WELDING, CUTTING, AND BRAZING

Gas fumes, radiation, and electric shock are very real hazards that you face on the job as a welder. Think about it - a welding arc is hot enough to melt steel, and the light it emits is literally blinding. It generates toxic fumes that are composed of microscopic particles of molten metal. Sparks and molten slag thrown by the arc can fly up to 35 feet and can cause fires and explosions.

Are you doomed to be injured if you are a welder? The job can be safe if you take the proper precautions and follow safe work practices.

WHERE ARE THE REGULATIONS?

The Occupational Safety and Health Administration (OSHA) have developed rules governing welding, cutting, and brazing. These regulations are found at 29 CFR 1910.251 through .255 in Subpart Q as a guide. Your department will train you to operate your welding equipment safely and to understand the welding process so that you perform your welding tasks safely.

WHAT ARE THE HAZARDS?

Whenever welding, cutting, or brazing occurs, everyone involved in the operation must take precautions to prevent fires, explosions, or personal injuries.

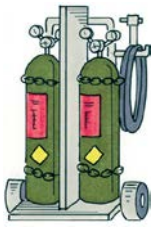
There are three basic types of welding operations:

- **Oxygen-fuel gas welding** joins metal parts by generating extremely high heat during combustion.
- **Resistance welding** joins metals by generating heat through resistance created to the flow of electric current.
- **Arc welding** joins or cuts metal parts by heat generated from an electric arc that extends between the welding electrode and the electrode placed on the equipment being welded.

These common hazards are associated with welding:

- Eyes and skin can be damaged from exposure to ultraviolet and infrared rays produced by electric arcs and gas flames.
- Closed containers that once held flammables or combustibles can explode under high heat (proper cleaning and purging procedures must be followed before hot-work is started).
- Toxic gases, fumes, and dust may be released during welding and cutting operations.
- Welding or cutting near combustible or flammable materials creates a fire hazard.
- Metal splatter and electric shock cause injuries.

COMPRESSED GAS CYLINDERS



A primary danger for oxygen-fuel gas welding operations stems from welding with compressed gas cylinders (CGCs) containing oxygen and acetylene. If CGCs are damaged, gas can escape with great force and the vessel itself can explode. Rocketing occurs when a CGC ruptures or is damaged. The cylinder can then act like a rocket with enough force to break through concrete walls.

Look for these danger signals when handling CGCs:

- Leaking (you may be able to hear or smell escaping gas).
- Corrosion.
- Cracks or burn marks.
- Contaminated valves.
- Worn or corroded hoses.
- Broken gauges or regulators.

Non-flammable compressed gases

Non-flammable compressed gases do not catch fire easily or burn quickly. However, they possess other hazards. The cylinder label and MSDS/SDS/SDS will tell you about toxic properties and physical hazards. Ammonia, argon, carbon dioxide, nitrogen, oxygen, chlorine, and nitrous oxide are all non-flammable compressed gases. These gases may:

- Cause dizziness, unconsciousness, or suffocation.
- Explode or accelerate fires if mishandled or exposed to high heat.
- Be harmful or toxic if inhaled.
- Irritate eyes, nose, throat, and lungs.

Flammable compressed gases

Flammable compressed gases have dangers besides those of high pressure. These gases can easily catch fire and burn rapidly. Flammable compressed gases include acetylene, hydrogen, natural gas, and propane.

Flammable compressed gases have the same dangers as non-flammable compressed gases, as well as:

- Ignition from heat, sparks, flames.
- Flash back if vapors travel to an ignition source.

FOLLOW SAFE WELDING PRACTICES

Here are a few practices for working safely that apply in many situations.

- When working above ground or floor level, use a platform with toeboards and standard railings, or use a safety harness and lifeline. Also protect workers from stray sparks or slag in the area below an elevated surface where welding is taking place.
- Aim the welding torch away from cement or stone surfaces. Moisture within these materials could cause them to explode when they reach a certain temperature.
- When finished welding or cutting, warn other workers of hot metal by marking or putting up a sign. Keep floors clean by putting electrode or rod stubs in an appropriate container.
- Never use bare conductors, damaged regulators, torches, electrode holders, or other defective equipment.
- Do not arc or resistance weld while standing on damp surfaces.

