WELDING AND CUTTING SAFETY

Welding, soldering, and brazing are commonly known as “hot work”. Hot work presents increased potential for fire and explosion hazards, especially when performed in confined and enclosed spaces. You must be aware of these hazards to work safely and avoid accidents and injuries.

COMMON HAZARDS

Air Contaminants- Hot work produces air contaminants. The most common contaminants include metal fumes and gases. Hazardous fumes may be produced from heating toxic metals found in common alloys. The fume particles created are small and can deposit deep in the lungs causing adverse health effects that can range from systemic poisoning to respiratory tract irritations. Setting up an appropriate work environment and using the appropriate goggles, face shields, and/or respirators will protect you from contaminants.

Radiation- Both visible ultraviolet (UV) and infrared (IR) radiation are produced when welding and cutting. These types of radiation can cause skin damage (sunburn and cancer) and eye damage (welder’s flash, cataracts, and burns). You may not be aware of these injuries until after they occur since UV and IR radiation is NOT detectable by the senses. Appropriate clothing and filter lenses will protect you from radiation damage.

Burns and Fires- Hot work can be a fire hazard. Burns, fires, or explosions can result from flames, arcs, molten metals, heated surfaces, or metal splatters. Sparks from welding operations have been known to travel as far as 35 feet horizontally from the welding sight. Be aware of fire hazards when welding and remember that you can cause fires or be burned when working. Unplug and place soldering irons or guns in holders or stands when not in use. Always assume that a soldering iron or gun is hot. Give equipment time to cool down before touching tongs and tips.

Electrical Shocks- Every year welders die from electric shock. Electric shocks can occur when proper precautions are not taken. Equipment must meet Underwriters Laboratories (UL) code and be checked and serviced regularly. Servicing and installation must only be undertaken by a qualified licensed electrician.

GENERAL RULES

The proper use of welding and cutting equipment will minimize injuries.

- Always follow the manufacturer’s recommendations for setting up and operating equipment, selection of tip size, and gas cylinder operating pressures.

- Always use a regulator to reduce gas cylinder pressure to the operating pressures recommended by the equipment manufacturer. All piping and equipment must meet the standards of the Compressed Gas Association.
- Always ensure that all connections are leak tight. Each time connections are loosened and retightened, each connection should be checked with a soap and water solution (oil free soap). Do not check with flame.
- Before connecting a regulator to a gas cylinder, open the cylinder valve for a moment. Called cracking the cylinder valve, this will blow out any foreign material that may have lodged in the valve during transit. Do not stand in front of the valve when “cracking”.
- Never perform welding, cutting, brazing, or heating operations in a poorly ventilated area. Avoid breathing fumes from these operations at all times; particularly when zinc, cadmium, or lead coated metals are involved.
- Never use defective, worn, or leaky equipment. Repair it or take it out of service.
- Never use acetylene in excess of 15 psi pressure. Higher pressures with acetylene are dangerous. If the cylinder is not fitted with a hand wheel valve control, any special wrench required must be placed on the cylinder while the cylinder is in service. On manifolds, one wrench for each manifold will suffice.
- Always have an appropriate fire extinguisher in good operating condition readily available when operating welding or cutting equipment.
- Never perform welding or cutting operations near combustible materials (gasoline cans, paints, paper, rags, etc.).
- Always protect you, other workers, welding hoses, gas cylinders, and flammable materials from the hot slag and sparks resulting from the welding and cutting operations.
- The welder and spectators must always wear goggles to protect the eyes from harmful light rays, sparks, and hot molten metal during welding, cutting, and heating operations. Eye protection must comply with the established ANSI Standards.
- Always wear clean, oil free clothing during welding and cutting operations. Protect the hands with leather welding gloves to avoid burns from radiation and hot molten slag. Low cut shoes and trousers with cuffs or open pockets should not be worn.
- Never use a match or cigarette lighter to light a cutting or welding torch. Always use a spark igniter. Fingers are easily burned by the igniting gas when a match or cigarette lighter is used.

