarely so that 2 wheels hit a threshold or large bump, use a diamond pattern. By leading with a corner, you ensure that only one-wheel crosses at a time making it more stable. The lower surface area allows you to cross the obstacle with less force.

# Paints, Inks, Dyes, Adhesives, Epoxies and Coatings

This code of safety provides guidelines to ensure the safe handling, storage, and use of paints, dyes, inks, and adhesives. Adhering to these practices will help prevent accidents, health risks, and environmental hazards.

## General Safety Guidelines

- **Awareness:** Ensure all personnel are aware of the hazards associated with the materials they are using, including potential toxicity, flammability, and inhalation risks.
- **Safety Data Sheets (SDS):** Keep Safety Data Sheets (SDS) for all materials readily accessible. Review these sheets to understand the proper handling, storage, and first aid measures for each substance.
- **No Open Flames:** Keep all sources of ignition, such as open flames, sparks, and smoking materials, away from areas where flammable paints, dyes, inks, or adhesives are used or stored.
- **Proper Containers:** Store all paints, dyes, inks, and adhesives in their original containers with labels intact. Ensure that lids and caps are securely closed when not in use to prevent spills and vapor release.
- Clean up spills immediately
- Never eat, or drink where chemicals are used or stored.

## Personal Protective Equipment (PPE)

- **Gloves:** Wear chemical-resistant gloves when handling paints, dyes, inks, and adhesives to protect the skin from harmful substances.
- **Respiratory Protection:** Use appropriate respirators or masks when working with materials that produce harmful vapors, fumes, or dust. Ensure proper fit and that the filters are appropriate for the specific chemicals.
- **Eye Protection:** Wear safety goggles or face shields when there is a risk of splashing or exposure to airborne particles.
- **Protective Clothing:** Wear long sleeves, aprons, or coveralls to protect clothing and skin from spills and splashes. Use clothing that is resistant to chemicals where necessary.

## Ventilation

- **Work in Well-Ventilated Areas:** Always use paints, dyes, inks, and adhesives in areas with adequate ventilation. When possible, perform tasks outdoors or in areas with active ventilation systems, such as fume hoods or exhaust fans.
- **Avoid Confined Spaces:** Do not use volatile substances in small, enclosed spaces unless they are equipped with proper ventilation systems to remove fumes.



## Handling and Application

- **Mixing and Diluting:** When mixing or diluting substances, do so slowly and in well-ventilated areas. Use tools and containers specifically designated for each type of material to avoid cross-contamination.
- **Application Tools:** Use appropriate tools for applying paints, dyes, inks, and adhesives. Clean tools immediately after use and store them properly.
- **Avoid Inhalation and Skin Contact:** Minimize exposure to vapors by keeping containers closed when not in use and by using applicators rather than pouring directly from the container.

## Waste Management

- **Waste Disposal:** Dispose of paints, dyes, inks, adhesives, and contaminated materials (e.g., rags, brushes, containers) according to hazardous waste regulations. Do not pour chemicals down drains or into trash bins. Reference the Hazcom Safety Standard and Contact EHS if further guidance is needed.
- **Minimizing Waste:** Mix only the amount of material needed for the task to reduce waste. Reuse or recycle materials when possible.

## Paint Booth



Painting and operations within a paint booth involve specific hazards, including exposure to harmful chemicals and fumes, fire risks from flammable materials, and respiratory issues. Ensuring safety in these environments requires strict adherence to protocols designed to minimize risks. Here's a comprehensive guide to safety for painting and paint booth operations

### PPE

Use appropriate respirators to protect against inhalation of harmful vapors and particulates. Ensure the respirator is approved by the National Institute for Occupational Safety and Health for the specific type of vapors and particulates present in the paint. Wear safety goggles to prevent eye irritation or injury from splashes and vapors. Use gloves resistant to chemicals, along with coveralls or aprons, to protect skin from contact with paint and solvents. Utilize earplugs or earmuffs in areas where high noise levels are generated by equipment.

### Ventilation and Air Quality

Ensure that the paint booth is equipped with a proper ventilation system designed to remove harmful fumes and supply fresh air. Use air filters capable of capturing paint particulates and replace them regularly according to the manufacturer's recommendations. Regularly check air quality to ensure that hazardous substance concentrations do not exceed safe levels.

### Fire Safety

When dealing with flammable materials, store paints, thinners, and other flammable supplies in approved, fire-resistant cabinets when not in use. Prohibit smoking, open flames, and sparks in or near the paint booth area. Ensure that appropriate fire extinguishers are readily accessible, and that staff are trained in their use.

### Safe Handling of Paints and Solvents

Keep Safety Data Sheets for all chemicals on hand for reference in case of emergency and to inform workers of specific hazards. Dispose of paint waste, empty containers, and soiled rags in accordance with local environmental regulations to prevent pollution

and fire hazards. Have a spill response plan in place, including spill kits with absorbent materials and protective gear for cleanup.

### **Equipment and Machinery Safety**

Perform regular inspections and maintenance on paint booths and associated equipment to ensure they are in good working condition and free from defects.

### **Grounding and Bonding**

Ground and bond equipment to prevent static electricity buildup, which could lead to sparks and fire. Train workers on the safe operation of paint booths and associated equipment, emphasizing the importance of adhering to operating manuals and safety protocols.

### **Training and Emergency Preparedness**

Provide comprehensive training on the safe handling of paints and solvents, equipment operation, PPE use, emergency response, and fire safety. Develop and communicate a clear emergency response plan for fires, chemical spills, and exposure incidents, including evacuation routes and assembly points.

# Propane Tank Handling

Propane, as a liquid petroleum gas (LPG), is commonly used fuel for forklifts. It is a safe fuel when handled properly. When handled improperly, it can cause serious injury or death.

## Potential Hazards

- LPG vapor is heavier than air and will seek the lowest lying area. It can collect in pockets if not dissipated and may ignite if exposed to a heat source.
- LPG is extremely flammable.
- LPG is extremely cold when exposed to the atmosphere. If your skin is exposed to LPG, you can get frostbite.