Handling compressed gas cylinders

The following procedures will reduce hazards of handling CGCs:

- Identify a gas and its dangers before you use it. You can find this information on labels, MSDS/SDS/SDSs, and cylinder markings. If you don't know what's in a cylinder, don't use it.
- When accepting an acetylene delivery, make sure it arrived upright. Acetylene cylinders contain a stabilizing liquid that may have leaked from a horizontal cylinder.
- Make sure valves, hoses, connectors, and regulators are in good condition.
- Keep oil and grease away from oxygen CGCs, valves, and hoses. If your hands, gloves, or clothing are oily, do not handle oxygen CGCs. Oxygen makes materials more flammable. Oxygen and compressed air is not the same thing. Do not use them interchangeably.
- Check to see if regulators, hoses, and gauges can be used with different gases. Assume they cannot.
- Never open valves until regulators are drained of gas and pressure-adjusting devices are released. When opening CGCs, point outlets away from people and sources of ignition. Open valves slowly. On valves without hand wheels, use only supplier-recommended wrenches. On valves with hand wheels, never use wrenches. Never hammer a hand wheel to open or close a valve.
- When empty, close and return CGCs. Empty CGCs must be marked "MT" or "Empty." Empty acetylene CGCs must be so labeled.

Here are several things to remember when moving CGCs:

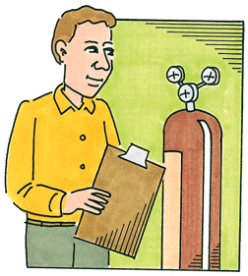
- Don't drop or bang CGCs.
- Don't roll, drag, or slide CGCs.
- You may carefully roll CGCs along the bottom rim for short distances.

- Don't lift CGCs by the cap unless using hand trucks so designed.
- Ropes and chains should only be used if a CGC has special lugs to accommodate this.
- Some CGCs may require special hand trucks.

Remember these guidelines when storing CGCs:

- When in storage, keep the steel protective cap screwed on. This step reduces the chance that a blow to the valve will allow gas to escape.
- Store cylinders upright.
- Group cylinders by types of gas.
- Store full and empty cylinders apart.
- Store gases so that old stock is removed and used first.
- To keep cylinders from falling over, secure them with chains or cables. (But never secure CGCs to conduit carrying electrical wiring.)
- Make sure fire extinguishers near the storage area are appropriate for gases stored there.
- Store oxygen CGCs at least 20 feet from flammables or combustibles, or separate them by a 5 foot, fire-resistant barrier.

Equipment inspection and maintenance



It almost goes without saying that welding equipment should be used according to the manufacturer's instructions. You must be familiar with the correct use and limitations of your welding equipment. In addition, routinely inspect and maintain your welding equipment, including welding cylinders. Inspect cylinders regularly to make sure all parts are in good working order, especially manifolds, distribution piping, portable outlet headers, regulators, hose, and hose connections.

Ventilation

Ventilation techniques vary depending on the size and type of the industry you work in. Some large facilities use sophisticated industrial exhaust systems like state-of-the-art electrostatic precipitators. Very often, however, a relatively simple ventilation method like the appropriate use of wall fans will be all that is required to provide good ventilation during welding operations.

Be aware that general ventilation should never be relied on as the only means of protection when air contaminants are toxic. Where ventilation is poor, you may need to use a respirator.

Fire prevention

You must do your welding in places safe from fire hazards. All fire hazards in the vicinity of a welding or cutting operation must be moved to a safe place before welding may begin.

When neither the object to be welded nor the fire hazards near it can be moved, guards must be set up to confine heat, sparks, and slag. Under these circumstances, your employer must issue a written authorization, or **hot work permit**, outlining the conditions under which the welding may occur.

Your employer must designate a worker as a fire watch whenever welding or cutting is performed in locations where other than a minor fire might develop or when any of the following conditions exist:

- Appreciable combustible material, in building construction or contents, is closer than 35 feet to the point of operation.
- Appreciable combustibles are more than 35 feet away but are easily ignited by sparks.
- Wall or floor openings within a 35-foot radius expose combustible material in adjacent areas including concealed spaces in walls or floors.
- Combustible materials are adjacent to the opposite side of metal partitions, walls, ceilings, or roofs and are likely to be ignited by conduction or radiation.

