



## **Shop Safety**

Department of Environmental Health and Safety  
800 West Campbell Rd., SG10  
Richardson, TX 75080-3021  
Phone 972-883-2381/4111 Fax 972-883-6115

<http://www.utdallas.edu/ehs>

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## Purpose

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. This chapter highlights essential safety information for working in a UTD shop. Refer to other sections in this manual, including General Safety, Electrical Safety, and Fire/Life Safety, for more information on handling many shop situations. The following table highlights common shop hazards:

<b>Potential Hazards</b>	<b>Hazard Sources</b>
<u>Physical:</u>	
- 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
<u>Electrical:</u>	
- Overload	- Too many cords per outlet
- Fire	- Frayed, damaged cords
- Shock	- Ungrounded tools, equipment
<u>Fire:</u>	
- Flammable chemicals	- Gasoline, degreasers, paint thinners, etc.
- Sparks	- Welders, grinders
- Static sparks	- Ungrounded tools or solvent containers
- Uncontrolled fire	- Lack of appropriate fire extinguishers
<u>Chemical:</u>	
- 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.

## 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
- Long loose hair

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

Always wear safety glasses with side shields when working with shop equipment. Anytime there is question regarding required wardrobe for personal protection, refer to respective departmental requirements. Additional protection using goggles or face shields may be necessary for the following types of work:

- Grinding, Chipping, Sandblasting
- Welding
- Glass working

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

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

For glove selection and requirement assistance contact Environmental Health and Safety (EH&S).

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

## **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
- Any other condition that you feel may jeopardize you or your co-worker's safety

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

## **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.
- All containers must be labeled with its contents.
- Leave tool and equipment guards in place.
- Leave in place and utilize all shielding on tools and equipment.
- 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.
- Always use flashback arrestors on cutting/welding torches.
- Take precautions against heat stroke and heat exhaustion.
- Wear infrared safety goggles when appropriate, e.g. when operating brazing or cutting torch.

EH&S periodically inspects all UTD shops. See the Shop Audit Checklist for questions regarding inspection criteria and what is being looked for during the shop inspections. Refer any questions regarding shop safety to the EH&S.

## **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.
  - Do not use a chisel as a screwdriver.
  - Do not use a knife as a screwdriver.
  - 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 or tool box.
  - 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.
  - 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 employees.
- 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.

## **Insulation**

Asbestos, fiberglass, man-made mineral fibers, PVC, and urethane foam can be extreme respiratory hazards. To protect yourself from these and other respiratory hazards, minimize your exposure to particulate matter from insulation, fumes, dusts, and aerosols. Refer to the General Safety chapter for more information on asbestos.

## **Ladders**

Refer to the Ladder safety policy in this manual for more information.

## **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 work pieces
- 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.
- Inspect wiring and mechanisms before operating.
- All machinery repairs must be completed by a certified repair person.

## **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 injure an employee.

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.*

## **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
- Compound miter saw
- Router
- Reciprocal saw
- Dremel tool

### **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.

### **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 work pieces 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 a run a few seconds at full speed to make sure it is balanced.

## Hot Work Permit

Refer to the Hot Work Policy through EH&S for more information. The following is an example of a Hot Work Permit:

### HOT WORK PERMIT

Hot work is any operation that generates heat, spark or open flame. This includes, but is not necessarily limited to welding, cutting, grinding, soldering, torch applied roofing, heat gun use and similar activities. Before initiating Hot Work, determine if there is a safer way to complete the work.

Date: \_\_\_\_\_ Location: \_\_\_\_\_ Job # \_\_\_\_\_

Type of Hot Work:  Soldering  Welding  Cutting  Roofing  Other \_\_\_\_\_

Hot Work Precautions Check List: Complete prior to any hot work beginning in an area not designated for hot work. Check each box where the statement is true. If any statements are not true, then hot work should not begin until that issue has been safely resolved.

