

WELDING AND CUTTING OPERATIONS

(For assistance, please contact EHS at (402) 472-4925, or visit our web site at <http://ehs.unl.edu>.)

This SOP provides an awareness of hazards associated with welding and cutting operations and strategies for minimizing associated risks. These hazards primarily consist of toxic fumes, dusts, burns, fires, explosions, electric shock, radiation, noise, and heat stress. This SOP should be used in tandem with the EHS SOP titled, ***Welding Lens Shade and Personal Protective Equipment (PPE) Selection***.

Oxy-Acetylene Processes

This type of process uses oxygen and acetylene gases to produce a flame with temperatures in excess of 6000 degrees F. By using the proper tips, rods, and fluxes, almost any metal can be welded, heated, or cut using the oxy-acetylene process.

Arc Welding

Arc welding also uses intense heat, but the heat is generated through an electric arc. Basic components of an arc welding system include an AC or DC power source, an electrode and electrode holder, the working metal piece, and a shielding gas. Basically, voltage from the power source feeds the electrode which is held close to but not touching the working metal piece, creating an arc between the electrode and the working metal piece. The shielding gas (generally argon, helium, or carbon dioxide) minimizes contact of the molten metal with air to avoid adverse chemical reactions that would weaken the resulting weld.

MIG (Metal Inert Gas, also known as GMAW, Gas Metal Arc Welding) welding uses an aluminum alloy wire as a combined electrode and filler material. The electrode is eventually consumed in the process as it becomes molten and forms the weld. TIG (Tungsten Inert Gas, also known as GTAW, Gas Tungsten Arc Welding) welding uses a non-melting electrode made of tungsten in combination with filler metal rod to create the weld.

Gas Hazards

Shielding gases used in arc welding are inert. The primary health hazard with these gases is the potential for displacement of breathing air if significant quantities are released into a poorly ventilated area. However, these gases are supplied in high pressure compressed gas cylinders which present physical hazards, such as rupture if exposed to intense heat.

Oxygen is supplied in a high pressure compressed gas cylinder, which is usually color coded green. Acetylene is supplied in a low pressure compressed gas cylinder in which the gas is dissolved in acetone. Acetylene cylinders are usually color coded black

(small acetylene cylinders are sometimes color coded gray, silver, or red). However, color coding is not universal, and may vary from manufacturer to manufacturer. Therefore, cylinder color should never be used as a positive means of identification. Welders should read and understand the Material Safety Data Sheets for welding/cutting gases.

- Oxygen is incompatible with organic material, contact with which can cause an explosion or fire. Therefore, it is very important to keep oxygen cylinder valves and connections clean and free of dirt, oil, and grease.
- It is equally important to keep acetylene valves and connections clean since acetylene is highly flammable and will ignite organic materials.
- The maximum safe working pressure for acetylene is 15 psig (103 kPa). Do not discharge cylinders at pressures above this limit.
- Never use oxygen or fuel gas to blow dirt or dust off clothing or equipment.
- Acetylene will form explosive deposits with certain metals and alloys. Do not use copper piping and fittings with acetylene (or alloys containing greater than 65% copper). Acetylene can also react with silver and mercury under certain conditions.

Cylinder Hazards

General compressed gas cylinder safety is discussed in the EHS SOP, ***Compressed Gas Cylinders in Laboratories***.

- Although it is important to store all compressed gas cylinders in an upright position, this is particularly important with acetylene since it is dissolved in acetone.
- Store cylinders in a cool, well-ventilated area, with the cylinder caps in place and in a manner that secures them from tipping (e.g., a cylinder stand or anchored with a chain).
- Store oxygen cylinders away from flammable gas cylinders (greater than 20 feet or separated by a 1 ½ hour-rated fire barrier at least 5 feet tall).
- Always keep the valve wrench on the acetylene cylinder valve when in use. Open the valve a maximum of 1½ turns.
- Do not subject cylinders to temperatures in excess of 130 degrees F.
- Use a hand cart specifically designed for moving cylinders. Do not roll or drag.

Welding Cart Usage and Storage

To reduce the risk of excessive wear and damage to caps and regulators from repeatedly removing and reinstalling, compressed gas cylinders may be stored on a single portable welding cart especially built for that purpose, but only if those gases are intended to be used on a regular basis (e.g., at least once per month). When stored on a cart, cylinder valves must be closed.