Fire watches must:

- Have fire extinguishing equipment readily available and be trained in its use.
- Be familiar with facilities for sounding an alarm in the event of a fire.
- Watch for fires in all exposed areas.
- Try to extinguish fires only when obviously within the capacity of the equipment available, or otherwise sound the alarm.
- Be maintained for at least a half-hour after completion of welding or cutting operations to detect and extinguish possible smoldering fires.

CONFINED SPACES

Welding or cutting in a confined space presents its own hazards. Follow permit-required confined space entry and rescue procedures. In addition:

- Evaluate the space for its limited work area, any hazardous atmosphere, or a slippery floor surface. Evaluate the space for flammability or combustibility hazards and for toxic fumes that could result from the welding process.
- Perform atmospheric testing for oxygen deficiency and for toxic and flammable or combustible gases before and during entry. If the tests show that flammable or combustible gases are present, the space must be ventilated until safe to enter. If the atmosphere is toxic and cannot be cleared through ventilation, appropriate respiratory protection equipment must be used. All energy sources that could cause employee injury must be disconnected and locked in the "off" position before entry.

- When working in confined spaces wear a safety harness attached to a lifeline. An attendant must tend the lifeline to observe the welder and initiate emergency rescue procedures.
- If hot work inside the space is interrupted, special precautions should be implemented. Disconnect power to arc welding or cutting units and remove the electrode from the holder. Turn off torch valves and shut off the gas supply to gas welding or cutting units at a point outside. Remove the torch and hose from the space, if possible. Cylinders for welding operations should never be placed in confined spaces.

USE PPE WHEN WELDING

It's important for welders to wear flame-retardant clothing and personal protective equipment. Necessary protective gear may include the following, depending on the job:

- Aprons - flame resistant (leather or other material that protects against radiated heat and sparks).
- Leggings - leather or similar protection.
- Safety shoes - ankle length (low cut shoes may catch slag).
- Protection during overhead work - shoulder cape or cover, skull cap made of leather or other protective material, other flame resistant cap worn under helmet.
- Ear protection - ear plugs, and, on very noisy jobs like high velocity plasma torches, ear muffs.
- Head protection - safety helmet or other head gear to protect against falling objects.
- Eye and face protection - operators, welders, or helpers should wear goggles, a helmet, and face shield to provide maximum protection for the particular welding or cutting process used. All filter lenses and plates must meet the test for transmission of radiant energy prescribed in ANSI Standard Z87.1, Practice for Occupational and Educational Eye and Face Protection.
- Respiratory protection - If gases, dusts, and fumes cannot be maintained below permissible exposure levels (PELs), welders should wear respiratory protective equipment designated by the National Institute of Occupational Safety and Health (NIOSH).

Clothing preferences

Welders should cover all parts of their bodies to protect against ultraviolet and infrared ray flash burn. Dark clothing works best to reduce reflection under the face shield.

Wool, leather, or cotton treated to reduce flammability is preferred for welding. Clothing should be thick enough to prevent flash-through burns, be clean, and be free of oil or grease. Clothes should have sleeves and collars buttoned and should have no front pockets that could catch sparks. Welders should wear pants without cuffs. Pants legs should cover the tops of shoes or boots.

If worn, thermal insulated underwear should be covered by other clothing and not exposed to sparks or other ignition sources. It should be down-filled or waffle weave cotton or wool.

Quilted nylon-shell/polyester-filled underwear and synthetic outer wear won't necessarily ignite more easily than cotton, but it melts as it burns, sticking tightly to skin, which can result in a very serious burn that is hard to treat and slow to heal.

HOUSEKEEPING IS A PRIORITY

Keeping welding areas free of combustibles is extremely important in avoiding fires. Collect used electrodes or rod stubs for safe disposal. Proper storage of compressed gas cylinders is also an element of fire prevention. As always, store tools in the appropriate place.

WORK AT WORKING SAFELY

In all welding operations, take time to evaluate the job and implement appropriate safety precautions. This step will not only prevent equipment and machine damage, but it will reduce the risk of an accident that could injure you or a co-worker.