

# **k e l l r o b o t i c s**

## **Safety Manual**

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## Accident Reporting

An accident is an unplanned occurrence that may result in damage to people, property, equipment, or the environment. When accidents are reported promptly, the injured person can receive timely medical care and unsafe conditions receive prompt corrective action. The team mentors will investigate accidents to identify accident trends, determine the effectiveness of current safety programs, and prevent future accidents.

***IMPORTANT:***

*Report all accidents to a teacher or mentor.*

Report unsafe conditions or potentially hazardous situations to a teacher or mentor as quickly as possible.

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## Dress Code

Dress in a manner that does not impair safety. Loose clothing, long hair, dangle jewelry, and sandals may be dangerous around moving equipment.

Always wear clothing that is appropriate for your job. Refer to the chapters on Personal Protective Equipment for more information.

## Hearing Conservation Program

Excessive noise levels may permanently or temporarily damage a person's hearing. Whenever possible, team members should reduce noise levels to an acceptable level. The following table outlines OSHA limits for acceptable noise exposure indicated as decibels (dB).

Duration/Day (Hours)	Sound Level (dB)
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/4 or less	115

**Hearing loss can be permanent — wear protective equipment when noise levels are high.**

Before using personal protective equipment, such as ear plugs or muffs, to reduce noise exposure, try to reduce noise levels by changing work procedures. Maintenance practices such as the following can reduce noise levels:

- Replacing worn or loose machine parts
- Performing high-noise operations during hours when people are less likely to be affected
- Maintaining and lubricating equipment to eliminate rattles and squeaks

Engineering controls, such as the following, can also reduce noise levels:

- Replacing noisy materials
- Using large, low speed fans
- Considering the noise level of new equipment or processes before purchasing or implementing
- Placing heavy machines on rubber mountings
- Using sound-absorbing acoustical tiles or baffles
- Placing noisy machinery or operations in a separate area or room
- Enclosing noisy conveyors

Areas that may require hearing protection include machine shops, the power plant, etc. Observe all warning signs and wear hearing protection whenever necessary. Do not interfere with, remove, or modify noise abatement equipment. Keep all equipment properly maintained, and report any malfunctions immediately.

Refer to the chapter on Personal Protective Equipment for more information on hearing protection. Direct all questions regarding hearing conservation to the Environmental Health & Safety Department. When requested and necessary, the Environmental Health & Safety Department monitors noise levels.

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## Housekeeping

Good housekeeping skills are essential for personal safety. Team members and mentors are responsible for reducing potential hazards and keeping their work areas safe and clutter-free. Good housekeeping guidelines include keeping aisles and stairways free from clutter, cleaning spills, minimizing combustibles in workplace and storage areas, and keeping all exits free from obstructions.

Maintain clear and unobstructed access to emergency equipment, such as fire extinguishers, pull stations, eye wash units, etc.

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## Lifting

All team members must use proper lifting techniques to avoid injury when lifting heavy objects. In general, team members should seek assistance when lifting objects that weigh 50 pounds or more. Use your good judgement to determine if you need assistance, a dolly, back support belt, or other tool to safely lift an object.

The back supports the weight of the entire upper body. When you lift objects or move heavy loads, your back has to support even more weight. If you exceed your body's natural limits, your back cannot support both your body and the extra load. The excess, unsupported pressure is transferred to the lower back, where injury is imminent. By using the muscles in your arms and legs and exercising proper lifting techniques, you can move loads safely and protect your back from possible injury.

Follow these guidelines to help avoid back injuries:

- Avoid moving objects manually. Plan jobs and arrange work areas so that heavy items may be moved mechanically.
- Keep in good physical condition. If you are not used to lifting and vigorous exercise, do not attempt difficult lifting tasks.
- Think before you act. Use proper lifting techniques and lifting aides such as back support belts, dollies, etc. Get help if you need it.

When lifting heavy objects, follow these steps and refer to the illustration on the following page:

1. Test the object's weight before handling it. If it seems too heavy or bulky, get assistance.
2. Face the object, place one foot behind the object and one foot along its side.
3. Bend at the knees.

4. Get a firm, balanced grip on the object. Use the palms of your hands, and use gloves if necessary.

5. Keep the object as close to your body as possible. (Pull the load in close before lifting.)

6. Lift by straightening your legs and slightly unbending your back.

- If the object is too heavy or bulky, get help.
- Do not twist the back or bend sideways.
- Do not perform awkward lifts.
- Do not lift objects at arm's length.

7. When moving objects, proceed with caution through doors and around corners.

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## Preventing Slips and Falls

It is easy to prevent falling accidents. Team members should always follow good house keeping practices and pay attention to their environment to avoid slips and falls.

In addition, team members should follow these guidelines:

- Turn on office lights. Ensure that passageways are adequately lighted.
- Avoid horseplay.
- Avoid unnecessary haste. Do not run in work areas.
- Use ladders or step-stools to reach high places. Never climb onto air, drawer, or shelves.
- Keep hallways and stairwells neat and free of obstacles.
- Remove items that may pose a potential slipping hazard.
- Clean up spills as soon as they occur.
- Never obstruct your view when walking.
- Do not wear clothing that is too long or shoes that have slippery heels or soles.
- Hold the handrail when using stairs.
- Be careful when walking on wet surfaces or when entering a building while wearing wet shoes.
- Report uneven surfaces, such as loose or missing floor tiles to a team mentor.

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## Visitor Safety

Team members must take special care to ensure visitor safety. This is particularly important when bringing visitors to potentially hazardous areas such as construction sites or laboratories.

**IMPORTANT:** All visitors should be escorted, supervised, *and monitored*.

If a visitor is injured, be sure to report the occurrence to the Environmental Health & Safety Department after attending to the injury.

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## General Safety

Common causes of accidents include the following:

- Slipping, tripping, and falling hazards
- Burning, cutting, and pinching hazards
- Improper lifting and handling techniques
- Unobservant and inattentive team members
- Improper office layout and arrangement
- Dangerous electrical wiring
- Exposure to toxic substances
- Horseplay

The following sections address several office safety practices. Other preventive measures not mentioned here may be necessary also.

Always use common sense when safety is a concern.

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## Good Housekeeping Practices

Many office accidents are caused by poor housekeeping practices. By keeping the office floor both neat and clean, you can eliminate most slipping, tripping, and falling hazards. Other good housekeeping practices include the following:

- Ensure that office lighting is adequate and available. Replace burned out light bulbs, and have additional lighting installed, as necessary.
  - Ensure that electrical cords and phone cords do not cross walkways or otherwise pose a tripping hazard. If you cannot move a cord, have a new outlet installed or secure the cord to the floor with cord covering strips. Do not tape cords down or run them underneath carpet.
  - Report or repair tripping hazards such as defective tiles, boards, or carpet immediately.
  - Clean spills and pick up fallen debris immediately. Even a loose pencil or paper clip could cause a serious falling injury.
  - Keep office equipment, facilities, and machines in good condition.
  - Store items in an approved storage space. Take care to not stack boxes too high or too tight. Ensure that boxes are clearly labeled with their contents.
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## Preventing Cuts and Punctures

Cuts and punctures happen when people use everyday office supplies without exercising care. Follow these guidelines to help reduce the chance for cuts and punctures:

- When sealing envelopes, use a liquid dispenser, not your tongue.