## Replacing LPG Cylinders

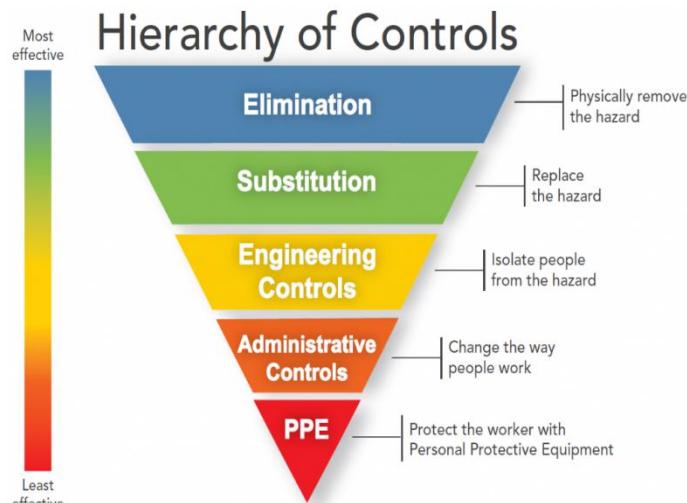
1. Park the truck in a designated safe area and stop the engine.
2. Wear appropriate PPE.
3. Close the cylinder valve and remove the coupling from the cylinder.
4. Remove the empty cylinder from the cradle and store in a designated area.
5. Select a full cylinder and inspect it for damage. A cylinder with a fuel level gauge is preferred to allow the operator to quickly identify how much fuel is available.
6. Inspect fuel lines and couplings prior to installation, ensure O-rings and washers are intact with no signs of damage or aging.
7. Carefully install the filled cylinder in the cradle on the truck ensuring that the locating hole in the cylinder collar aligns with the locator pin if there is one equipped and that the pressure relief valve is oriented upward. Full forklift propane cylinder can weigh 50 to 70 pounds and are an irregular shape; be sure to use proper lifting techniques minimize the risk of a lower back injury. *Whenever possible team-lift the tank into place.*
8. Reconnect the fuel line to the cylinder valve and open valve slowly.
9. Check for leaks. If a leak is found, close the valve immediately until repairs can be made.

## LPG Cylinder Storage:

1. Store LPG cylinders in a designated approved location.
2. Cylinders must be secured against tampering and damage.
3. Do not store cylinders or park propane forklifts near heat sources, sources of ignition, stairways, exits, or other egress areas.
4. Store LPG cylinders and unattended forklifts with their service valves closed.

## PPE

Personal Protective Equipment is the last line of defense to protect you from hazardous tasks. It should be provided to you by supervisors or employers any time it is needed. PPE is in place in case administrative controls, work practices and engineering methods cannot eliminate the hazards and to guard against hazards from errors. Standards that include PPE are Hazard Communication, The Laboratory Safety, Bloodborne Pathogens, Benzene, Formaldehyde, Vinyl Chloride and Methylene Chloride. Moreover, both Respirator Standards are forms of specialized PPE. Meeting the guidelines in those standards will satisfy the standard requirements in most cases. Although PPE is considered the last line of defense, determination of what PPE is to be issued or worn is to be made **without** consideration of other safety controls that are in place. The hazards associated with some tasks may require the simultaneous use of more than one item of PPE (i.e. respirator, gloves and lab coat; hard hat, safety glasses and safety shoes). EHS can provide guidance on hazards and appropriate PPE.



### General PPE Practices

- **Use:** Wear the correct PPE for the task and in the manner directed by training.
- **Inspection:** Inspect PPE before each use for signs of damage or wear. Replace any damaged or expired equipment immediately.
- **Fit and Comfort:** Ensure PPE fits properly and is comfortable to wear for the duration of the task. Improperly fitting PPE can reduce effectiveness and may cause additional hazards.
- **Clean:** Sanitize and clean according to instructions after every use

### Head and Eye<sup>16</sup> Protection

- Wear an ANSI<sup>17</sup> approved hardhat when there are low head clearances or potential for falling objects.
- Wear safety glasses or a face shield when there might be flying debris.
- Wear goggles when there is potential for chemical splashes.

<sup>16</sup> <https://case.edu/ehs/laboratory-safety/personal-protective-equipment/eye-protection>

<sup>17</sup> American National Standards Institute (ANSI) Z89.1

- Wear a welding helmet with the correct level of shading when welding or brazing.
- Wear ear plugs or earmuffs in areas of sustained noise or with levels over 85dB.

### **Hand Protection**

- Wear the appropriate gloves for the task. Example: Nitrile for chemical, Leather for heat.
- Do not wear gloves when they can be caught by machine movement or rotation.

### **Foot Protection**

- Wear steel toe shoes where there is a danger of crushing or rolling objects. If working with electricity, use shoes with composite toes.

**\*Fall Protection and respiratory protection are covered in their own sections.\***



# Respiratory Protection

Respirators protect the respiratory system from inhalation of hazardous atmospheres. Respirators provide protection either by removing contaminants from the air before they are inhaled or by supplying an independent source of respirable air.

## Categories

**Air-Purifying Respirators** - Ambient air passes through a filter, cartridge, or canister to remove contaminants before breathing. Different contaminants require different filters. Because these respirators use surrounding air, they cannot be used in oxygen-deficient environments.

- N-95/N-99/N-100 Disposable Respirators are single-use respirators generally approved only for nuisance dusts, such as cement and hay dusts. These respirators are not designed to filter chemicals.
- Half mask and full facepiece respirators provide protection against dust and particulates as well as chemical mists, fumes, vapors, gasses, or any combination of these contaminants.
- Powered Air-Purifying Respirators (PAPRs) contain a portable blower that pushes ambient air through a filter and supplies purified air to the wearer. The powered type is equipped with a tight-fitting facepiece or a loose-fitting helmet, hood, or suit.

**Atmosphere-Supplying Respirators**– These respirators provide a breathable atmosphere, independent of the surrounding air. These respirators include Self-Contained Breathing Apparatus (SCBA) and Air-Line Respirators.

**To wear a respirator, employees must complete the following steps:**

1. Complete the *OSHA Respirator Medical Evaluation Questionnaire*<sup>18</sup>
2. Submit to a medical evaluation by CWRU Health Services to ensure that wearing a respirator will not be a health hazard,
3. Attend Respirator Training to learn how to wear and maintain a respirator safely.
4. Complete a Fit Test at the EHS office to ensure that the respirator fits properly and securely. Call 216.368.2907 to schedule a time.

<sup>18</sup> <https://case.edu/ehs/media/1691>

# Storage

Well organized and planned storage reduces the possibility of injury, helps create a culture of good housekeeping and allows for faster locating of items tagged for retrieval.

## General Storage Guidelines

- Clearly designate and label storage areas for different types of materials and equipment. These spaces should be clean and dry.
- Store frequently used items in easily accessible areas to minimize the need for reaching, bending, or climbing. Less frequently used items should be stored higher or lower, depending on their size and weight.
- Label all storage containers, shelves, and drawers clearly. This helps in locating items and ensures that materials are returned to the correct place after use.
- Ensure that storage areas are well-ventilated, especially when storing chemicals, paints, or other materials that could emit harmful fumes.
- Keep stored items at least 18 inches below sprinkler heads and 24 inches from the ceiling in non-sprinklered areas (except along walls).
- Maintain 36 inches of clearance from electrical equipment, and fire systems.

