

Welding, Cutting and Brazing Part 1: Methods

Welding, cutting and brazing are hot work techniques that workers use to bond, cut, solder or form metals at extremely hot temperatures.

Methods and Hazards

All hot work involves hazards like fires, burns, the potential for heat stress, and other issues associated with extremely hot temperatures. There are hazards that depend on the method and materials involved in welding, cutting and brazing. This job aid will provide an overview of methods and hazards. You will receive additional training from your employer about the specific hazards associated with your work and work area.

In **gas torch welding and cutting**, workers commonly use a torch filled with a fuel gas and oxygen to produce a flame that melts metal. Fuel gases may include acetylene, methylacetylene, hydrogen, propane or propylene. The type of gas can affect this method's hazards in terms of fumes, fire and explosion potential.

Electrical arc welding and cutting uses an electrical arc between the work piece and the welding electrode. It creates a pool of molten metal and commonly involves a protective shield of gas or molten metal to prevent or minimize contact with air. Types of electrical arc welding are distinguished by the types of electrodes and gas shields they use. When performing electrical arc welding, be aware of the dangers of plasma (ionized gas that strikes work pieces with high heat and kinetic energy), ultraviolet (UV) rays or light, inhalation of gases and fumes, and electrical shock.

Brazing involves joining metal items by heating and applying a filler metal with a lower melting point than the work piece.

Common filler **metals** include copper, nickel, aluminum and brass alloys. Be aware that **metals** at hot temperatures can react chemically with elements in the air, such as oxygen and nitrogen, and with ambient temperatures and UV to create dangerous fumes and gases. The type of metal involved in the work piece or in the filler can affect the hazards that may be present.

Your employer will train you about the metals you will work with and their hazards. You may also refer to Safety Data Sheets (SDSs) for information about welding fluxes, solders, consumable electrodes and filler materials.

Gas Torch Welding and Cutting Safety

Pressurized Filler Gas	Fuel Gas
<ul style="list-style-type: none">• Oxygen may be combined with fuel gases• Oxygen helps objects burn• Keep gloves, oxygen fittings and connections free from oil or grease because oxygen reacts explosively with these substances• Store oxygen and flammable gases at least 6 meters (20 feet) apart or use a half-hour fire-rated partition at least 1.6 meters (5 feet) tall to separate storage areas	<ul style="list-style-type: none">• Fuel gases may include acetylene, methylacetylene, hydrogen, propane or propylene• Acetylene is the most common fuel gas• It is very flammable and can ignite at a wide range of concentrations• Acetylene becomes unstable (combusts or explodes) at high pressures, so NEVER use acetylene at pressures above 104 kilopascals (kPa) or 15 pounds per square inch (psi)• Keep acetylene cylinders in an upright position because acetylene is stabilized in acetone liquid that may spill or get into the regulator, line or torch if a cylinder is stored on its side

Before you open welding gas cylinders:

- Ensure there are no ignition sources nearby because they can cause gas to ignite or explode
- Perform a visual pre-use inspection for defects or dirtiness of the torch, lines and regulator to prevent gas leaks, fires and explosions
- Ensure clothing and welding gear are free from oil and grease smears
- Make sure there are no hydrocarbon-based lubricants on the regulator, hose, torch or cylinder valve threads

Note that some cylinders valves require tools, which you should keep nearby for quick adjustments or to stop flow in the event of hose fires or other emergencies. **Stand to the side** of the cylinder outlet and regulator and keep torch nozzles and regulator faces pointed away from your body. Blow out the cylinder valve before connecting the regulator by opening the valve slightly and then closing.

Check for leaks after making new connections by listening for hissing, investigating smells and using leak check solutions to look for bubbles. Do NOT crack open the valves of hydrogen cylinders, even momentarily; the compressed gas can self-ignite in certain conditions. Do NOT vent gases toward yourself or in confined spaces or other areas with limited ventilation.

Before you light a gas welding torch:

- Purge oxygen and fuel gas passages individually by slowly allowing each gas to flow through its respective hose separately
- Keep the tip of the torch pointing away from your body

To safely light a gas welding torch, keep the nozzle pointed away from your body.

1. Release the fuel gas.
2. Light the flame with a long-handled flint striker.
3. Slowly and fully open the oxygen and adjust it down to create the desired flame size.

If you release the oxygen before the fuel gas, you will hear a loud BOOM as the flame ignites. Releasing the fuel gas first allows you to better control the flame and avoid creating a flash fire.

When you finish the job, follow manufacturer instructions for shutting down the gas welding torch. For many torches, the steps are:

1. Close the oxygen gas valve first, then the fuel gas valve.
2. Ensure the valves of both cylinders are fully closed.
3. Open the oxygen gas valve a 1/2 turn and bleed pressure from the line.
4. Close the oxygen torch valve and turn the regulator adjusting screw to the OFF position.
5. Open the fuel gas valve a 1/2 turn and bleed pressure from the line.
6. Close the fuel gas valve and turn the regulator adjusting screw to the outward or OFF position.

Neatly coil the hoses and store the equipment per the manufacturer's instructions.

Electrical Arc Welding and Cutting Safety

Electrical shock CAN cause injury or death. You WILL receive a shock if your body touches both sides of the welding circuit – the electrode and the work piece or welding ground – at the same time.

Follow these electrical arc welding and cutting guidelines:

- Use well-insulated electrode holders and cables that are in good condition
- Keep welding cables, your body and personal protective equipment dry and free of grease and oil
- Keep the working ends of welding cables apart
- Wear dry, hole-free gloves; clothing should also be dry
- Never touch the electrode or metal parts of the electrode holder with skin or wet clothing
- Dry any insulation between your body and metal
- Prevent welding leads from sustaining damage due to equipment rolling over them

Remember: Stick electrodes are always electrified even when you are not welding.

Practices, Positioning and Personal Protective Equipment (PPE)

The job hazard analysis should prescribe the safest welding method and materials. Keep your face as far away from the welding plume as possible. Employers may monitor air quality and use ventilation, exhaust and other measures to reduce exposure to gases and fumes. Position your body to avoid fumes, sparks and molten metal.

SAFE CLOTHING offers some protection from sparks, molten metal, UV exposure and flames:	UNSAFE CLOTHING doesn't offer adequate skin protection and may melt/burn:
<ul style="list-style-type: none">• Flame-resistant wool, denim, canvas or heavy cotton• Fitted• Long-sleeve shirts, long pants that overlap shoe/boot tops, welding jackets or coveralls	<ul style="list-style-type: none">• Many synthetic fibers• Frayed or worn• Unbuttoned cuffs or open pockets• Flammable material such as lighters/matches in pockets and smeared oil/grease/solvents

Personal protective equipment (PPE) is designed to supplement other controls to help protect your skin, hair and eyes from molten metal spatter, sparks and UV. Check the **job hazard analysis** to determine the specific equipment you must wear for each welding task. PPE for welding, cutting or brazing work may include:

- Welding goggles or a welding helmet with a cap underneath
- Insulated welding gloves
- Fire-resistant (FR) sleeves
- Fire-resistant or leather cape or shoulder covers (for overhead work)
- Electrically rated leather shoes with safety toes
- A respirator with appropriate medical and fit testing (for some operations)
- Earplugs or earmuffs (for noisy operations and those that generate sparks)

The job hazard analysis should identify welding helmets or goggles that have the appropriate ratings for the potential exposures to UV, impact and heat for the job at hand. Some helmets may have shields that automatically darken or lighten based on light intensity. Refer to the operator's manual for information about any manual adjustments needed for specific welding methods. Never use a helmet if the filter plate or cover lens is cracked or broken.