- Be careful when using kitchen knives, scissors, staplers, letter openers, and box openers. Any of these items could cause a painful injury.
  - Avoid picking up broken glass with your bare hands. Wear gloves and use a broom and a dust pan.
  - Place used blades or broken glass in a rigid container, such as a box, before disposing in a wastebasket.
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## Preventing Machine Accidents

Only use machines that you know how to operate. Never attempt to operate an unfamiliar machine without reading the machine instructions or receiving directions from a qualified team member. In addition, follow these guidelines to ensure machine safety:

- Secure machines that tend to move during operation.
- Do not place machines near the edge of a table or desk.
- Ensure that machines with moving parts are guarded to prevent accidents. Do not remove these guards.
- Unplug defective machines and have them repaired immediately.
- Do not use any machine that smokes, sparks, shocks, or appears defective in any way.
- Close hand-operated paper cutters after each use and activate the guard.
- Take care when working with copy machines. If you have to open the machine for maintenance, repair, or troubleshooting, remember that some parts may be hot. Always follow the manufacturer's instructions for troubleshooting.
- Unplug paper shredders before conducting maintenance, repair, or troubleshooting.

Some items can be very dangerous when worn around machinery with moving parts. Avoid wearing the following items around machines within unguarded moving parts:

- Loose belts
  - Jewelry
  - Long, loose hair
  - Long, loose sleeves or pants
  - Scarves
  - Ties
- 

## Preventing Slips and Falls

As outlined in the General Safety chapter of this manual, the easiest way to avoid slips and falls is to pay attention to your surroundings and to avoid running or rushing. To ensure safety for others in the office, however, follow these guidelines:

- Arrange office furnishings in a manner that provides unobstructed areas for movement.
- Keep stairs, steps, flooring, and carpeting well maintained.
- Ensure that glass doors have some type of marking to keep people from walking through them.
- Clearly mark any difference in floor level that could cause an accident.
- Secure throw rugs and mats to prevent slipping hazards.
- Do not place wastebaskets or other objects in walkways.

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## General Shop Safety

The hazards associated with shop work require special safety considerations. Whether you work in a metal shop, wood shop, automotive shop, glass shop, or electrical shop, the potential hazards for personal injury are numerous.

The following table highlights common shop hazards:

Potential Hazards	Hazard Sources
<b>Physical:</b>	
Compressed air/gases	- Oxygen, acetylene, air
- Flying debris	- Grinders, saws, welders
- Noise	- Any power tool
- Pinching, cutting, amputation	- Vises, power tools, hand tools
- Slipping, tripping	- Wood/metal chips, electrical cords, oil, etc.
- UV radiation	- Welding
<b>Electrical:</b>	
- Overload	- Too many cords per outlet
- Fire	- Frayed, damaged cords
- Shock	- Ungrounded tools, equipment
<b>Fire:</b>	
- Flammable chemicals	- Gasoline, degreasers, paint thinners, etc.
- Sparks	- Welders, grinders
- Static sparks	- Ungrounded tools or solvent containers
- Uncontrolled fire	- Lack of appropriate fire extinguishers
<b>Chemical:</b>	
- Toxic liquids	- Cleaning solvents, degreasers, etc.
- Toxic fumes, gases, dusts	- Welding, motor exhaust, etc.

It is not possible to detail all the risks involved with shop work. However, it is possible to foresee many hazards by carefully planning each job. To prevent accidents, utilize your knowledge, training, and common sense. Evaluate potential sources of injury, and attempt to eliminate any hazards.

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## Personal Protection

There are several measures you must take to protect yourself from shop hazards. For example, do not wear the following when working around machinery:

- Loose fitting clothing
- Neckties
- Jewelry

If you must wear a long sleeved shirt, be sure the sleeves are rolled down and buttoned. Snug fitting clothes and safety shoes are essential safety equipment in the shop.

Always wear safety glasses with side shields when working with shop equipment. Additional protection using goggles or face shields may be necessary for the following types of work:

- Grinding, Chipping, Sandblasting
- Welding
- Glassworking

Wear approved hard hats whenever there is a chance of objects falling from above. In addition, wear suitable gloves, preferably leather, when working with the following:

- Scrap metal or wood
- Sharp-edged stock
- Unfinished lumber

Refer to the Personal Protective Equipment chapter in this manual for more information.

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## Job Safety

Before beginning work in a shop, be sure you are authorized to perform the work to be done and inspect your tools and equipment. If a procedure is potentially hazardous to others in the area, warn fellow workers accordingly. Use warning signs or barriers, as necessary.

Notify your supervisor if you notice any unsafe conditions such as the following:

- Defective tools or equipment

- Improperly guarded machines
- Oil, gas, or other leaks

Inform other team members if you see an unsafe work practice; however, be careful not to distract a person who is working with power tools.

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## Safety Guidelines

Follow these guidelines for general shop safety:

- Know the hazards associated with your work. Be sure you are fully educated on the proper use and operation of any tool before beginning a job.
  - Always wear appropriate safety gear and protective clothing.
  - Wear nitrile gloves when cleaning with degreasers or ferric chloride.
  - Ensure that there is adequate ventilation to prevent exposure from vapors of glues, lacquers, paints and from dust and fumes.
  - Maintain good housekeeping standards.
    - Keep the work area free from slipping/tripping hazards (oil, cords, debris, etc.).
    - Clean all spills immediately.
    - Remove sawdust, wood chips, and metal chips regularly.
    - It is recommended that electrical cords pull down from an overhead pulley rather than lying on the floor.
  - Leave tool and equipment guards in place.
  - Know where fire extinguishers are located and how to use them.
  - Make sure all tools and equipment are properly grounded and that cords are in good condition.
    - Double-insulated tools or those with three-wire cords are essential for safety.
    - Use extension cords that are large enough for the load and distance. Secure all compressed gas cylinders. Never use compressed gas to clean clothing or skin.
  - Secure all compressed gas cylinders. Never use compressed gas to clean clothing or skin.
  - Always use flashback arrestors on cutting/welding torches.
  - Take precautions against heat stroke and heat exhaustion.
  - Wear infrared safety goggles when appropriate.
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## Hand Tools

Hand tools are non-powered tools. They include axes, wrenches, hammers, chisels, screw drivers, and other hand-operated mechanisms. Even though hand tool injuries tend to be less severe than power tool injuries, hand tool injuries are more common. Because people take everyday hand tools for granted, they forget to follow simple precautions for safety.