## Material and Equipment Storage

- Store heavy items on lower shelves or the floor to prevent accidents from lifting or dropping. Use appropriate lifting techniques to move heavy items.
- Organize small tools and supplies in labeled bins, drawers, or toolboxes. Keep these items in a specific area to prevent clutter and loss.
- Store long or bulky items, such as lumber, pipes, or fabric rolls, horizontally on racks designed to support their weight. Ensure they are securely fastened to prevent tipping or falling.
- Store sharp tools, such as knives, and scissors, in secure locations with protective covers or sheaths. Keep these items out of reach of unauthorized personnel.



## Shop General Safety

Wood and metal working tools are dangerous, and all users require training in safe operating procedures. This training must be documented, retraining must occur in the event of incidents or violations. Shop managers shall be responsible for these logs and determining what training should occur for their particular uses. This Code of Safety serves as reference and provides the basic procedures that should be followed in campus shops. If you are unclear or do not understand tasks, equipment or safety procedures, ask for assistance from instructors, supervisors or EHS. If procedures are overlooked severe injury can occur.

### General Safety Guidelines

- **Authorization and Supervision:**
  - Students must complete safety training and receive authorization before using any equipment or tools in the shop.
  - A trained supervisor or instructor must be present when the shop is in use.
- **Personal Protective Equipment (PPE):**
  - Always wear appropriate PPE, N-95 dust masks when sanding, safety glasses for debris risks, hearing protection (even if you aren't the operator), gloves for material handling, full length pants, closed-toe shoes. Consult EHS for more PPE guidance.
  - Long hair must be tied back, and loose clothing or jewelry should be secured or removed to avoid entanglement.
  - Use ventilation/dust collectors and air filters if they are available.
- **No Distractions:**
  - Maintain focus on the task at hand. Avoid using phones, headphones, or engaging in distracting conversations while operating machinery or tools.
  - Never leave machinery running unattended.
- **Housekeeping:**
  - Keep the work area clean and free of clutter. Regularly sweep up dust, metal shavings, and debris.
  - Plan ahead to leave time for clean up
  - Store tools and materials in designated areas when not in use.
- **Emergency Procedures:**
  - Familiarize yourself with the location of emergency exits, fire extinguishers, first aid kits, and eyewash stations.
  - Report any accidents, injuries, or unsafe conditions to the supervisor immediately.

## Tools - Hand and Power



Hand tools carry inherent risk due to sharp edges and moving parts but often aren't given the same critical attention that larger tools receive. The power tool classification encompasses anything with a power source: Electric, liquid fueled, pneumatic (air), hydraulic, and powder actuated.

### General Safety

- Always wear appropriate PPE, N-95 dust masks when sanding, safety glasses for debris risks, hearing protection (even if you aren't the operator), gloves for material handling, full length pants, closed-toe shoes. Consult EHS for more PPE guidance.
- Long hair must be tied back, and loose clothing or jewelry should be secured or removed to avoid entanglement.
- Inspect tools before each use for damage or defects.
- Be aware of your surroundings and ensure observers are a safe distance away.
- Service and maintain tools according to manufacturer's recommendations
- Clean up any mess or debris generated by the tool after it is used.

### Hand Tool Safety

- Use the right tool for the job, not everything is a hammer.
- Remove any damaged tools from service. Inspected for cracked handles, cracks due to metal fatigue, mushroomed heads on impact tools, or loose components.
- Tools capable of piercing should be carried with the point towards the ground.
- Cut away from your body

### Power Tool Safety

- Never use a tool with a guard that has been altered or removed.
- Do not carry tools by power cords or hoses
- Keep fingers away from switches and triggers when plugging a device in.
- Disconnect devices before servicing or making adjustments. This includes reloading staples or nails and changing bits or sandpaper.
- Keep hoses and power cords away from heat and out of situations where they could be cut or rolled over.
- Whenever possible, secure work pieces. (vises, clamps, screws etc)
- Keep a hand on any power tool that rotates or moves so that you maintain control of the device until the energy has been dissipated after shutdown. (Sanders, routers, etc)

## Tools - Band Saw



Band saw blades are a continuous circle kept under tension and are used to cut a variety of materials, including wood and metal. Bandsaws can be either vertical or horizontal, on vertical machines the work piece is fed into the cutting edge, but on horizontal band saws, the blade is fed into the piece. The metal band blade rides on two wheels rotating in the same plane. Band saws can be used to produce straight cuts but are often used to cut intricate, irregular or curved shapes.

### **Potential Hazards:**

- **Contact with moving blade** – lacerations or amputations.
- **Kickback/stock ejection** – workpiece can be thrown at operator.
- **Entanglement** – loose clothing, jewelry, or hair caught in moving parts.
- **Noise** – prolonged exposure can cause hearing loss.
- **Flying chips and dust** – eye or respiratory injury.
- **Blade breakage** – broken blade fragments may strike operator.
- **Improper setup** – increases risk of binding, poor cut, or accidents.

### **Before Operation**

#### **PPE**

- Safety glasses or face shield (mandatory).
- Hearing protection if noise levels are high.
- Dust mask or respirator when cutting materials that generate fine dust.
- No loose clothing, jewelry, or gloves. Long hair must be tied back.

#### **Machine Setup**

- Adjust blade guard to within  $\frac{1}{4}$  inch of the workpiece.
- Use the correct blade type and tooth pitch for the material.
- Ensure workpiece is flat and stable before cutting.

- Check blade for tightness.

### Operation

- Keep hands at least 3 inches away from the blade; use a push stick or push block for small stock.
- Feed material at a steady rate, do not force it into the blade.
- Do not back out of a cut while the saw is running unless absolutely necessary; if required, stop the saw first.
- Maintain balanced footing and firm control at all times.
- Never reach across or around the blade.

### After Operation

#### Machine Shutdown

- Turn off the saw and wait until the blade comes to a complete stop before removing cut-offs or making adjustments.
- Clean the work area, removing sawdust and scrap pieces.
- Report any unusual vibrations, noises, or blade issues to a supervisor immediately.

#### Emergency Procedures

- In case of blade breakage or abnormal operation: Turn off the saw immediately and stand clear until the blade stops.
- For injuries: **Stop the machine, call for help, and follow site-specific first aid protocols.**



## Tools - CNC Mill



### Potential Hazards:

- Moving parts (spindles, cutters, tool changers) can cause severe injury.
- High-speed cutting tools can eject chips and broken fragments.
- Electrical hazards from machine wiring and controls.
- Noise exposure during machining.
- Slips and trips from coolant, chips, and oil on the floor.

### Before Operation

#### PPE

- ANSI Z87.1 safety glasses with side shields (mandatory).
- Face shield when setting up or handling sharp tooling.
- Hearing protection if noise levels exceed safe limits.
- Closed-toe, non-slip shoes; steel-toe boots recommended.
- No loose clothing, jewelry, or gloves near rotating tools.
- Long hair tied back and secured.

#### Machine Inspection and Preparation

- Review setup sheet, tool list, and CNC program.
- Inspect machine for damage, loose covers, or leaks.
- Verify that guards, interlocks, and emergency stops function correctly.
- Ensure all fixturing devices are secure.
- Load and secure cutting tools in proper holders.
- Check the coolant level and type.
- Clear the table of unnecessary tools and materials.