#### Required Safety Precautions

- Fire suppression sprinklers, fire hoses or fire extinguishers are available and operable.
- Hot work equipment is operable and in good repair.
- Smoke / fire detectors in the immediate area of the hot work have been temporarily disabled until the hot work is complete.
- Building occupants have been protected or isolated from the hot work area.
- Drums, barrels and tanks have been cleaned and purged of flammables and toxics, all tank feeds are closed, and the tank is vented. Requirements within 35 feet:
  - Area within 35 feet of the work area has been properly swept to remove any combustible debris.
  - Flammable and ignitable materials and debris have been moved at least 35 feet from the hot work area or covered and protected with fire resistant materials.
  - Cracks or holes in floors, walls and ceilings (including ductwork) are covered or plugged
  - Combustible floors covered with fire-resistive material

#### Requirements within 50 feet

- Explosives, compressed gas cylinders or stored fuel have been moved at least 50 feet from the hot work area or have been protected from the hot work. Work on walls or Ceilings
- Construction is noncombustible and has no combustible covering or insulation.

\_\_Areas adjacent to walls being worked on are checked for combustibles and any combustibles are either removed or protected. Fire Watch required during Hot Work and a minimum of 30 minutes following completion of work.

Yes \_\_\_\_ No \_\_\_\_ Name: \_\_\_\_\_

*A fire watch is needed for all hot work activities unless the hot work area has no fire hazards or combustible exposures. The fire watch must have fire-extinguishing equipment readily available and be trained in its use. They must also be familiar with the procedures for sounding an alarm in the event of a fire. The fire watch will watch for fires in the exposed areas and are responsible for extinguishing spot fires and communicating alarms immediately. The fire watch may be assigned other work duties while in the hot work area; however they need to be vigilant in watching for fires.*

When work is completed:

\_\_Inspect work area, and any potentially affected surrounding areas, for fire, fire damage, or potential for fire.

\_\_Reactivated smoke/fire detectors that were disabled because of the hot work.

I verify that the above location has been examined and the necessary precautions have been taken to prevent the outbreak of fire due to Hot Work.

Employee Signature (Issued): \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_

Employee Signature (Closed): \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_

Supervisor Signature: \_\_\_\_\_ Date: \_\_\_\_\_

This Permit is valid only for the day issued

### **Jointer and Shaper Safety**

Follow these safety guidelines when using jointers and shapers:

- Ensure that jointers are equipped with cylindrical cutting heads.
- Use a push stick, as necessary.
- Do not use single cutter knives in shaper heads.
- Ensure that knives are balanced and correctly mounted.
- Adjust cut depth before turning the machine on.
- Do not use the jointer for strips that are less than 1 inch wide.

### **Lathe Safety**

Follow these safety guidelines when working with wood lathes:

- Examine wood for knots and other defects before placing it in the lathe. Use caution when working with wood that has knots.
- 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 to the material being worked on.
- When filing work in a lathe, always face the head stock and chuck.
- See that tailstock, tool holder, 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.

### **Nail/Air Gun Safety (Pneumatic Fastening Tools)**

Nail guns and 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.

### **Planer Safety**

Follow these safety guidelines for working with planers:

- Examine wood for knots and other defects before placing it in the planer.
- Do not plane against the grain of the wood.
- Let go of the materials as the feeder rolls catch. Do not follow the work with your hands.
- Do not run boards that are more than 2 inches shorter than the distance between the in-feed and out-feed rolls.
- Use a push stick if a board stops with its end on the in-feed table.
- If a board sticks under the cutter head, turn off the machine to keep from burning the cutter knives.

## **Forging Machines**

Once punches, 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 air hammer 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.

## **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 down stroke 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.

## **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, filters and ventilation ducts frequently to avoid heavy accumulations of paint, dust, and pigment.

## **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.
- Check all other cords for frays and damages
- 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.
- Refer to Hot Work Policy through EH&S.

## **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 employees 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:

- Electrocution
- 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 non-reflective, 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 section in this manual for more information on gas cylinders safety:

- Ensure that acetylene/oxygen systems are equipped with flame or flashback arrestors attached to the regulators.
- 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 flow-rate.
- Never use a match to light a torch. Use an approved lighter.