The most common hand tool accidents are caused by the following:

- Failure to use the right tool
- Failure to use a tool correctly
- Failure to keep edged tools sharp

- Failure to replace or repair a defective tool
- Failure to store tools safely

**IMPORTANT:**

*Use the right tool to complete a job safely, quickly, and efficiently.*

Follow these guidelines for general hand tool safety:

- Wear safety glasses whenever you hammer or cut, especially when working with surfaces that chip or splinter.
- Do not use a screwdriver as a chisel. The tool can slip and cause a deep puncture wound.
- Do not use a chisel as a screwdriver. The tip of the chisel may break and cause an injury.
- Do not use a knife as a screwdriver. The blade can snap and injure an eye.
- Never carry a screwdriver or chisel in your pocket. If you fall, the tool could cause a serious injury. Instead, use a tool belt holder.
- Replace loose, splintered, or cracked handles. Loose hammer, axe, or maul heads can fly off defective handles.
- Use the proper wrench to tighten or loosen nuts. Pliers can chew the corners off a nut.
- When using a chisel, always chip or cut away from yourself. Use a soft-headed hammer or mallet to strike a wooden chisel handle. A metal hammer or mallet may cause the handle to split.
- Do not use a wrench if the jaws are sprung.
- Do not use impact tools, such as chisels, wedges, or drift pins, if their heads are mushroom shaped. The heads may shatter upon impact.
- Direct saw blades, knives, and other tools away from aisle areas and other team members.
- Keep knives and scissors sharp. Dull tools are more dangerous than sharp tools.
- Iron or steel hand tools may cause sparks and be hazardous around flammable substances. Use spark-resistant tools made from brass, plastic, aluminum, or wood when working around flammable hazards.

Improper tool storage is responsible for many shop accidents. Follow these guidelines to ensure proper tool storage:

- Have a specific place for each tool.
- Do not place unguarded cutting tools in a drawer. Many hand injuries are caused by rummaging through drawers that contain a jumbled assortment of sharp-edged tools.
- Store knives or chisels in their scabbards.
- Hang saws with the blades away from someone's reach.
- Provide sturdy hooks to hang most tools on.
- Rack heavy tools, such as axes and sledges, with the heavy end down.

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## Power Tools

Power tools can be extremely dangerous if they are used improperly. Each year, thousands of people are injured or killed by power tool accidents. Common accidents associated with power tools include abrasions, cuts, lacerations, amputations, burns, electrocution, and broken bones. These accidents are often caused by the following:

- Touching the cutting, drilling, or grinding components
- Getting caught in moving parts

- Suffering electrical shock due to improper grounding, equipment defects, or operator misuse
- Being struck by particles that normally eject during operation
- Touching hot tools or workpieces
- Falling in the work area
- Being struck by falling tools

When working around power tools, you must wear personal protective equipment and avoid wearing loose clothing or jewelry that could catch in moving machinery. In addition to general shop guidelines, follow these guidelines for working with power tools:

- Use the correct tool for the job. Do not use a tool or attachment for something it was not designed to do.
- Select the correct bit, blade, cutter, or grinder wheel for the material at hand. This precaution will reduce the chance for an accident and improve the quality of your work.
- Keep all guards in place. Cover exposed belts, pulleys, gears, and shafts that could cause injury.
- Always operate tools at the correct speed for the job at hand. Working too slowly can cause an accident just as easily as working too fast.
- Watch your work when operating power tools. Stop working if something distracts you.
- Do not rely on strength to perform an operation. The correct tool, blade, and method should not require excessive strength. If undue force is necessary, you may be using the wrong tool or have a dull blade.
- Before clearing jams or blockages on power tools, disconnect from power source. Do not use your hand to clear jams or blockages, use an appropriate tool.
- Never reach over equipment while it is running.
- Never disable or tamper with safety releases or other automatic switches
- When the chance for operator injury is great, use a push stick to move material through a machine.
- Disconnect power tools before performing maintenance or changing components.
- Keep a firm grip on portable power tools. These tools tend to "get away" from operators and can be difficult to control.
- Remove chuck keys or adjusting tools prior to operation.
- Keep bystanders away from moving machinery.
- Do not operate power tools when you are sick, fatigued, or taking strong medication.
- When possible, secure work pieces with a clamp or vise to free the hands and minimize the chance of injury. Use a jig for pieces that are unstable or do not lie flat.

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## Guards

Moving machine parts must be safeguarded to protect operators from serious injury. Belts, gears, shafts, pulleys, fly wheels, chains, and other moving parts must be guarded if there is a chance they could contact someone.

As mentioned before, the hazards associated with moving machinery can be deadly. Hazardous areas that must be guarded include the following:

- Point of operation:

Area where the machine either cuts, bends, molds, or forms, the material.

- Pinch/nip point:

Area where moving machine parts can trap, pinch, or crush body parts (e.g., roller feeds, intermeshing gears, etc.).

- Sharp edges
- Stored potential energy

There are three types of barrier guards that protect people from moving machinery. They consist of the following:

- Fixed guards
- Interlocked guards
- Adjustable guards

A fixed guard is a permanent machine part that completely encases potential hazards. Fixed guards provide maximum operator protection.

Interlock guards are connected to a machine's power source. If the guard is opened or removed, the machine automatically disengages. Interlocking guards are often preferable because they provide adequate protection to the operator, but they also allow easy machine maintenance. This is ideal for problems such as jams.

Self-adjusting guards change their position to allow materials to pass through the moving components of a power tool. These guards accommodate various types of materials, but they provide less protection to the operator.

***IMPORTANT:***

*Guards must be in place. If a guard is removed to perform maintenance or repairs, follow lockout/tagout procedures. Replace the guard after repairs are completed. Do not disable or move machine guards for any reason. If you notice that a guard is missing or damaged, contact your supervisor and have the guard replaced or repaired before beginning work.*

***NOTE:***

*Hand-held power tools typically have less guarding in place than stationary power tools. Use extreme caution when working with hand-held power tools and always wear a face shield.*

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## Safety Guidelines

In addition to the safety suggestions for general power tool usage, there are specific safety requirements for each type of tool. The following sections cover safety guidelines for these types of tools:

- Drill press
- Grinder
- Jointer and shaper
- Lathe
- Nail/air gun
- Planer
- Forging machines
- Sander
- Saw:
  
- Band
- Circular
- Radial arm
- Table

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## Drill Press Safety

Follow these safety guidelines when using drill presses:

- Securely fasten work materials to prevent spinning. Never use your hands to secure work materials.
- Use a center punch to score the material before drilling.
- Run the drill at the correct speed. Forcing or feeding too fast can break drill bits.
- Never attempt to loosen the chuck unless the power is off.
- Lower the spindle before removing a chuck.
- Never use a regular auger bit in a drill press.
- Frequently back the drill out of deep cuts to clean and cool the bit.

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## Grinder Safety

Follow these safety guidelines when working with grinders:

- Ensure that no combustible or flammable materials are nearby that could be ignited by sparks from the grinder wheel.
- Ensure that a guard covers at least 270 degrees of the grinding wheel on bench-mounted machines.
- Place the grinder tool rest 1/8 inch from the wheel and slightly above the center line.
- Allow the grinder to reach full speed before stepping into the grinding position. Faulty wheels usually break at the start of an operation.
- Unless otherwise designed, grind on the face of the wheel.
- Use a vise-grip plier or clamp to hold small pieces.
- Slowly move workpieces across the face of wheel in a uniform manner. This will keep the wheel sound.
- Do not grind non-ferrous materials.
- Periodically check grinder wheels for soundness. Suspend the wheel on a string and tap it. If the wheel rings, it is probably sound.
- Replace wheels that are badly worn or cracked.
- Never use a wheel that has been dropped or received a heavy blow, even if there is no apparent damage.
- Before using a new wheel, let it run a few seconds at full speed to make sure it is balanced.