#### Operation

- Power up machine following manufacturer's instructions.
- Load program and verify tool paths via simulation (dry run).
- Run machine at reduced feed/speed during first piece verification.
- Keep all machine guards closed during operation.
- Never reach inside the machine while spindle or tool is moving.
- Stop the machine immediately if unusual noise, vibration, or tool breakage occurs.

- Do not bypass or disable interlocks or safety devices.
- Remain alert. Never leave a CNC mill unattended during critical operations.

### **After Operation**

#### **Machine Shutdown**

- Stop spindle, coolant, and motion before opening machine doors.
- Remove part and tooling only after all movement has stopped.
- Clean chips, coolant, and debris using a brush or vacuum, never use hands or compressed air directly.
- Return tools, holders, and fixtures to their storage locations.
- Wipe down work area and mop spills to prevent slip hazards.
- Power down machine according to shutdown procedure.
- Record job completion and any issues in the maintenance log.

#### **Training Requirements**

- Completion of CNC mill operator training program.
- Demonstrated ability to load, simulate, and run programs safely.
- Annual retraining and refresher on emergency shutdown and PPE use.

## Tools - CNC Router



Operating a CNC router involves precision and adherence to safety protocols to prevent accidents and ensure efficient machining. Here's a comprehensive guide to safely using a CNC router.

### Before Operation

#### PPE

- Wear safety glasses or goggles to protect against flying debris.
- Hearing protection is crucial due to the noise generated by the CNC router.
- Depending on the material being machined, a dust mask or respirator may be necessary to prevent inhalation of harmful particles.

### Machine Inspection and Preparation

- Inspect the CNC router for any signs of damage or wear, particularly on the cutting tools and the spindle.
- Ensure all moving parts are lubricated and free from obstruction.
- Check that the workpiece is securely clamped to the machine bed to prevent movement during operation.
- Verify that the dust collection system is connected and functional to manage sawdust and debris efficiently.

### Software Setup

- Load the correct program for your project into the CNC router's control software.
- Double-check the tool paths and settings for accuracy against your project requirements.
- Perform a dry run without the cutting tool engaged to verify the path and ensure there are no errors in the programming.

### During Operation

#### Operating the CNC Router

- Stay clear of the machine bed while the router is in operation. Moving parts and debris can cause injury.
- Monitor the operation closely without interfering directly. If an emergency arises, use the emergency stop button to halt the machine immediately.
- Adjust feed rates and spindle speeds according to the material being machined and the type of cutting tool used.

- Double-check the tool paths and settings for accuracy against your project requirements.

## **Focus and Awareness**

- Maintain a high level of focus and avoid distractions. The CNC router should never be left unattended while in operation.
- Be aware of emergency shutdown procedures and the location of emergency stop buttons.

## **Safe Practices**

- Never attempt to adjust the workpiece or change tools while the machine is running.
- Keep hands and other body parts away from moving parts during operation.
- Regularly check the condition of cutting tools. Dull or damaged tools can break or cause the machine to malfunction.

## **After Operation**

### **Machine Shutdown**

- Turn off the CNC router and wait for all moving parts to come to a complete stop before leaving the machine or starting post-operation procedures
- Disconnect the router from the power source if maintenance or repair is required.

### **Clean-Up and Maintenance**

- Clean the machine and work area of all debris and dust. A clean machine is essential for accurate operation and extends the life of the equipment.
- Inspect tools and bits for wear and replace them as necessary.
- Perform regular maintenance checks as recommended by the manufacturer, including checking for loose components and ensuring that the spindle and axes move smoothly.

### **Documentation**

- Log the operation details, including any issues encountered and how they were resolved. This can help in troubleshooting future operations and maintaining a record for maintenance purposes.

## Tools - Drill Press

A drill press can drill holes of various sizes in wood, metal, and other materials. They can be floor or tabletop mounted and consist of a base, column, table, spindle, and drill head. All types have a feed lever to move the head vertically and some have speed control to adjust for the material being used. Whenever able, choose the speed appropriate to the material. The table can also be adjusted vertically as needed to accommodate the project.



### PPE

- Obtain training and authorization.
- Wear safety glasses or goggles to protect your eyes from flying debris.
- Use hearing protection if working in an environment with constant loud noise.
- Remove loose clothing, jewelry, and secure long hair to prevent entanglement in moving parts.

### Before Operation

- Inspect the drill press for any damage or wear. Check the chuck and bit for tightness and condition.
- Ensure the drill press is securely anchored to the floor or workbench.
- Select the correct drill bit for your material and secure it properly in the chuck.
- Adjust the table or workpiece to the correct height, ensuring it is firmly locked in place and that you won't drill into it.

### Work Area Preparation

- Keep the floor around the drill press clean and free of oil, grease, and scrap material to prevent slips and trips.
- Ensure adequate lighting and ventilation in the work area.

### During Operation

- Use a clamp or vise to securely fasten the workpiece to the table. Never hold the workpiece by hand while drilling.
- Adjust the speed according to the material and drill bit size. Refer to the drill press manual for recommended speeds.
- Use the feed handle to apply steady pressure. Do not force the drill bit into the workpiece; let the tool do the work.
- Keep hands and fingers away from the rotating drill bit.

### **Focus and Awareness**

- Stay focused on the drilling task. Do not be distracted or engage in conversation while operating the drill press.
- Be aware of the location of the emergency stop button or switch.

### **Safe Practices**

- Do not attempt to remove chips or cuttings from the drill bit or workpiece while the machine is running. Use a brush or other tool to clear away debris after the machine has stopped.
- Never reach over or across the rotating drill bit.
- If the drill bit binds in the workpiece, turn off the drill press immediately and carefully remove the bit from the workpiece.

### **After Operation**

- Turn off the drill press and wait for it to come to a complete stop before making adjustments or removing the workpiece.
- Disconnect the drill press from the power source if maintenance or repair is required.

### **Clean-Up**

- Clean the drill press and surrounding area. Remove all chips, dust, and debris.
- Return all tools and accessories to their designated storage areas.

### **Maintenance**

- Perform regular maintenance checks as recommended by the drill press manufacturer. This includes lubricating moving parts, checking for loose bolts, and ensuring safety guards are in place and functional.

## Tools - Grinders (Angle, Die, Rotary Tools)

### Angle Grinders

Due to their power and the nature of tasks they perform, angle grinders warrant additional caution. Use a guard at all times and be aware of kickbacks. Only use discs rated for the grinder's RPM and for the material you are working with. Use both hands for better control and stability.



### Die Grinders and Rotary Tools (Dremel)

When using die grinders, especially with metal, be mindful of sparks and metal shavings. Work in a well-ventilated area away from combustible materials. When using rotary tools for detailed work, ensure a stable work surface and consider using a flexible shaft attachment for intricate tasks.