- Ensure that the material being welded or cut is secure and will not move or fall on anyone.
- Never use a welding, cutting, or heating torch on a container that has held a flammable liquid. Explosive vapors can accumulate and linger in closed containers for extended periods of time.
- Never use a regulator for gasses other than those for which it was designed for by the manufacturer, since the diaphragm and seat materials may not be compatible with other gasses.
- Never tamper with the safety devices on cylinders, fuse plugs, safety discs, etc., and do not permit torch flames or sparks to strike the cylinder.
- All cylinders, particularly acetylene, should be restrained securely in an upright position to prevent accidents. A non-vertical position for an acetylene cylinder in use would allow the discharge of acetone through the regulator and into the cutting torch, clogging the mixer passages and creating a fire hazard. It would reduce the efficiency of the flame and contaminate the weld area. It can also cause voids in the porous material inside the cylinder, which can lead to acetylene explosions.
- Keep all burning or flammable substances away from the oxygen or fuel gas storage area (at least 20 feet) and post “No Smoking” signs.
- Fire is the biggest hazard in welding. The area should be cleared for a radius of 35 feet. Fire shields should be used. Upon completion of a welding, heating, or cutting operation, immediately inspect the surrounding areas for smoldering embers. Allow at least 30 minutes to elapse before leaving the area and conduct another thorough inspection just before leaving. Also alert other personnel of fire possibilities.
- Always have the properly fitted wrench to fasten a regulator to a cylinder. Never tighten the regulator by hand.
- Always leave the fuel gas cylinder valve wrench in place when the cylinder valve is open so that it can be closed quickly in an emergency. Do not open acetylene valves more than one-quarter (1/4) turn.
- After attaching a regulator to a gas cylinder, be sure the regulator adjusting screw is fully released (backed off in a counter clockwise direction so that it swivels freely) before the cylinder valve is opened. Never stand in front of a regulator when you are opening a cylinder valve.
- Always open the cylinder valve slowly so that gas pressure will build up slowly in the regulator (particularly in the oxygen cylinder). Quick opening of the cylinder valve causes a buildup of heat due to recompression of the

gas. When combined with combustible materials, ignition and explosion may result.

- If a leak develops in a fuel gas cylinder that cannot be stopped by closing the valve, immediately place the cylinder outside of the building away from possible fire or ignition sources. Place it in a location that is free from wind currents that might carry the gas to an ignition source.
- When a gas cylinder is ready for return to the supplier, be certain the cylinder valve is closed to prevent internal contamination and the shipping cap is in place to protect the cylinder valve. Identify empty cylinders.
- Never use oxygen or other gasses as a substitute for compressed air in operation of air-operated tools, blowing off parts, or for ventilation purposes.
- Do not attempt to do your own repair on welding equipment. Equipment that is improperly repaired can cause leaks and other hazardous conditions. Repairs must be performed by qualified repair personnel.
- Never repair welding hose with tape. Use of tape and many hose splicers can reduce the pressure to the torch and can cause hazardous conditions. Welding hose must meet the specifications of the Compressed Gas Association.
- Use the shortest length of hose possible. Longer hoses require higher gas pressures and can be hard to handle.
- Never use oil or grease on any part of welding or cutting equipment and never let it come into contact with oil or grease. This includes gas cylinders, work bench, regulators, torches, tips, threads on bottles, and clothes that are worn, such as jackets, gloves, and aprons. Oxygen and oil or grease can cause explosions and fire.
- Never use a hammer on the valve cover caps to loosen them. Use a piece of wood to soften the impact and prevent sparks and damage to the cap. Do not hammer on any cylinder. Do not tamper with the relief valves. If you have trouble, contact the supplier for assistance.
- When moving gas cylinders, always roll them on their bottom edges or in a cart designed for their movement. Sliding, dragging, or rolling causes excessive wear and may weaken their walls by metal erosion. Slings and electromagnets are not authorized when transporting cylinders.
- Never use cylinders as rollers to move material. Do not let them bump into each other or let them fall.
- Fuel gas and liquefied fuels must be stored and shipped valve end up.
- Do not hammer on any cylinder. Do not tamper with the relief valves. If you have trouble, contact the supplier for assistance.