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## Lathe Safety

Follow these safety guidelines when working with wood lathes:

- Examine wood for knots and other defects before placing it in the lathe.
- Ensure that glued materials are set before placing them in the lathe.
- Before turning the lathe on, slowly turn rough materials a few times to ensure they will clear the tool rest.
- Keep hands off the chuck rim when the lathe is moving.
- Hold all wood cutting tools firmly with two hands.
- Start all jobs at the lowest speed. Ensure that materials are in a cylindrical form before advancing to higher speeds. Never turn large diameter materials at a high speed.
- Firmly screw faceplate work to the faceplate. Take care to avoid cutting too deep and hitting the screws.
- Do not cut too deep or scrape too long.
- Remove the "T" rest when sanding or polishing.

Follow these safety guidelines when working with metal lathes:

- Make sure that all gear and belt guards are in place.
- Never leave a chuck wrench in a chuck.
- Keep your hands off chuck rims when a lathe is in operation.
- Do not attempt to screw the chuck onto the lathe spindle with the power on, as it may get cross-threaded and cause injury. Stop the machine, place a board under the chuck, and then screw on by hand.
- Steady rests should be properly adjusted to conform with the material being worked on.
- When filing work in a lathe, always face the head stock and chuck.
- See that tailstock, toolholder, and work are properly clamped before turning on power.
- Never attempt to adjust a tool while the lathe is running.
- Never apply a wrench to revolving work or parts.
- Always use a brush to remove chips; never your hands.
- When possible, use pipe sleeves to cover work protruding from the end of the lathe.
- Before removing your work from the lathe, remove the tool bit.

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## Air Gun Safety (Pneumatic Fastening Tools)

Air guns are powered by compressed air. The main danger associated with pneumatic fastening tools is injury from one of the tool's attachments or fasteners.

Follow these safety guidelines for working with pneumatic tools:

- Ensure that pneumatic tools which shoot nails, rivets, or staples are equipped with a device that keeps fasteners from ejecting unless the muzzle is pressed against a firm surface .
- Never point a tool at items you do not want to fasten.
- Keep your finger off the trigger until you are ready to begin work. Most pneumatic tools have a *hair-trigger* that requires little pressure to activate the gun.
- Treat air hoses with the same care as an electrical cord.

- Do not drive fasteners into hard, brittle surfaces or areas where the fastener may pass through the material and protrude on the other side.
- 

## Forging Machines

Once punchers, shears, and benders are activated, it is impossible to stop them until the end of a cycle. Use extreme care when working with these tools.

- Inspection and maintenance:

All forge shop equipment must be maintained in a condition which will ensure continued safe operation.

- Hammers and presses:

All hammers must be positioned or installed in such a manner that they remain on or are anchored to foundations sufficient to support them according to applicable engineering standards.

- Hammers:

Die keys and shims must be made from a grade of material that will not unduly crack or splinter.

- Presses:

All manually operated valves and switches must be clearly identified and readily accessible.

- Power-driven hammers:

Every steam or airhammer must have a safety cylinder head to act as a cushion if the rod should break or pull out of the ram.

- Gravity Hammers:

Air-lift hammers must have a safety cylinder head.

- Forging and trimming presses:

When dies are being changed or maintenance is being performed on the press, ensure the following:

- The power to the pressure is locked out.
- The flywheel is at rest.
- The ram is blocked with a material of the appropriate strength.

- Upsetters:

All upsetters must be installed so that they remain on their supporting foundations.

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## Sander Safety

Follow these safety guidelines for working with circular and belt sanders:

- Ensure that sanding belts are not too tight or too loose. Never operate a sanding disk if the paper is too loose.
  - Use the correct grade of abrasive material.
  - Ensure that the distance between a circular sander and the edge of the table is not greater than 1/4 inch.
  - Do not push materials against sanders with excessive force.
  - Sand only on the downstroke side of a disk sander.
  - Do not hold small pieces by hand. Use a jig for pieces that are difficult to hold securely.
- 

## Saw Safety

There are numerous types of power saws, such as band saws, circular saws, radial arm saws, saber saws, and table saws. Regardless of the type of saw you use, never reach over the sawline to position or guide materials.

Follow these safety guidelines for working with band saws:

- Set the blade evenly with the proper amount of tension.
- Keep your hands on either side of the cut line. Never reach across the cut line for any reason.
- Do not stand to the right of the band saw.
- Be sure the radius of your cutting area is not too small for the saw blade.
- If you hear a rhythmic click, check the saw blade for cracks.

Follow these safety guidelines for working with circular saws:

- Do not raise the saw any higher than absolutely necessary.
- Fasten a clearance block to the fence when cutting off short pieces.
- Never attempt to clear away scraps with your fingers.
- Do not cut thin tubular materials with a circular saw.
- Ensure that the fence is not in the cut line of the saw.
- Take care when working with warped or twisted lumber.

Follow these guidelines when working with a radial arm saw:

- Push the saw blade against the stop before turning on the power.
- Never place one piece of wood on top of another when using this saw. The top piece may kick over.

- This saw pulls itself into wooden materials. It may be necessary to hold the saw back to prevent it from choking.
- Never leave the saw hanging over the end of the arm.

Follow these guidelines when working with table saws:

- Circular table saws must have a hood over the portion of the saw above the table. The hood must automatically adjust to the thickness of, and remain in contact with, the material being cut.
- Circular table saws must have a spreader aligned with the blade. The spreader must be spaced no more than 1/2 inch behind the largest blade mounted in the saw. Providing a spreader while grooving, dadoing, or rabbeting is not required.
- Circular table saws used for ripping must have non-kickback fingers or dogs.
- Feed rolls and blades of self-feed circular saws must be protected by a hood or guard to prevent the operator's hand from coming in contact with the in-running rolls.

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## Spray Paint Booths

When working with paint or painting equipment, it is important to have adequate ventilation and to avoid flames or other sources of ignition. Because most paints, varnishes, and thinners are flammable, spray paint jobs should be conducted in a well-ventilated enclosure such as a spray paint booth. Spray paint booths minimize toxic vapors and flammable fumes while providing adequate ventilation. Always wear personal protective equipment when working with paint. In addition, clean the booths and ventilation ducts frequently to avoid heavy accumulations of paint, dust, and pigment.

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## Welding and Cutting

Welding and cutting are two forms of hot work that require special safety considerations. Unless they are done in a designated shop area, welding and cutting are strictly prohibited without proper authorization.

Before conducting welding or cutting operations, inspect your equipment for the following:

- Welding leads must be completely insulated and in good condition.
- Cutting tools must be leak-free and equipped with proper fittings, gauges, regulators, and flashback devices.
- Oxygen and acetylene tanks must be secured in a safe place.

In addition, follow these guidelines for most welding and cutting procedures:

- Conduct welding and cutting operations in a designated area free from flammable materials. When welding or cutting is necessary in an undesignated or hazardous area, have someone nearby act as a fire attendant.
- Periodically check welding and cutting areas for combustible atmospheres.
- Take care to prevent sparks from starting a fire.