### PPE

- Wear safety glasses or goggles to protect eyes from flying debris.
- Ear protection is recommended to guard against noise.
- Dust masks or respirators should be used when generating significant dust.
- Use gloves for grip and protection but ensure they are tight-fitting to avoid getting caught in moving parts.

### Before Operation

- Inspect the tool for damage or wear before use. Check cords, batteries, and accessories.
- Ensure the work area is clean, well-lit, and free of flammable materials.
- Securely clamp down the workpiece to prevent movement.

### Operation

- Select the appropriate bit or accessory for the material and task at hand.
- Keep hands and body parts away from rotating parts and cutting edges.
- Apply steady pressure without forcing the tool. Let the tool do the work.
- Turn off the tool and wait for all moving parts to stop before setting it down.

### After Operation

Disconnect the tool from the power source before changing accessories or performing maintenance. Clean the tool and work area removing dust and debris and then, store the tool and accessories in a safe, dry place.

### Additional Safety Tips

Always use the tool at the correct speed setting for the material. Be mindful of the potential for entanglement with loose clothing or long hair. Understand the specific risks associated with the material you are working on, such as toxic dust from certain types of wood or metal. Maintain a firm grip and body control to manage torque or kickback.

## Tools - Lathe

### Potential Hazards:

- **Entanglement:** Loose clothing, jewelry, and hair can be pulled into rotating parts.
- **Flying Objects:** Workpieces, chips, or broken tools may eject at high speeds.
- **Hot Surfaces/Chips:** Cut materials and swarf can cause burns or cuts.
- **Noise:** Prolonged exposure may require hearing protection.



### PPE

- ANSI-approved safety glasses or face shield (mandatory).
- Hearing protection when required.
- Close-fitting clothing; no loose sleeves, jewelry, or lanyards.
- Non-slip, closed-toe footwear.
- Tie back or cover long hair.
- No long sleeves

### Operation

- Ensure the workpiece and tool are securely clamped before starting.
- Remove chuck keys, wrenches, and gauges immediately after use.
- Always check spindle speed before engaging the machine.
- Keep hands a safe distance from rotating parts—never touch a spinning workpiece.
- Use proper cutting tools and maintain them sharp and secure.
- Stand to the side when starting the lathe to avoid debris or part ejection.
- Use guards and shields whenever possible.
- Stop the lathe completely before making adjustments, measurements, or cleaning.

### After Operation

- Turn off and lock out the lathe when not in use.
- Remove tools and clean chips with a brush (never hands or compressed air).
- Wipe down and return the machine to a safe, clean condition.

### Training Requirements

- Complete lathe safety training.
- Demonstrate competency under supervision before independent use.
- Renew authorization periodically or after extended non-use.

## Tools - Liquid Fuel

Liquid fuel-powered equipment and tools are usually powered by gasoline or a gas and oil mixture. Examples of liquid fuel tools include lawn mowers, leave blowers, chain saws, and pressure washers. Like any other tool, improper use can present serious hazards, so it is important to follow the manufacturers' instructions for proper use. The most common hazards are burns and dangerous exhaust fumes. Proper ventilation, PPE and fuel handling are necessary for safe operation.

### Safety Guidelines:

- Shutdown and allow the engine to cool before refilling a fuel tank.
- Keep a fire extinguisher nearby while working.
- Wear PPE during operation to protect hearing, eyes, face, arms and hands.
- Ensure that all fuel is stored in approved flammable containers.
- This equipment should never be operated indoors due to ventilation concerns regarding carbon monoxide.



## Tools - Milling Machines



Milling is the process of removing material from a workpiece by feeding it into a rotating cutter at a chosen direction. When using a manual mill the operator turns handles that feed the workpiece into the rotating cutter along the X, Y, and Z axes. The process of milling can shave down surfaces, cut pockets, cut angled chamfers and drill holes.

### PPE

- Safety glasses with side shields **shall be worn at all times**.
- Face shields shall be used when there is increased risk of flying chips.
- Hearing protection shall be worn where noise levels require it.
- Long hair must be tied back; no jewelry, gloves, neckties, or loose garments.

### Before Operation

- Inspect the mill for damage, ensuring the emergency stop is operational.
- Ensure guards and shields are in place and functional
- Verify correct tooling for the material and operation.
- Ensure the work area is clean, dry, and free of obstructions.
- Remove chuck keys, wrenches, and setup tools before starting the machine.
- Never hold work by hand. Workpieces **must be securely clamped** using:
  - Vises, clamps and t-slots, or fixtures designed for milling.
- Never bypass guards or safety devices.
- Ensure tools are properly seated and tightened.
- Use the shortest tool length practical to minimize deflection.

### During Operation

- Set correct spindle speed and feed rate **before** starting the machine.
- Keep hands clear of rotating cutters and moving parts at all times.
- Use brushes or to remove chips, **never hands or compressed air**.
- Lock unused axes to prevent unintended movement.
- Do not leave the machine unattended while running.
- Stop the spindle before changing tools, measuring or making adjustments.
- Be alert to unusual vibration, noise, or tool chatter.
- Use coolant or cutting fluid as required and in accordance with shop policy.
- Avoid excessive depth of cut or feed rates

### After Operation

- Return tools, clamps, and accessories to proper storage after use.
- Wipe down machine surfaces when finished.
- Clean chips only after the spindle has stopped.

## Tools - Miter (Chop) Saw

Miter saws, also known as “chop saws”, are designed for making straight and angled cuts in wood and other materials. Here are key safety instructions.

### PPE

- Wear safety glasses or goggles to protect against flying debris.
- Use ear protection due to the high noise levels.
- Dust masks are recommended, especially when cutting materials that generate harmful dust.

### Before Operation

- Inspect the saw for damage or wear, particularly the blade and safety guards.
- Ensure the work area is clean, well-lit, and free of obstructions.
- Securely clamp the material to be cut, ensuring it cannot move during the cutting process.



### During Operation

- Keep hands and fingers well away from the blade's path.
- Use the saw's handle to lower the blade smoothly through the material without forcing it.
- Wait for the blade to reach full speed before beginning the cut and allow it to stop completely before lifting the saw.

### After Operation

- Disconnect the chop saw from the power source before changing blades or performing maintenance.
- Clean the saw and work area, removing all sawdust and debris

## Tools - Panel Saw



### Potential Hazards

- **Contact with the Blade:** Risk of severe cuts or amputations if hands or body parts come into contact with the saw blade.
- **Kickback:** Sheets can bind or be thrown back toward the operator.
- **Flying Debris:** Chips, dust, or broken material may cause eye or skin injuries.
- **Noise Exposure:** Prolonged use may cause hearing damage.
- **Dust Inhalation:** Wood dust and composite board particles can irritate lungs and may be carcinogenic.
- **Ergonomic Hazards:** Handling large or heavy panels can cause strains, sprains, or crush injuries.
- **Electrical Hazards:** Risk of shock or fire if wiring or power supply is faulty

### Before Operation

#### PPE

- Safety glasses with side shields (or face shield for cutting composite panels).
- Hearing protection.
- Dust mask or respirator when cutting MDF, particleboard, or similar materials.
- Gloves only when handling materials, never while cutting.

