Welding Safety Hazards

Welding operations present several hazards to both those undertaking the activity and others in the vicinity. Therefore, it's important that you are aware of the risks and hazards welding poses, and understand what precautions you can take to protect yourself.

Welding Hazards are as follows:

1. **Exposure to Fumes and Gases:**

   Undertaking welding activities will expose you to invisible gaseous fumes, including ozone, nitrogen oxides, chromium and nickel oxides, and carbon monoxide which can easily penetrate into your lungs. Depending on the gas or fume, the concentration and duration of your exposure, the resultant damage can be severe. Exposure to fumes and gases can be controlled by adhering to these safety precautions.

   Health Problems caused by welding fumes and gases include:

   - **Pneumonia.** Regular exposure to welding fumes and gases can result in a lung infection which could then develop into pneumonia. While antibiotics can usually stop the infection, severe pneumonia can result in hospitalisation, serious illness and fatalities.
   - **Occupational asthma.** Chromium oxides and nickel oxides produced by stainless steel and high nickel alloy welding can both cause asthma.
   - **Cancer.** All welding fumes are internationally considered 'carcinogenic'.
   - **Metal fume fever.** Welding or hot work on galvanised metal and high steel weld fume exposure can often result in 'flu-like' symptoms, which are usually worse at the start of the working week. You might have heard that drinking milk before welding will help you avoid developing metal fume fever, but this is a **myth.**
   - **Throat and lung irritation,** including throat dryness, tickling of the throat, coughing and tight chests.

2. **Physical Hazards:**
   Physical hazards that can cause burns, eye damage, cuts, and crushed toes and fingers are ever-present when welding. With the appropriate Personal Protective Equipment (PPE) and other safety measures, you can protect your workers against physical hazards.

2.2.2 Noise Hazards

When carrying out welding activities, you are likely to be exposed to loud, prolonged noises. A loud noise is considered to be above 85 dB(A), and welding activities such as flame cutting and air arc gouging can produce noise levels of over 100 dB(A). This can be very damaging to the ears and can result in hearing impairment.

Regular or immediate exposure to loud noises can cause permanent noise-induced hearing loss.

Noise-induced hearing loss can have the following side effects:

- Ringing in the ears, known as tinnitus.
- Occasional dizziness, known as vertigo.
- Increased heart rate.
- Increased blood pressure.

2.2.3 Exposure to UV and IR Radiation

Looking at the intense bloom of UV light produced when welding, without appropriate PPE or welding curtains, can result in a painful and sometimes long-lasting condition called arc-eye. Many factors can affect the severity of a flash burn injury, such as distance, duration and the angle of penetration. Long-term exposure to arc flashes could also potentially result in cataracts and lead to a loss of vision.

Other forms of eye damage include:

- **Foreign bodies** entering the eye, including grit, sparks and dust.
- **Particulate fumes and gases,** which could lead to conjunctivitis.

2.2.4 Exposure to Fumes and Gases

Undertaking welding activities will expose you to invisible gaseous fumes, including ozone, nitrogen oxides, chromium and nickel oxides, and carbon monoxide which can easily penetrate into your lungs. Depending on the gas or fume, the concentration and duration of your exposure, the resultant damage can be severe.

2.2.5 Burns

The combination of high-temperature welding arcs, UV rays and molten metal means you are susceptible to severe burns when welding. These burns can affect the skin or eyes and can be very serious. They can also happen **very** quickly.

Burns usually occur when welders think they can skip taking precautions for a few quick welds. This is bad practice. If you follow our outlined precautions, you should be able to prevent burns.

3. Electric Shock

Electrocution is the most immediate and serious risk for a welder. The sudden discharge of electricity to the human body can cause serious injury and even death. Electrocution risk from welding can be minimized through these basic precautions.
During the arc welding process, live electrical circuits are used to create a pool of molten metal. Therefore, when welding, you are at risk of experiencing an electric shock. Electric shock is the most serious hazard posed by welding and can result in serious injuries and fatalities, either through a direct shock or from a fall from height

after a shock. You are also at risk of experiencing a **secondary electric shock** should you touch part of the welding or electrode circuit at the same time as touching the metal you are welding.

You are particularly at risk if you work in electrically hazardous conditions. These include welding:

- In damp conditions.
- While wearing wet clothing.
- On metal flooring or structures.
- In cramped conditions where you are required to lie, kneel or crouch.

To avoid from Electric shock, Proper Earthing is necessary in all Points of Switch boards as well Whole Installation. It is duty of all Mechanical Supervisors to ensure Earthing in each and every points of Electric board. If not, It is approached to Electrical Section/ Department of Railway Workshop/Loco Sheds/ C&W Depot.