- Remove unused gas cylinders from the welding and cutting area.
- Keep hoses out of doorways and away from other people. A flattened hose can cause a flashback.
- Mark hot metal with a sign or other warning when welding or cutting operations are complete.

The following table provides an overview of welding and cutting hazards:

## Welding Guidelines

Proper selection of personal protective equipment is very important when welding; make sure your welding helmet visor is dark enough to provide adequate protection. Wear fireproof apron and gloves. In addition, take care to protect other people from the hazards of welding. For example, use a welding curtain to protect other team members from UV radiation.

There are three types of welders:

- AC welders:

These welders are used for standard welding procedures, AC welders are powered by an electrical cord.

- DC welders:

These are portable welders that are commonly used in manholes. DC welders have their own power supply.

- Wire-feed welders:

These welders use inert gas for light metal work (e.g., stainless steel, aluminum, etc.).

Common hazards associated with welding include the following:

- Electrocutation
- Burns
- UV radiation exposure
- Oxygen depletion
- Sparking

In addition to the general guidelines for welding and cutting, follow these specific guidelines for safe welding operations:

- Make sure the welding area has a nonreflective, noncombustible surface.
- Ensure that adequate ventilation and exhaust are available.
- Be aware of electrocution hazards, particularly in damp conditions. Be sure that electrical cords are properly grounded. It is advisable for cords to pull down from an overhead pulley.

## Cutting Guidelines

Gas welding and cutting tools are often powered by oxygen or acetylene gas cylinders. These tanks require special safety precautions to prevent explosions and serious injuries. Follow the safety guidelines below, and refer to the Laboratory Safety chapter in this manual for more information on gas cylinders safety:

- Ensure that acetylene/oxygen systems are equipped with flame or flashback arrestors.
  - Store acetylene bottles upright and secured.
  - Keep cylinder fittings and hoses free from oil and grease.
  - Repair or replace defective hoses by splicing. Do not use tape.
  - Do not tamper or attempt to repair cylinders, valves, or regulators.
  - Do not interchange regulators or pressure gauges with other gas cylinders.
  - Carefully purge hoses and torches before connecting a cylinder.
  - Set acetylene pressure at or below 15 psig. Always use the minimum acceptable flowrate.
  - Never use a match to light a torch. Use an approved lighter.
- 

## General Electrical Safety

The danger of injury through electrical shock is possible whenever electrical power is present. When a person's body completes a circuit and thus connects a power source with the ground, an electrical burn or injury is imminent. Most fatal injuries result from high-voltage exposure; however, people can sustain severe injuries from low voltage power if it has a high current flow.

Electrical safety is important in every work environment. The following sections cover circuit breaker loads, electrical grounding, electrical safety guidelines, and electrical emergency response.

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## Definitions

The following definitions help clarify general electrical safety:

- Amps:
  - The standard unit for measuring electrical current.
- Watt:
  - A unit of electrical power, equal to the power developed in a circuit by a current of amp flowing through a potential difference of one volt.
- Voltage:

- Electromotive force expressed in volts.
- Circuit Breaker:
  - A device that automatically interrupts the flow of an electrical current.
- Breaker Box:
  - An insulated box on which interconnected circuits are mounted.
- Electrical Panel:
  - An insulated panel on which electrical wires are mounted.
- Current Flow:
  - The rate of flow of an electrical charge, generally expressed in amps.
- Electrical Load:
  - The amount of power delivered by a generator or carried by a circuit. A device to which the power is delivered.
- Ground-Fault Circuit Interrupter (GFCI):
  - A GFCI detects grounding problems and shuts electricity off to prevent a possible accident.
- High Voltage:
  - The term high voltage applies to electrical equipment that operates at more than 600 Volts (for terminal to terminal operation) or more than 300 Volts (for terminal to ground operation). Low voltage, high current AC or DC power supplies are also considered to be high voltage.
- Hazardous Energy Sources:
  - This term applies to stored or residual energy such as that in capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure.
- Lockout:
  - The placement of a lock on an energy-isolating device. This act prevents workers from operating a piece of equipment until the lock is removed.
- Tagout:
  - The placement of a tag on an energy-isolating device. A tagout device is a prominent warning device of a lockout.
- Energy-Isolating Device:
  - A mechanical device that prevents the transmission or release of energy. Examples include the following:

- Manually operated circuit breakers
- Disconnect switches
- Line or block valves

Pushbuttons, selector switches, and other control circuit devices do not isolate energy.

Energy-isolating devices should be lockable by means of a hasp or other type of attachment. It should not be necessary to dismantle or reassemble a device to lock it.

- Authorized Team Member:

A person who locks out or tags out equipment for service or maintenance. Authorized team members have been formally trained in proper lockout/tagout procedures.

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## Circuit Breaker Loads

Most office and laboratory locations have 20 amp circuit breakers that serve two or more outlets. These breakers can handle most office equipment; however, the widespread use of personal computers and associated hardware can create an electrical overload. To determine your current electrical load, follow these steps:

1. Check office/laboratory equipment for a manufacturer's rating label that indicates total watts or amps. Take special care to check appliances that use electricity to generate heat.
2. Convert the watts rating to amps:  
$$\text{Amps} = \text{Watts} \div 120 \text{ Volts}$$
3. Total the amps for each circuit.
4. If the total equals more than 15 amps per 20 amp circuit, you may be overloading the circuit. Move enough equipment to a different circuit to reduce the circuit load; otherwise, have the Physical Plant inspect the circuit wiring.

---

## Electrical Grounding

Proper electrical grounding can help prevent electrical injury. Most electrical equipment is grounded with either a three-prong plug or a two-prong plug and insulation. Because a grounding system may be defective without your knowledge, use a GFCI to ensure electrical safety. GFCIs are required in moist or potentially damp environments.

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## Electrical Panels

Electrical panels or breaker boxes require special safety considerations, including the following:

- Know where your panel box is located.
- Do not tape circuit switches to keep a breaker from tripping.
- Ensure that breaker circuits are accurately labeled within panel boxes.
- Ensure that panel box doors are securely attached.
- Do not block panel boxes. There should be at least 30 inches of clear space in front of a panel box.

Report tripped breakers and refer any electrical questions to the Physical Plant.

---

## Electrical Safety Guidelines

Follow these guidelines for general electrical safety:

- Be familiar with the electrical hazards associated with your workplace.
- Unplug electrical equipment before repairing or servicing it.
- If a prong breaks off inside an outlet, do not attempt to remove it yourself. Call the Physical Plant for assistance.
- Ensure that outlets are firmly mounted. Report loose outlets to the Physical Plant.
- Report all electrical problems, including tripped breakers, broken switches, and flickering lights, to the Physical Plant.
- All appliances used in should be UL or FM (Factory Mutual) labelled.
- Do not use an appliance that sparks, smokes, or becomes excessively hot, unless the appliance is specifically designed to exhibit these characteristics.
- Portable electrical heaters must be placed to avoid causing a trip hazard and must be kept away from combustible material. Never leave a heater unattended. Unplug the heater at the end of the day or when not in use.
- Keep electrical equipment away from water, unless the appliance is specifically designed for use around water, such as a wet-dry shop vacuum.
- Use GFCIs whenever possible.
- Be aware of overhead power lines when working with tall equipment (e.g., grain augers, cranes, sailboats, etc.).
- Follow lockout/tagout procedures, as appropriate.