#### Setup

- Inspect blade for sharpness, cracks, or damage; replace if necessary.
- Verify guards, riving knife (if equipped), and safety interlocks are in place and functioning.
- Confirm dust extraction system is on and operational.
- Ensure work area is clean, dry, and free of obstructions.

#### Operation

- Always keep hands clear of the blade and cutting path.
- Use push sticks, guides, or clamping systems to move material—never force material through.
- Stand to the side of the cutting line to reduce kickback risk.
- Cut only one sheet at a time.
- Maintain control of large panels with a second person if necessary.
- Never reach across the saw while it is running.
- Do not disable safety devices or interlocks.

#### Machine Shutdown

- Power off the saw and wait for the blade to come to a complete stop before removing cut pieces or cleaning.
- Disconnect power supply before changing blades or performing maintenance.

## Tools - Pneumatic (nail and staple guns)



For nearly every hand and power tool there is a pneumatic (air powered) counterpart. The primary pneumatic tools encountered in shops are staplers, brad and finish nailers. They can greatly decrease the time needed to fasten pieces during assembly. However, they can also easily fire projectiles across a room if used improperly.

### Personal Protective Equipment (PPE)

- Eye Protection: Always wear safety goggles or a face shield to protect your eyes from flying debris, nails, or fasteners.
- Hearing Protection: Use earplugs or earmuffs to protect your hearing from the noise produced by pneumatic tools.
- Hand and Body Protection: Wear durable work gloves to protect your hands. Avoid loose clothing, jewelry, and tie back long hair to prevent entanglement in moving parts.

### Pre-Use Inspection

- Tool Condition: Inspect the pneumatic tool before each use. Check for signs of wear, damage, or malfunction, such as cracks or missing components. Make sure all screws and fasteners are secure.
- Air Hose and Connections: Check the air hose for leaks, cracks, or wear. Ensure that all connections between the tool and air compressor are secure and undamaged.
- Compressor Settings: Ensure the air pressure does not exceed the tool's maximum operating pressure. Over-pressurization can cause the tool to malfunction or result in serious injury.



### Operating Procedures

- Correct Air Pressure: Set the air compressor to the appropriate pressure level recommended for the specific tool. Never exceed the tool's rated air pressure.
- Controlled Operation: Maintain a firm grip on the pneumatic tool while operating. Keep hands, fingers, and other body parts away from the trigger and discharge area when not in use.

- **Tool Activation:** Only engage the trigger when the tool is properly positioned against the workpiece. Avoid dry firing the tool, as this can cause damage and create safety hazards.
- **Trigger Control:** Be cautious when using tools with contact trip triggers. Use sequential triggers where possible to reduce the risk of accidental discharge.

## Avoiding Hazards

- Never hold a piece of material directly behind or immediately next to where you are nailing/stapling. Unseen knots or defects can cause fasteners to bend and change direction causing them to exit the material in an unexpected location. You also run the risk of puncturing fingers or hands if the incorrect length of fastener is used.
- **Disconnect Power When Not in Use:** Always disconnect the pneumatic tool from the air supply before changing accessories, performing maintenance, or leaving the tool unattended.
- **Hose Management:** Keep the air hose out of high-traffic areas and ensure it is not kinked or twisted. This helps prevent trips and falls, as well as accidental tool activation.
- **Fastener Safety:** When using nailers or staplers, never point the tool at yourself or others, even if it is disconnected. Ensure that no one is in the line of fire before operating.
- **Routine Maintenance:** Follow the manufacturer's guidelines for routine tool maintenance, including lubrication and cleaning. Regularly inspect the air compressor, hoses, and tool for wear or damage.

## AIR TOOLS AVERAGE AIR REQUIREMENTS

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Tool	CFM	Tool	CFM
Nailer, framing	9	Impact wrench, 1/2"	4
Nailer, roofing	5	Impact wrench, 3/4"	10
Nailer, finish	6	Angle grinder	9
Nailer, brads	1.5	Orbital sander	6
Stapler, sheathing, decking	7	Straight-line sander	8
Stapler, roofing	4.5	Needle scaler	6
Spray gun, 15 to 50 psi	3		
Spray gun, 40 to 85 psi	10		

Note: CFM requirements vary widely depending on usage and manufacturer. Actual requirement may be less, especially with tools like nailers and staplers where hits per minute determine air requirements.

## Tools - Radial Arm Saw

Radial arm saws are versatile tools for crosscutting, ripping, and more intricate cuts. Due to their complexity, they require strict adherence to safety guidelines.

### PPE

- Safety glasses or goggles are essential to protect from flying particles.
- Hearing protection should be used to minimize noise exposure.
- Dust masks are advisable to avoid inhalation of sawdust.



### Before Operation

- Check the saw for any signs of damage especially, the blade, guards and the arm's adjustment mechanisms.
- Make sure the cutting area is clear of obstructions and that the workpiece is securely fastened.
- Verify the blade is appropriate for the material and type of cut.

### During Operation

- Maintain a firm stance and keep your body to the side of the blade path to reduce risk in case of kickback.
- Control the saw's arm with both hands when making cuts to ensure stability and accuracy.
- Never reach under the blade while it is spinning, and avoid cross-arm cutting, which places your arm over the blade's path.

### After Operation

- Turn off the saw and wait for the blade to come to a complete stop before making adjustments or removing the workpiece.
- Disconnect the saw from the power source before changing the blade or performing any maintenance.
- Clean the saw, especially the guard and blade, to ensure it remains in good working condition.

### General Safety Practices

- Regularly inspect and maintain the saws to ensure they are in safe working order.
- Always use the saws for their intended tasks, adhering to the manufacturer's guidelines.
- Keep the work area clean and free of tripping hazards.
- Understand and practice emergency stop procedures.

## Tools - Router

Routers are versatile tools capable of various tasks, including shaping edges, cutting grooves, dados, and creating intricate joinery. It can also be used for decorative carving, template routing, and can come with a variety of bases for different tasks.



### PPE

- **Eye Protection:** Always wear safety goggles or a face shield to protect your eyes from wood chips, dust, and debris.
- **Hearing Protection:** Use earplugs or earmuffs to protect your hearing from the high noise levels produced by routers.
- **Respiratory Protection:** Wear a dust mask or respirator to prevent inhaling wood dust, which can be harmful over time.

### Pre-Use Inspection

- **Router and Bits Check:** Inspect the router for any damage or wear before use. Ensure that the power cord and switch are in good condition. Check the router bit for sharpness, cracks, or defects. Replace any damaged bits immediately.
- **Workpiece:** Check the material for defects and obstructions that could damage bits.