It is also desirable to ensure proper use of Earthing clamp while perform welding on Locomotive/ Coach/ Wagon/DEMU/MEMU and nearest to these to save them from problems like Hot axle etc.

4. Fire and Explosion

Flammable materials around the working area are the number one cause of a fire. This can be prevented by maintaining a clean working area before proceeding to weld and these other safety controls. It is also important to know the location of fire alarms, emergency exits, and fire extinguishers in the event of a fire.

Welding Safety Precautions

Ensuring high levels of safety is vital when undertaking any welding activity. Ignoring your PPE and safe working practices can have serious repercussions and might even lead to fatalities. Therefore, you should follow the safety precautions below to protect yourself at work.

Always Wear Appropriate PPE

Your employer or manager has a duty to provide you with appropriate **Personal Protective Equipment (PPE)**. The PPEs used while done welding include:

- **Welding helmets with side-shields-**
  Welding helmets protect you from UV radiation, particles, debris, hot slag and chemical burns. It's important that you wear the right lens shade for the work you are carrying out. follow the manufacturer's guidelines and gradually adjust the lens filter until you have good visibility that does not irritate your eyes. You should also use a fire-resistant hood under your helmet to protect the back of your head.
- **Respirators-**
  Respirators protect you from fumes and oxides that the welding process creates. Your respirator must be suitable for the work you are carrying out.
- **Fire resistant clothing-**
  Fire resistant clothing protects you from heat, fire and radiation created in the welding process and shields you from burns. It should have no cuffs, and pockets must be covered by flaps or taped closed. You should not use synthetic clothing. Instead, opt for leather and flame-resistant treated cotton.

- **Ear protection-**
  Ear protection protects you from noise hazards. It's important you wear ear protection that is appropriate for the noise created in your workplace, and use fire resistant ear muffs if there is a risk of sparks or splatter entering the ear.
- **Boots and gloves-**
  Insulated, flame resistant gloves and rubber-soled, steel toe-capped safety shoes shield you from electric shocks, heat, fire, burns and falling objects.

To receive full protection from your PPE, you must not:

- **Roll up sleeves or trousers.** Rolling up your clothes will leave you susceptible to molten metal or sparks getting caught in the folds, which could potentially lead to severe burns. You should also never tuck your trousers into your work boots.
- **Remove your helmet while welding.** You must always wear your helmet when welding and when in the vicinity of another welder. While the intensity of the radiation produced decreases the further you are from a welding arc, those less than 10 metres away are still susceptible to arc-eye. Therefore, it's important that you remain behind welding curtains or wear the correct PPE, even if you aren't the worker carrying out the welding operation.

Welding Safety Precautions and Tips

Safety precautions in welding are action steps welders can do to prevent welding-related incidents or injuries such as burns, eye injuries, and other skin injuries and even deaths due to explosions, electrocutions, and asphyxiation. In order to eliminate or reduce the most common welding hazards, welders should practice the following safety precautions and tips accordingly:

- Provide adequate ventilation and local exhaust to keep fumes and gases from the breathing zone and the general area.
- Report concerns to a supervisor so your exposure to substances of the welding fumes can be checked.
- Fire and electricity resistant clothing, hand shields, welding gloves, aprons, and boots can be worn to protect workers from heat, fires, electrocution, and burns. Take note that flame retardant treatments become less effective with repeated laundering. Pant legs must not have cuffs and must cover the tops of the boots. Cuffs can collect sparks.
- Earmuffs and earplugs can also protect workers against noise.
- Perform lockout and tag out procedures when performing repairs. Only qualified repair technicians should service or repair welding equipment.
- Keep a suitable Class ABC fire extinguisher nearby while welding. Make sure the extinguisher gauge is full. If an extinguisher is not available, be sure to have access to fire hoses, sand buckets, or other equipment that houses a fire.
- If welding within 35 feet of flammable materials, put a piece of sheet metal or fire-resistant blanket over the flammable material and have a fire watcher nearby to keep track of sparks.

- **SAFETY IN OXY-CUTTING & WELDING-**

Personal Protection-

Protection of	Protection from	Recommendation
Eyes	IR Radiation, Spatter	Use correct goggles -shade # 3-6 for cutting -shade # 4-8 for welding 
Skin	IR Radiation, Spatter, Hot metal, Burn	Wear leather gloves & apron 
Apparel	Spatter, Fire	Wear apron
Feet	Spatter, Burn	Wear safety shoes

- **SAFETY IN OXY-CUTTING & WELDING-**

USE OF ACETYLENE-

- ► Do not draw more than 15% acetylene content per hour from a cylinder
- ► Always use cylinder in upright position
- ► Always use correct hose, regulator & fittings
- ► Do not use oxy-acetylene torch in a closed space
- ► Do not use copper piping/parts in acetylene line
- ► Never use Acetylene at a pressure higher than 1kg.