Follow these guidelines for electrical plug and cord safety:

- Do not remove the prongs of an electrical plug. If plug prongs are missing, loose, or bent, replace the entire plug.
- Do not use an adapter or extension cord to defeat a standard grounding device. (e.g., Only place three-prong plugs in three-prong outlets; do not alter them to fit in a two-prong outlet.)
- Use extension cords only when necessary and only on a temporary basis. Do not use extension cords in place of permanent wiring. Request new outlets if your work requires equipment in an area without an outlet.

- Use extension cords that are the correct size or rating for the equipment in use. The diameter of the extension cord should be the same or greater than the cord of the equipment in use.
  - Do not run electrical cords above ceiling tiles or through walls.
  - Keep electrical cords away from areas where they may be pinched and areas where they may pose a tripping or fire hazard (e.g., doorways, walkways, under carpet, etc.)
  - Avoid plugging more than one appliance in each outlet. If multiple appliances are necessary, use an approved power strip with surge protector and circuit breaker. Do not overload the circuit breaker.
  - Discard damaged cords, cords that become hot, or cords with exposed wiring.
  - Never unplug an appliance by pulling on the cord; pull on the plug.
- 

## Electrical Emergency Response

The following instructions provide guidelines for handling three types of electrical emergencies:

### 1. Electric Shock:

When someone suffers serious electrical shock, he or she may be knocked unconscious. If the victim is still in contact with the electrical current, immediately turn off the electrical power source. If you cannot disconnect the power source, try to separate the victim from the power source with a nonconductive object, such as a wood-handled broom.

***IMPORTANT:***

*Do not touch a victim that is still in contact with a power source; you could electrocute yourself.*

Have someone call for emergency medical assistance immediately. Administer first-aid, as appropriate.

### 2. Electrical Fire:

If an electrical fire occurs, try to disconnect the electrical power source, if possible. If the fire is small, you are not in immediate danger, and you have been trained in fighting fires, use any type of fire extinguisher except water to extinguish the fire.

***IMPORTANT:***

*Do not use water on an electrical fire.*

### 3. Power Lines:

Stay away from live power lines and downed power lines. Be particularly careful if a live power line is touching a body of water. The water could conduct electricity.

If a power line falls on your car while you are inside, remain in the vehicle until help arrives.

# Lockout/Tagout Procedures

Lockout/tagout procedures are used to isolate hazardous energy sources from electrical, hydraulic, or pneumatic machinery. Furthermore, when service or maintenance work is required, lockout and tagout devices help ensure personal safety from possible energy releases. All team members whose work involves hazardous energy sources must be trained in lockout/tagout procedures.

Before performing service or maintenance work on machines, turn them off and disconnect them from their energy sources. To further ensure safety, lockout and tagout energy-isolating devices.

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## Applying Lockout/Tagout Devices

Only authorized team members may apply lockout/tagout devices. The following steps provide a brief outline of approved application procedures:

1. Notify team members that the equipment requires service or maintenance and is scheduled for shutdown and lockout/tagout.
2. Use established procedures to identify the type, magnitude, and hazards of the equipment's energy source. Make sure you know the proper methods for controlling the energy source.
3. If the equipment is currently operating, shut it down using normal shutdown procedures.
4. Isolate the equipment from its energy source by activating the energy-isolating device(s). Either lockout or tagout the energy-isolating device(s).
5. Dissipate or restrain stored and residual energy using methods such as grounding, repositioning, blocking, bleeding, etc. (Capacitors, springs, hydraulic systems, and air/gas/water pressure system may contain stored or residual energy.)
6. Ensure that all team members are removed from the equipment. Then, test the equipment for successful isolation by attempting to operate it.

***IMPORTANT:***

*After verifying isolation, return the controls to neutral or off.*

---

## Removing Lockout/Tagout Devices

When service and maintenance are completed, authorized team members may remove lockout/tagout devices and return equipment to normal operations. The following steps provide a brief outline of approved removal procedures:

1. Inspect the work area and remove any nonessential items. Make sure the isolation equipment is intact and in good working condition.
2. Ensure that all team members are safely removed from the equipment.
3. Verify that the equipment controls are in neutral or off.
4. Remove the lockout/tagout devices and re-energize the equipment.

***NOTE:***

*The removal of some forms of blocking may require the equipment to be re-energized before safe removal.*

5. Notify team members that the equipment is ready for operation.
-

## High Voltage Procedures

In addition to the guidelines associated with general electrical safety and lockout/tagout procedures, there are more stringent safety requirements for high voltage procedures.

Ensure that only authorized team members work around high voltage equipment.

- Label entrances with a High Voltage Sign.
- Ensure that terminal voltage ratings can withstand surges caused by electrical faults or switching transients.
- Be careful around output circuits even when the input power is off. Parallel power sources and energy storage devices can still be dangerous.
- Be careful when working with power supplies that serve more than one area.
- Before working in a high voltage area, inspect the power supply and check all protective devices.
- Do not work alone near high voltage.
- Label equipment to identify power sources. Label input power sources to identify connected power supply loads.
- Attach emergency shutdown instructions and phone numbers to equipment that is remotely controlled or unattended while energized.
- Before entering a power supply or associated equipment enclosure to work on hazardous energy sources, complete the following:
  - De-energize the equipment.
  - Open and lockout the main input power circuit breaker.
  - Check for auxiliary power circuits that could still be energized.
  - Inspect automatic shorting devices for proper operation.
  - Short the power supply with grounding hooks.

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## General Fire/Life Safety

Fire/life safety involves numerous safety issues including fire prevention, fire suppression, and emergency evacuation/response. Fire/life safety is everyone's responsibility.

### ***IMPORTANT:***

*Learn how to prevent fires and respond to fires — what you learn will be invaluable.*

Kell Robotics is committed to providing a safe environment for building occupants and emergency response personnel.

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## The Effects of a Fire

Most fires produce an immense amount of smoke that is highly toxic. In fact, smoke is responsible for more fire fatalities than flames. A smokey fire can have the following effect on humans:

Within 30 seconds \_ Disorientatio

Within 2 minutes \_ Unconsciousness

Within 3 minutes \_ Death

Timing is critical during a fire. To ensure your safety, you must know how to prevent and respond to any fire emergency.

---

## Fire Prevention

The greatest protection against property loss and injuries from fire is prevention. Follow these guidelines to promote fire/life safety:

- Minimize combustible storage.
- Store waste materials in suitable containers.
- Use flammable materials in well-ventilated areas. Use and store flammables away from ignition sources, such as cigarettes.
- Keep equipment in good working order. Have electrical wiring and appliances inspected regularly.
- Ensure that heating units are properly safeguarded.
- Do not hunt for gas leaks using an open flame. Use approved gas indicators.
- Report and repair all gas leaks immediately.
- Conduct hot work in well-ventilated areas.
- Test enclosed or confined spaces for flammable atmospheres.
- Use open flames carefully. Do not use open flames where flammable atmospheres may be present.