### Safe Work Environment

- **Work Area Preparation:** Ensure that your work area is clean, well-lit, and free of clutter. Avoid working near flammable materials, as routers can produce sparks.
- **Stable Workpiece:** Secure the workpiece firmly using clamps or a bench vise to prevent movement while routing.

### Operating the Router

- **Correct Positioning:** Hold the router firmly with both hands to maintain control. Keep a stable stance with feet shoulder-width apart for balance.
- **Router Direction:** Always move the router against the rotation of the bit (typically counterclockwise for outside edges) to maintain control and avoid kickback.
- **Speed Control:** Adjust the router speed according to the material and bit size. Larger bits should be used at lower speeds to prevent overheating or damage.
- **Start and Stop Safely:** Always turn off and unplug the router before changing bits or making adjustments. Wait for the router to stop completely before setting it down after use.

### Avoiding Hazards

- **Kickback Prevention:** Keep the router bit in motion to avoid the risk of kickback. Never force the router through the material; let the tool do the work.
- **Changing Bits:** Bits are often very hot after use. Avoid burns by allowing them to cool down or by wearing gloves.
- **Cable Management:** Keep the power cord out of the way and clear from the cutting area to prevent accidents or damage.
- **Avoid Loose Clothing and Jewelry:** Ensure that long hair, loose clothing, and jewelry are secured to prevent them from getting caught in the rotating router bit.

## Tools - Sandblaster

Bead blasting is the process of forcibly propelling a stream of abrasive material against a surface under high pressure to smooth a rough surface, roughen a smooth surface, or remove surface contaminants.



### Primary Hazards

- **Airborne Particulates:** Respiratory injury from silica, metal dust, abrasive media, and coatings.
- **High-Pressure Abrasive Stream:** Can cut skin, damage eyes, and penetrate clothing. If gloves or seals are damaged, do not use the cabinet.
- **Noise Exposure:** Long-term hearing loss from compressor and blasting noise.
- **Exposure to Chemicals or Coatings:** Old paint, rust, and coatings may contain hazardous substances. Do not use media contaminated with oil, moisture, or unknown substances.
- **Ergonomic Hazards:** Repetitive gripping, awkward posture, and vibration may cause fatigue or strain.

### Required PPE

- **Respiratory Protection:** NIOSH-approved respirator (minimum P100; supplied-air respirator if using silica or blasting in open-air).
- **Eye/Face Protection:** Full-face shield or blasting hood with safety-rated lens.
- **Hearing Protection:** Earplugs or earmuffs.
- **Hand Protection:** Heavy gloves rated for abrasion use.
- **Body Protection:** Long sleeves, closed-toe shoes, and protective clothing rated for blasting.

### Before Use

- Inspect cabinet seals, gloves, window and hoses for leaks or damage.
- Verify dust collection or ventilation system is functioning.
- Confirm abrasive media type and compatibility with material.
- Confirm air pressure regulator is functioning and set to approved ranges

### During Operation

- Keep both hands inside the cabinet gloves while machine is running.
- Keep the nozzle at a controlled distance (typically 4–12 inches depending on surface and media).
- Never direct the nozzle at the cabinet window, lighting or gloves

- Stop blasting if the cabinet becomes clouded, allow dust collection to clear the chamber.

#### **After Use**

- Shut off air supply and depressurize before opening the cabinet or removing the nozzle.
- Allow dust to settle before opening cabinet doors.
- Collect waste media and dispose of according to shop environmental procedures.

#### **Environmental & Housekeeping Requirements**

- Operate only in designated blasting booths or cabinets.
- Keep the floor free of spilled media to prevent slips.
- Store media in labeled, sealed containers away from moisture.

## Tools - Sanders (Vertical and Horizontal)

### Horizontal / Vertical Sander

Using a horizontal sander safely is crucial to prevent accidents and ensure a smooth operation. Here are safety instructions tailored for the use of a horizontal sander.

#### Before Operation

##### PPE

- Wear safety glasses or goggles to protect your eyes from sanding debris.
- Use hearing protection to guard against prolonged exposure to noise.
- Dust masks or respirators are recommended to prevent inhalation of dust particles.
- Remove loose clothing, jewelry, and ensure long hair is tied back to avoid entanglement with the sander.



##### Inspection and Preparation

- Check the horizontal sander for any signs of damage or wear. Ensure the sanding belt is properly secured and in good condition.
- Verify that all guards are in place and securely attached.
- Ensure the work area is clean, well-lit, and properly ventilated to manage dust.
- Confirm the sander is securely mounted or clamped to a stable work surface.

##### Workpiece Preparation

- Inspect the material to be sanded for any metal objects like nails or staples that could damage the sanding belt or cause injury.

#### During Operation

##### Operating the Sander

- Turn on the dust collection system if available to minimize airborne dust particles.
- Start the sander before making contact with the workpiece.
- Gently feed the workpiece against the motion of the sanding belt. Do not force the material; let the sander do the work.
- Keep fingers and hands away from the sanding belt while the machine is in operation.
- Use push sticks or holders for small pieces to keep hands at a safe distance from the sanding surface.

## Focus and Awareness

- Stay focused on the sanding task. Avoid distractions and be mindful of your hand placement at all times.
- Be aware of the direction of the sanding belt's movement to feed the workpiece accordingly and prevent kickback.

## Safe Practices

- Never leave the sander running unattended. Turn it off if you need to step away, even for a short period.
- Do not attempt to sand small pieces without proper holding devices.
- Avoid adjusting the machine or changing sanding belts while the sander is running.

## After Operation

### Power Down

- Allow the sander to come to a complete stop before turning it off.
- Disconnect the sander from the power source if performing maintenance or changing the sanding belt.

### Clean-Up

- Clean the machine and surrounding area of all dust and debris after use. Use a vacuum or dust collection system to remove dust particles.
- Inspect the sanding belt for wear or damage and replace if necessary.

### Maintenance

- Regularly check the sander for loose components, damaged belts, and ensure guards are intact and functional.
- Lubricate moving parts as recommended by the manufacturer to keep the sander in good working condition.

## Additional Considerations for Vertical Sanders

- Vertical Space: Ensure there is adequate vertical space above the sander for the size of the pieces being worked on.
- Many vertical sanders allow the table angle to be adjusted. Ensure this is set correctly for your task and securely locked before beginning.
- When using the sander for edge work, ensure the workpiece is firmly supported against the table or work support.

## Tools - Saws - General

Common within all work areas of the shop is the use of various types of saws, such as table saws, circular saws, jig saws, and hand saws. All employees must receive documented training before operating any type of saw. Using a saw can be extremely dangerous if safe and proper operating procedures are not learned and followed.