- Suitable eye protection shall be worn for all welding and cutting operations. See chart below
- Cylinders shall be secured. Valves shall be closed when unattended and caps shall be on the cylinders when the regulators are not on the cylinders.
- Cylinders shall be upright when they are transported in powered vehicles.
- All fuel gases shall be used through a regulator on cylinder or manifold.
- Compressed gas cylinders shall be upright except for short periods for transportation.
- Oxygen regulators shall be marked “Use No Oil”. Regulators and fittings shall meet the specifications of the Compressed Gas Association.
- Caps shall be on cylinders during transportation.
- Proper personal protective equipment shall be worn by all welders and assisting personnel.
- All welding personnel should be advised of the hazards from heating zinc, lead, cadmium, and any other substances that could cause health problems from the welding activity.

(The Following Apply to Arc Welding):

- Chains, wire ropes, hoists, and elevators shall not be used to carry welding current.
- Wear appropriate PPE
- Take precautions against electrical shock
- Conduits with electrical conductors in them shall not be used to complete a welding circuit.
- Welding leads shall be inspected regularly for damage to insulation. Stingers shall be removed when not in use
- Never hold leads under the arm or drape them around the body
- Only proper splicing will be authorized. There should be no splices in stinger lead within 10 feet of the stinger and the leads should never be wrapped around the body.

Typical Welding PPE

Protective shade chart for welding operations:

Table 1: Filter Lenses for Protection during Shielded Metal Arc Welding

Operation	Electrode Size – inch (mm)	Arc Current (Amperes)	OSHA Minimum Protective Shade Number	ANSI & AWS Shade Number Recommendations*
Shielded Metal Arc Welding (SMAW)	Less than 3/32 (2.4)	Fewer than 60	7	-
	3/32-5/32 (2.4-4.0)	60-160	8	10
	More than 5/32-1/4 (4.0-6.4)	More than 160-250	10	12
	More than 1/4 (6.4)	More than 250-550	11	14

Table 2: Filter Lenses for Gas Welding and Oxygen Cutting Operations

Operation	Plate Thickness Inches	Plate Thickness mm	OSHA Minimum Protective Shade Number	ANSI & AWS Shade Number Recommendations*
Gas Welding	Under 1/8	Under 3.2	4	5
	1/4 to 1/2	3.2 to 12.7	5	6
	Over 1/2	Over 12.7	6	8
Oxygen Cutting	Under 1	Under 25	3	4
	1 to 6	25 to 150	4	5
	Over 6	Over 150	5	6

Table 3: Filter Lenses for Protection during Other Welding and Cutting Operations

Operation	Arc Current (Amperes)	OSHA Minimum Protective Shade Number	ANSI & AWS Shade Number Recommendations*
Gas Metal Arc Welding (GMAW) and Flux Cored Arc Welding (FCAW)	Fewer than 60	7	-
	60-160	10	11
	More than 160-250	10	12
	More than 250-500	10	14
Gas Tungsten Arc Welding (GTAW)	Fewer than 50	8	10
	50-150	8	12
	More than 150-500	10	14
Air Carbon Arc Cutting (CAC-A) (Light)	Fewer than 500	10	12
Air Carbon Arc Cutting (CAC-A) (Heavy)	500-1000	11	14
Plasma Arc Welding (PAW)	Fewer than 20	6	6-8
	20-100	8	10
	More than 100-400	10	12
	More than 400-800	11	14
Plasma Arc Cutting (PAC) (Light)**	Fewer than 300	8	9
Plasma Arc Cutting (PAC) (Medium)**	300-400	9	12
Plasma Arc Cutting (PAC) (Heavy)**	More than 400-800	10	14
Torch Brazing (TB)		3	3 or 4
Torch Soldering (TS)		2	2
Carbon Arc Welding (CAW)		14	14

** As a rule of thumb, start with a shade that is too dark to see the weld zone. Then, go to a lighter shade which gives a sufficient view of the weld zone without going below the minimum.* During oxygen gas welding or cutting where the torch produces a high yellow light, it is desirable to use a filter lens that absorbs the yellow or sodium line in the visible light (spectrum) of the operation.

** Values apply where the actual arc is clearly seen. Lighter filters may be used when the arc is hidden by the workpiece.