For more information on fire/life safety, refer to other chapters in this manual, including Emergency Preparedness, Electrical Safety, Laboratory Safety, Chemical Safety, Confined Space, etc.

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## Fire Response

If you see a fire or smoke, or if you smell smoke, complete the following steps:

1. Pull the fire pull station to begin evacuating the building.
2. If you are not in immediate danger, call 9-911 to report the fire. Provide the operator with the following information:
  - Building or area name
  - Approximate location of the fire
  - Size and type of fire
  - Your name

3. If you are formally trained in fire fighting techniques and are not in immediate danger, you may attempt to fight the fire. Do not place yourself or others in unnecessary danger.
4. Exit the building by following posted evacuation routes. Do not use elevators during an emergency.

During actual emergencies, building occupants must receive permission from the UPD, the Fire Department, or the Environmental Health & Safety Department before re-entering the building.

**NOTE:**

*Evacuation plans and fire drills are essential for building occupants to respond correctly to a fire alarm. Refer to the Emergency Preparedness chapter for more information.*

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## Combustible Storage

By storing excess combustible materials improperly, team members not only increase the potential for having a fire, they increase the potential severity of a fire. To reduce the hazards associated with combustible storage, follow these guidelines:

- Eliminate excess combustible materials such as paper and cardboard.
- Do not store combustible materials in hallways, stairwells, or mechanical rooms.
- When stacking combustible materials, leave at least 18 inches between the top of the stack and the ceiling.

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## Emergency Access and Egress

Emergency access and egress are critical during an emergency situation such as a fire. During a fire, timing and quick response are essential to save lives and property. Effective emergency access ensures that fire trucks can reach a building in time to extinguish the fire. Unobstructed emergency egress ensures that building occupants can exit a building to safety.

These definitions help clarify the concept of emergency access and egress:

- **Emergency Access:**

Pertinent facilities and equipment remain available and unobstructed at all times to ensure effective fire detection, evacuation, suppression, and response.

- **Emergency Egress:**

A continuous and unobstructed way to travel from any point in a public building to a public way. A means of egress may include horizontal and vertical travel routes, including intervening rooms, doors, hallways, corridors, passageways, balconies, ramps, stairs, enclosures, lobbies, courts, and yards.

***IMPORTANT:***

*Each location within a building must have a clear means of egress to the outside.*

The following sections offer safety guidelines and procedures for maintaining emergency access and egress.

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## **Corridors, Stairways, and Exits**

An exit corridor and/or stairway is a pedestrian pathway that allows direct access to the outside of a building and/or allows access to a building entrance and subsequent pathways to the outside of a building (i.e., an exit corridor is the quickest, easiest, and most direct pathway for leaving a building.) Because exit corridors or passageways are the primary means of egress during an emergency, team members must follow the safety guidelines outlined in this section.

***IMPORTANT:***

*There must be at least 44 inches clear width of unobstructed, clutter-free space in all corridors, stairways, and exits.*

Follow these guidelines to promote safe evacuation in corridors, stairways, and exits:

- Keep all means of egress clean, clutter-free, and unobstructed.
- Do not place hazardous materials or equipment in areas that are used for evacuation.
- Do not use corridors or stairways for storage or office/laboratory operations. Corridors may not be used as an extension of the office or laboratory.

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## **Fire Extinguishers**

Fires are classified according to three basic categories. Each type of fire requires special treatment to control and extinguish it. Therefore, all fire extinguishers are clearly marked to indicate the fire classes for which they are designed.

Fires are classified as indicated below. Refer to the table on the following page for additional information.

- **Class A:**

Fires involving ordinary combustibles such as wood, textiles, paper, rubber, cloth, and trash. The extinguishing agent for a Class A fire must be cool. Water and multi-purpose dry chemical fire extinguishers are ideal for use on these types of fires.

- **Class B:**

Fires involving flammable or combustible liquids or gases such as solvents, gasoline, paint, lacquer, and oil. The extinguishing agent for a Class B fire must remove oxygen or stop the chemical reaction. Carbon dioxide, multi-purpose dry chemical and halon fire extinguishers are ideal for use on these types of fires.

- **Class C:**

Fires involving energized electrical equipment or appliances. The extinguishing agent for a Class C fire must be a nonconducting agent. Carbon dioxide, multi-purpose dry chemical, and halon fire extinguishers are ideal for use on these types of fires. **Never use a water fire extinguisher on a Class C fire.**

There are numerous types of fire extinguishers; however, most extinguishers contain water, carbon dioxide, or dry chemicals. The Halon agent is no longer available for purchase. Halon has been determined to be an ozone-depleting agent. Halon fire extinguishers are safe to use, however, if used, the extinguisher will be replaced by a different type.

## **USING FIRE EXTINGUISHERS**

Most fire extinguishers provide operating instructions on their label; however, the time to learn about fire extinguishers is not during a fire. The sooner you know how to use a fire extinguisher, the better prepared you are.

***NOTE:***

*Portable fire extinguishers are located throughout all University facilities. They are mounted in readily accessible locations such as hallways, near exit doors, and areas containing fire hazards. Make sure that fire extinguishers are accessible and securely mounted.*

The Environmental Health & Safety Department provides fire extinguisher classes. When using a fire extinguisher to fight or control a fire, aim the spray at the base of the fire. Because most extinguishers only work for a short time, employ a sweeping motion and work quickly to control the fire.

***IMPORTANT:***

*Do not attempt to fight a fire unless it is small and controllable. Use good judgment to determine your capability to fight a fire. When fighting a fire, always maintain an escape route. Never allow a fire to block your egress.*

---

## **First Aid**

First aid training is necessary to prevent and treat sudden illness or accidental injury. The primary objective of first aid is to save lives. This objective is achieved with the following:

- Preventing heavy blood loss
- Maintaining breathing
- Preventing further injury
- Preventing shock
- Getting the victim to a physician or Emergency Medical Service (EMS)

People who provide first aid must remember the following:

- Avoid panic.
- Inspire confidence.
- Do only what is necessary until professional help is obtained.

The following sections provide general information for handling common injuries and illnesses.

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## **First Aid Kits**

A basic first aid kit should be readily available in the team workshop and pit areas when competing. Suitable contents for this kit include sterile bandages, tape, scissors, ice packs, plastic gloves, and a mouth-to-mouth breathing tube. Aspirin or other oral medications, ointments or creams, eye drops, antiseptic solutions, or inhalants are not recommended in first aid kits.

Inform team members of the location of first aid kits. Inventory supplies and restock items, as necessary.

---

# Initial First Aid

If you are the first one on the scene of a medical emergency, your first priority is to remain calm. Your action will vary depending upon the nature of the situation, but the following four rules apply to any medical emergency:

## 1. Assess the Situation:

- Can you safely approach the victim? If not, what can you do to help without threatening your own safety?
- Determine what is wrong with the victim.

## 2. Set Priorities:

- Is the victim conscious?
- How serious is the emergency?
- Can someone else call EMS, if necessary? If no one else is available, decide if it is more important to administer first aid immediately or to call EMS and leave the victim unattended.

### **NOTE:**

*Never leave a victim in a life-threatening situation without first trying to help.*

## 3. Check the ABCs (unconscious victims only):

### **A. Airway**

Place the victim on his/her back. Place one hand on the forehead and one hand under the chin and tilt the head back.