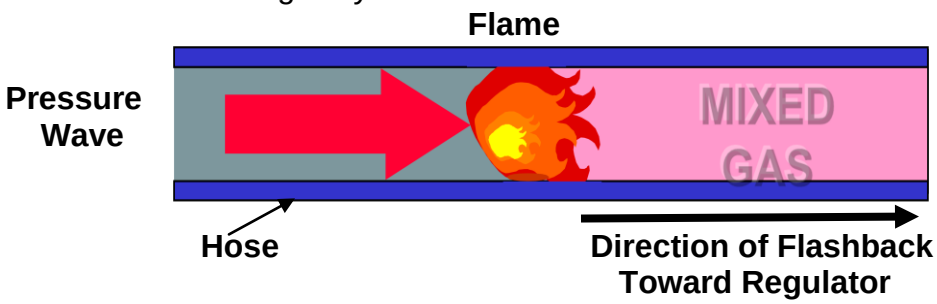
(i) Backfire -

Flame burns back inside torch, usually with a shrill sound, or flame is extinguished with a loud pop. Sustained flashback indicates something seriously wrong. In the event of backfire:

- ► Immediately shut of the oxygen supply, (otherwise high pressure oxygen can get into low pressure FG line causing mixed gas and explode).
- ► Then shut off FG supply
- ► Set the pressures correctly
- ► Clean the nozzle and seat, start again

(ii) Flashback-

A flame and it's pressure wave (75x gas pressure in bar) travel back through the torch and into the gas system.



Cause: This problem occurs due to Improper purging & pressures of O_2 & DA lines.
The flame speed is too fast to be blocked by the check valve in the hose and proceeds right past it through the hose. Use of suitable Flash Back Arrestor recommended.

- **SAFETY IN BRAZING-**

► For manual brazing safety requirements are essentially same as in gas welding
► Use goggles for eye protection (shade # 3-4 for gas brazing)
► Additional safety measures must be taken for protection against flux & toxic metal vapours by assuring ventilation & respiratory protection as required

- **SAFETY IN SOLDERING-**

► Precautions for fire hazard, specially when flame is used,
► Use goggles for eye protection
(use shade # 1.5-3 for soldering with gas torch)
► Ventilation to remove toxic metal & chemical vapours,
► Precaution from hot metal and burns.

- **SAFETY IN PLASMA CUTTING-**

To protect	Protection from	Recommendation
Eyes	IR, UV Radiation,Spatter	Use correct goggles (shade # 8-14)
Skin	IR, UV Radiation, Spatter, Hot metal, Burn	Wear leather gloves & apron
Apparel	Spatter, Fire	Wear apron
Ear	Sound	Use ear plug
Feet	Spatter, Burn	Wear safety shoes
Body	Electric shock	Follow safety instructions
General	Toxic Fumes	Use exhaust, Ventilate

Welding Safety Equipment at a glance -

Sr.No.	Safety equipment	Protection From
1	Welding helmet	Wearing a welding helmet, hood, or mask can protect welders from sparks and radiation emitted by the arc that can quickly damage the skin and eyes.
2	Eye protection	Wearing of googles or hand-held face shields can prevent eye damage or loss of vision.
3	Respirators	Protect welders from inhalation of harmful fumes and gases to enter the body.
4	Flame-resistant welding gloves	Wearing flame-resistant welding gloves can lessen the exposure to intense heat and radiation
5	Protective suits	Protect the welder from extreme temperatures, flames, and sparks.
6	Welding-specific work boots	Protect the top of the foot from flames and sparks.
7	Ear Muff	Protects you from noise hazards. It's important you wear ear protection that is appropriate for the noise created in your workplace, and use fire resistant ear muffs if there is a risk of sparks or splatter entering the ear.

CUTTING AND WELDING

DO…

● Wear proper clothing.
● Wear eye protection.
● Protect other workers from flashes.
● Have an adequate fire extinguisher readily available.
● Provide fire watch if needed.
● Remove combustible materials from the vicinity of cutting and welding operations.
● Secure all connections, couplings and fittings on your rig.
● Inspect equipment before use.
● Contain sparks and slag created by welding or burning operations.
● Protect welding leads and burning hoses by covering or suspending.
● Store gas cylinders upright with the valve end up.
● Separate oxygen and acetylene in storage by 20 feet or a five-foot, half-hour rated fire wall.
● Clear debris from work area after work is completed. .

