

ARC WELDING

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

Arc welding is a method that utilizes intense heat (i.e., 6500 F or greater) generated through creation of an electric arc to fuse metals. Basic components of the welding system include an AC or DC power source, an electrode and electrode holder, the working metal piece, and usually 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 a filler metal rod to create the weld.

Arc welding hazards include toxic fumes, dusts, burns, fires, explosions, electric shock, radiation, noise, and heat stress. In addition to the safety procedures discussed in the related EHS SOPs, ***Welding Lens Shading, Fumes and Gases from Welding and Cutting***, and ***General Safety Tips for Welding***, observe the following additional safety precautions to minimize hazards associated with arc welding.

- Use only welders that carry a seal of approval by the Underwriters Laboratories (UL) or National Electric Manufacturers Association (NEMA).
- Install stationary welders and associated electrical supplies in compliance with applicable electrical codes, including grounding and circuit protection.
- Ensure adequate ventilation. If non-hazardous metals and coatings are involved general ventilation of 2000 cubic feet per minute per welder is satisfactory. If hazardous metals or coatings are involved, local exhaust is needed and respiratory protection may be required. Consult with EHS on recommended ventilation for specific operations.
- Whenever possible, conduct welding only in areas that are fire safe (e.g., fire resistant floor construction, protection of the area with fire resistant curtains or metal sheets, etc.). The welding shop should be free of combustibles and flammables within a 35-foot radius around the welding area. Make sure that a dry-chemical ABC fire extinguisher is available in the immediate work area.

- Utilize a hot work permit system in non-fire safe areas. See the EHS SOP, **Hot Work**.
- Wear DRY and appropriate clothing:
 - Long sleeves and pants or coveralls. Do not wear synthetic fiber clothing and/or clothes with pockets, holes, or cuffs. Remove flammable materials (i.e., lighters, matches, etc.) from pockets.
 - Welder's gloves that are free of holes.
 - High-top leather shoes or boots with rubber soles.
 - Welder's apron.
 - Welder's helmet and eye protection. Wear the correct lens shade for the work being conducted. See the EHS SOP, **Welding Lens Shading**. Never look at the arc with unprotected eyes. Use welding screens to protect others in the area.
 - Consider a flammable resistant skull cap to cover the hair and head.
 - Additional personal protective equipment (PPE), such as hearing and respiratory protection may be necessary depending on the specific situation.
- Only trained and authorized employees are allowed to operate welders. Supervisors must ensure that employees are appropriately trained.
- 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.
 - Work lead is firmly attached to the work.
 - 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 compresses 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.
 - Wear insulated gloves and shut off power when adjusting equipment.
- If power is provided by a generator:
 - Make sure ventilation is adequate.
 - Make sure the enclosure is complete and guards are in place.
 - Turn off the engine before refueling.
- Gas cylinders and welding machines should be left on the outside at all time when welding in a confined space. When welding in an unventilated or confined space, additional **Confined Space Program** requirements apply. Consult EHS prior to conducting this type of welding operation. For additional safety precautions related to compressed gases, see relevant portions of the EHS SOP, ***Use of Compressed Gas Cylinders in Laboratories***.
- Welding equipment repair should be made only by qualified personnel. Damaged equipment should be disconnected and tagged until repair is made.
- Be aware of the potential for heat stress.
- Do not weld dirty metals or used drums or like items that may have previously held a potentially hazardous material.