### **NOTE:**

*Never move a victim if you suspect back or neck injury.*

Open the victim's mouth and check for obstructions. If the victim is unconscious and an obstruction is visible, remove it with your fingers.

### **B. Breathing**

Place your ear above the victim's mouth and look at the chest. Listen for breathing and look for the rise and fall of the chest. If the victim is not breathing, someone formally trained in mouth-to-mouth breathing should begin resuscitation.

### **C. Circulation**

Using two fingers, gently feel for the carotid artery in the neck and check the pulse. To find the artery, place your fingers on the victim's Adam's apple and then slide them down the side of the neck until you feel the groove between the windpipe and neck muscles. If there is no pulse, someone formally trained in CPR should begin cardiopulmonary resuscitation.

## 4. Administer first aid and/or call EMS, as appropriate.

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## Bleeding (External)

Most bleeding injuries are minor; however, heavy external bleeding can cause death in three to five minutes.

In addition to the procedures for initial first aid, follow these steps for external bleeding:

1. Using a sterile dressing, clean cloth, or other material, apply pressure directly over the wound.

**IMPORTANT:**

*Direct contact with a victim's blood may expose you to various communicable diseases. Always wear plastic gloves when assisting a bleeding victim.*

2. If possible, elevate the bleeding area. Otherwise, lay the victim flat, and elevate the legs.
3. Keep the victim lying down.
4. Treat the victim for shock, if necessary.
5. Do not release pressure or lift the bandage until you are sure the bleeding has stopped.
6. Have someone call EMS, if necessary.

**IMPORTANT:**

*Do not use a tourniquet unless an arm or leg has been amputated.*

**NOTE:**

*For deep chest wounds, use a heavy dressing to keep air from passing through the wound. For gaping stomach wounds, use a damp dressing; do not move or try to replace protruding organs.*

---

## Eye Injury

If hazardous liquid, particles, or gas irritate a person's eye, have the victim flush the eye with water for at least 15 minutes. Use an eye wash station, sink, or water fountain. Seek assistance from a physician, as necessary.

If a foreign object (e.g., glass, pencil lead, etc.) is embedded in the eye, place a plastic cup or gauze over the affected eye. This will keep the eye from moving and inflicting further damage. Seek assistance from a physician immediately.

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## Personal Protective Equipment Defined

Personal Protective Equipment (PPE) includes all clothing and work accessories designed to protect team members from workplace hazards. Protective equipment should not replace engineering, administrative, or procedural controls for safety — it should be used in conjunction with these controls. Team members must wear protective equipment as required and when instructed by a supervisor.

***IMPORTANT:***

*Always remove protective clothing before leaving the work area. Do not wear PPE in public elevators, classrooms, restrooms, breakrooms, etc.*

---

## Arm and Hand Protection

Arms and hands are vulnerable to cuts, burns, bruises, electrical shock, chemical spills, and amputation. Always wear the appropriate hand and arm protection. Double your hand protection by

wearing multiple gloves when necessary. For arm protection, wear a long-sleeved shirt, a laboratory coat, chemical-resistant sleeves, or gauntlet-length gloves.

Follow these guidelines to ensure arm and hand safety:

- Inspect and test new gloves for defects.
- Always wash your hands before and after using gloves.
- Do not wear gloves near moving machinery; the gloves may become caught.
- Do not wear gloves with metal parts near electrical equipment.

***IMPORTANT:***

*Gloves are easily contaminated. Avoid touching surfaces such as telephones, door knobs, etc. when wearing gloves.*

---

## Ear and Hearing Protection

If you work in a high noise area, wear hearing protection. Most hearing protection devices have an assigned rating that indicates the amount of protection provided. Depending on your level of exposure, you may choose from the following devices:

- Disposable earplugs
- Reusable earplugs
- Headband plugs

- Sealed earmuffs

Earplugs may be better in hot, humid, or confined work areas. They may also be better for team members who wear other PPE, such as safety glasses or hats. Earmuffs, on the other hand, may be better for team members who move in and out of noisy areas, because the muffs are easier to remove. Before resorting to hearing protection, attempt to control noise levels through engineering or operational changes.

To avoid contamination, follow these guidelines when using earplugs:

- Wash your hands before inserting earplugs.
- Replace disposable earplugs after each use.
- Clean reusable earplugs after each use.

---

## Eye and Face Protection

Team members must wear protection if hazards exist that could cause eye or face injury. Eye and face protection should be used in conjunction with equipment guards, engineering controls, and safe practices.

***NOTE:***

*Safety glasses are required in workshops.*

Always wear adequate eye and face protection when performing tasks such as grinding, buffing, welding, chipping, cutting, or pouring chemicals. Safety glasses with side shields provide protection against impact and splashes, but safety goggles provide protection against impact, splashes, and hazardous atmospheres.

- If you wear prescription glasses, wear goggles or other safety protection over the glasses.
- Safety glasses with sideshields provide primary protection to eyes and are four times as resistant as prescription glasses to impact injuries.
- Goggles protect against impacts, sparks, chemical splashes, dust, and irritating mist. Wear full goggles, not just safety glasses, when working with chemicals.
- Eyecup welding goggles with filter lenses give protection from glare and sparks.
- A welding helmet protects from flashburn due to welding, soldering, or brazing, but does not provide primary eye protection; safety glasses or goggles should be worn with the helmet.
- A face shield is designed to protect the face from some splashes or projectiles, but does not eliminate exposure to vapors. A face shield should be worn with goggles or safety glasses.
- Sunglasses are useful to prevent eyestrain from glare and to minimize ultraviolet light exposure.

---

## Foot Protection

To protect feet and legs from falling objects, moving machinery, sharp objects, hot materials, chemicals, or slippery surfaces, team members should wear closed-toed shoes, boots,

footguards, leggings, or safety shoes as appropriate. Safety shoes are designed to protect people from the most common causes of foot injuries — impact, compression, and puncture.

***IMPORTANT:***

*Do not wear sandals or open-toed shoes.*

---

## Head Protection

Accidents that cause head injuries are difficult to anticipate or control. If hazards exist that could cause head injury, team members should try to eliminate the hazards, but they should also wear head protection.

Safety hats protect the head from impact, penetration, and electrical shock. Head protection is necessary if you work where there is a risk of injury from moving, falling, or flying objects or if you work near high-voltage equipment.

Hard hats should be water resistant, flame resistant, and adjustable. Wear one of the following hard hats as appropriate for your work situation:

- Class A - General service, limited voltage protection
- Class B - Utility service, high-voltage protection
- Class C - Special service, no voltage protection

Follow these guidelines for head safety:

- Check the shell and suspension of your headware for damage before each use. Look for cracks, dents, gouges, chalky appearance, and torn or broken suspension threads. Discard damaged hats or replace broken parts with replacements from the original manufacturer.
  - Discard any hat that has been struck or dropped from a great height, even if there is no apparent damage.
  - Do not wear a hard hat backwards, unless this is necessary to accommodate other protective equipment (e.g., welders face shield).
  - Do not paint the plastic shell of a hard hat or alter it in any way.
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