- The cylinders must be oriented on the cart in an upright position and restrained at all times.
- The cart must be constructed of non-combustible materials and stable to prevent possible tip-over. The cart must be kept on a firm level surface.
- The cart must be kept in a well-protected, well-ventilated, dry location at least 20 feet from highly combustible materials such as oil, etc.

- A cart with mixed gas cylinders (oxygen and acetylene) may not be stored with other incompatible compressed gas cylinders, such as other flammable gases or other oxygen cylinders.
- If a welding cart is not used more than once a month the cylinders should be removed and stored separately in accordance with cylinder storage requirements (e.g., regulators removed and caps secured).

Regulator Hazards

The purpose of a regulator is to reduce the cylinder pressure to a safe working pressure. An oxygen regulator is unique to oxygen. Oxygen regulators have right hand threads and regulators for acetylene and other fuel gases have left hand threads. Acetylene regulators have their gauge scales marked in red starting at 15 psig, as a reminder not to exceed the safe working pressure for acetylene.

- Always make sure a regulator is in the closed position to prevent unregulated gas flow before attaching it to a cylinder. Stand to the side of a regulator, not in front of it when opening cylinder valves.
- Do not leave regulators attached to the cylinders when not in use.
- Do not use sealants.
- Do not use a regulator for more than one type of gas.

Hoses

In the United States, oxygen hoses are colored green. Acetylene and other fuel gas hoses are colored red.

- Inspect hoses for defects/deterioration before use.
- Use a bubble solution (never a flame!) to check hoses for leaks before use.
- Protect hoses from damage. Oil, sunlight, and chemical fumes can degrade hoses; as can physical abrasion and sharp objects.
- Position hoses away from traffic patterns and protect them from flames, sparks, and splatter during welding and cutting.
- Ensure the presence of a check valve and flame arrestor.
- Disconnect hoses after use- do not leave residual gases in the hoses.

AC/DC

- Use only welders that carry a seal of approval by the Underwriters Laboratories (UL) or National Electric Manufacturers Association (NEMA).
- Inspect equipment and area prior to use and prepare for welding. Ensure that:
 - ✓ The area is dry and protected from combustibles. Never weld in the rain or while standing in water or on wet floors.
 - ✓ The equipment is properly grounded and in good working condition.
 - ✓ The correct sized cables are intended for use. Overloading can cause cable failure and result in electrical shock or fire.
 - ✓ The work lead is firmly attached to the work.
 - ✓ The ground cable is connected as close as possible to the area where welding is being conducted, and is connected to clean metal (no rust, paint, or coating). The work lead is not a ground lead.

- ✓ Magnetic work clamps are free of metal particles of spatter or other contaminants on contact surfaces.
- ✓ Electrode holders and cable insulation in good condition. Do not use the equipment if insulation is damaged or missing, or if there are loose cable connections on the electrode holders. Replace damaged cables.
- ✓ All electrical connections are tight, clean, and dry.
- ✓ Cables are neatly organized and unrolled when in use to avoid overheating and damage to insulation. Keep welding cables away from power supply cables. Workers should never loop the cables around their bodies.
- During use, ensure that hot electrodes and hot surfaces do not contact bare skin.
- After use, ensure that:
 - ✓ Electrode holders are placed in a way that accidental contact with persons, conducting objects, and compressed gas tanks will not occur.
 - ✓ Electrodes are removed from the holder and disconnected from the welding machine.
 - ✓ The welding machine is isolated from the power source.
 - ✓ Hot metals are marked or other means implemented to provide some means of warning other workers.

Other

- Never light a torch with matches or a lighter. Always use a striker.
- Do not carry lighters, matches, or other flammable objects in pockets when welding or cutting.
- Wear appropriate apparel and personal protective equipment. See EHS SOP, ***Welding Lens Shade & Personal Protective Equipment (PPE) Selection***.
- Conduct welding/cutting work in permanently established and specifically designed areas; or conduct work in accordance with hot work permit requirements. See EHS SOP, ***Hot Work Permit Operations***.
- Ensure adequate ventilation in the work area. Increased ventilation and/or respiratory protection may be necessary when welding or cutting involves cadmium, zinc, lead, fluorine compounds, or other toxic materials. Do not weld dirty metals or used drums or like items that may have previously held a potentially hazardous material.
- Only trained and authorized employees are allowed to operate welders. Supervisors must ensure that employees are appropriately trained.