### Wear the proper PPE

Proper PPE consists of safety glasses, goggles, and when necessary, a face shield. Reminder: Face shields alone **do not** qualify as wearing appropriate eye protection. It is also possible to get chips from below. This makes wearing goggles a necessity. Even if you are not operating power tools and woodworking machines, always wear hearing protection. Wear tight-fitting work gloves only when handling materials. Never wear gloves while working with power tools.

Appropriate shop attire must be worn when using hand and/or power tools including full-length pants (or equivalent) and closed-toe shoes. In addition to the codes of safe practices for specific types of saws, here are some general safety guidelines.

- Obtain training and understand the device in use.
- Always talk to your instructor or supervisor if you discover a faulty machine or tool or if you are not fully qualified to operate the machine or tool.
- Remove rings, watches, necklaces, other jewelry, and loose clothing and leave them in your locker or bag.
- Restrain long hair to keep it away from machinery, tools, and points of operation. This is vital as fatalities have occurred from long hair getting caught in rotating equipment.
- Inspect tools and machinery prior to starting to ensure they are safe to use.
- Immediately lockout and tagout damaged machinery and power tools and report it to your supervisor. For additional information regarding lockout and tagout, read the [\*\*CWRU Lockout/Tagout Policy\*\*](#) for more information.
- Shut off and disconnect all power tools and machinery from their power source prior to making adjustments or changing out components; wait for the machine/tool to come to a complete stop.
- Never leave machinery or power tools running unattended.
- Sweep up and clean away sawdust and scraps as needed throughout the work process to keep the floor free of slip, trip, fall hazards and the work area clean. Sweep and clean again prior to leaving the area.
- Keep saws in good condition, making sure they are sharp and clean for optimal performance. Follow manufacturer instructions for lubricating and changing accessories.
- Never operate the saw while under the influence of drugs, alcohol, or medication that could impair your judgment or motor skills.

## Tools - Water Jet



A waterjet cutter uses a stream of water pressurized and forced through a small nozzle to cut materials. For harder materials, fine abrasive particles (commonly garnet) are mixed with the water stream, creating a high-velocity slurry that can cut metals, stone, glass, and composites with extreme precision.

### **Potential Hazards:**

- **High-Pressure Injury:** Even a pinhole leak in a pressurized line can penetrate skin and cause life-threatening internal injuries.
- **Flying Debris:** The cutting process can eject fragments of material and abrasive at high speed.
- **Noise Exposure:** The system can exceed safe decibel levels, requiring hearing protection.
- **Slip and Fall Risks:** Water, sludge, and abrasive can make the floor slippery.
- **Dust and Fumes:** Some materials may release hazardous particles or fumes when cut.
- **Electrical Hazards:** Water and electrical systems in close proximity increase shock risk.

## Before Operation

### PPE

- Safety glasses with side shields (ANSI Z87.1) at all times.
- Face shield when operating with cover open (if applicable).
- Hearing protection (earplugs or earmuffs).
- Cut-resistant gloves when handling materials.
- Steel-toe shoes/boots.
- Protective apron/coat when handling abrasive material.

### Machine Inspection and Preparation

- Complete training and log usage
- Inspect machine for leaks, cracks, or damaged components.
- Verify all emergency stop buttons are functional.
- Ensure abrasive hopper is filled and secured.
- Confirm that the water catch tank is at proper level.
- Secure the workpiece firmly to prevent shifting.
- Remove all unnecessary tools and objects from cutting area.

## During Operation

### Operating the waterjet

- Load the part file into the control system.
- Verify tool path and simulate before running.
- Close safety covers/guards before activating the waterjet.
- Start the cut from the operator console—never by reaching inside the cutting area.
- Monitor operation continuously. Do not leave the water jet unattended
- Do not bypass or override interlocks or safety switches. If any are found to be non-functioning, immediately shutdown and take the machine out of service until interlocks and safeties can be repaired and shown to be functional.
- If abnormal sounds, leaks, or vibration occur: press Emergency Stop immediately.

## After Operation

### Machine Shutdown

- Power down the system per manufacturer's instructions.
- Remove cut parts only after the waterjet head has stopped and pressure is released.
- Clean the cutting bed and surrounding area (sludge, abrasive, scrap).
- Log usage time, material type, and any issues in the equipment logbook.
- Store PPE and return the workspace to a safe condition.

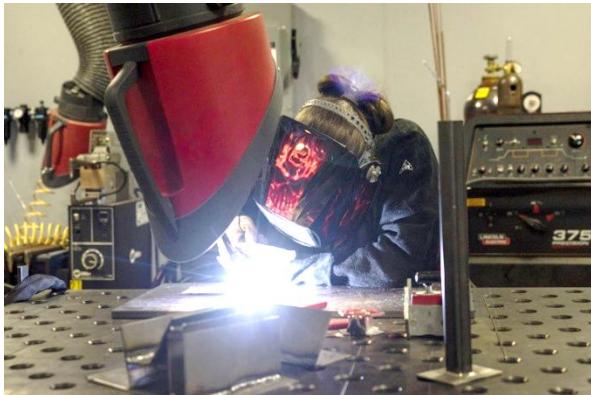
### Documentation

OSHA General Duty Clause (29 U.S.C. § 654)

ANSI B11.0 Safety of Machinery

Manufacturer's Operating Manual

## Tools - Welding/Brazing/Soldering



Welding, brazing, and soldering are essential techniques used at all levels across the university from experiments to plumbing work. Welding, which typically uses high heat to fuse metals, is often used for larger, load-bearing pieces, while brazing involves joining metals using a filler material that melts at a lower temperature than the base metals. Soldering is similar to brazing but is generally

for more delicate work such as electronics or small parts. Both processes require strict safety protocols due to the risks of burns, fumes, and eye injuries. Students and employees must be properly trained to be authorized to do any of this work.

### General Guidelines

- Use appropriate PPE for each task, leathers, gloves, fire retardant jackets, welding helmets.
- Inspect all equipment before use, checking for leaks, openings, and that self-shading lenses are functional.
- Require shaded goggles or welding helmets for anyone that might be observing the welding process.
- Shield the welding area with non-combustible materials or screens to protect adjacent workers from infrared rays.
- Conduct welding, soldering and cutting operations in well-ventilated areas that have been made fire safe and with 35' of clear space.
- Maintain a fire watch whenever cutting, welding, or soldering and ensure they have a suitable extinguisher ready for use.
- Do not consume or store food or drinks in the welding area.
- When work has been completed, thoroughly clean hands with soap and water.

### Arc Welding

- Always turn off the welder and disconnect the power source when not in use or when leaving the work area.
- Never unplug a machine while it is in the “on” position.
- Remove electrodes from the holders when leaving the work area.
- Avoid welders flash or “arc eye” by wearing the appropriate filter lens. Ensure observers completely cover their skin to avoid ultraviolet burns.
- Avoid accident arcs by being aware of your surroundings and proximity to material that may complete welding circuit.