DON'T…

● Cut or weld in an area with oily rags, dust or other combustible material nearby.
● Weld in an area unless other workers have a welding screen to protect them from the welding arc.
● Transport bottles with gauges installed.
● Use worn cable.
●Use worn hoses.
● Wear clothes of synthetic fabrics.
● Assist anyone cutting or welding unless you are wearing eye protection.
● Leave your area of work without notifying others of the burn hazard.
● Work in an area that is not grounded.
● Weld or cut hot tanks or pipe without proper precautions.
● Run welding leads and burning hoses through doorways.
● Attempt to transfer compressed gas from one cylinder to another.
●Use valve protection caps to lift cylinders.

Do and Don'ts during TIG Welding-

- Do ensure your weld surface is as clean as possible. TIG welding on a dirty or impure work surface will result in a messy and uneven weld.
- Do take the time to prepare your tungsten by grinding it to a fine point – much like a sharp pencil.
- Do look after your TIG welder. Before you start to weld, think about the angles you will be welding at and whether you need to use water or air cooling.
- Don't be tempted to use too much torch gas when working with aluminum A/C.
- Do mix your argon with a little helium if you are going to be TIG welding aluminum and use a 50/50 mix when welding magnesium or thick alloy.

- Don’t forget to do as sufficient research into tungsten sizes before you start welding. Always use the right tungsten for the job at hand.
- Don’t weld in windy conditions if you can help it. The shielding gases will lose coverage and this will result in your weld becoming porous and full of pinholes.
- Do think about investing in a foot pedal to control heat.
- Don’t even think about welding without the right safety equipment. You will need a helmet, welding gloves, fire retardant clothing and also equipment to extract fumes where necessary.
- Make the most of your TIG welder by working with a wide array of materials.

DO'S IN WELDING MACHINES -

- Check and double-check your work area for flammable materials. Make sure that there are no openings in the floor or cracked windows through which sparks can pass.
- Remove flammable liquids and gasses from the area. All it takes is a little spark to set off a huge explosion.
- Remove all combustible materials a safe distance away. All combustible materials should be no closer than 20 feet to your project.
- Clean the floor before you start. Dust and debris on the floor can provide a source of fuel for any sparks that happen to land there.
- Cover all combustible materials that cannot be moved. If you are unable to move all of them from the workspace, cover them with non-combustible materials such as metal sheeting or an asbestos curtain.
- Cover and wet a combustible floor. If the flooring material itself is combustible, cover it with metal sheeting or asbestos materials.
- follow all proper procedures when working with materials that contain or contained flammable liquids. This includes isolation, blanking, purging and inverting. Test the materials immediately before MIG welding to ensure that no flammable vapors remain. Consider filling the container/tank to be welded with water to a few inches of the work area for an extra safety precaution.
- Protect hoses. Keep hoses a safe distance away from any machinery.
- Secure all cylinders. Only transport them with their caps in place.
- Make sure that all electrical equipment is properly installed. Follow all recommended circuit load limits with the recommended circuit protection.
- Uncoil all hoses before use. The hoses of your equipment should be uncoiled and located at a safe distance from the process.
- Protect welding leads. Cover or suspend the leads to prevent damage.
- Store oxygen and acetylene in separate locations. Separate the gasses by a distance of at least 20 feet or by a five-foot, half-hour rated firewall.
- Establish a fire watch if needed. If in doubt, always err on the side of caution.

- Ensure that a fire extinguisher is readily accessible. The last thing you want to be doing in the event of a fire is scrambling around looking for something to quench it.
- Ensure sufficient space is between you and other welders. You don't want to be in the path of sparks from another operator.
- Double-check all connections on your rig. All couplings and fittings should be snug before you begin working.
- Inspect all your equipment before each use. This step is critical to ensure that you don't end up operating a rig that is improperly configured.
- Store all gas cylinders upright. The valve end should be facing up and not sideways or towards the floor.
- Wear eye protection. Eye injuries account for approximately 25 percent of all welding and plasma cutting related injuries and is, in fact, the most common among welders. Those who produce industrial/commercial machinery, computer materials, and fabricated metal products are especially at risk. Wear goggles or safety glasses with side shield compliant with ANSI Z87.1 beneath your helmet at all times.
- Locate the best ground clamp you can find. A good ground clamp will have copper contact points on the jaws as well as a shunt.
- Use a good anti-splatter spray. If you work in a code-enforced location, you will probably need to purchase an approved anti-spatter spray. However, if you are a recreational welder or are in an independent contractor with your own business, you might be able to get by with using PAM cooking spray, which has fewer health risks and is cheaper to boot.
- Keep a spare liner on hand. Change the liner before it reaches a point where the wire is unable to feed through properly.
- Use the correct amperage circuits and fuses where you plug in your rig. Be sure that the wiring is sufficient to safely carry the current.
- Use a sufficient flow rate for shielding gas. The average flow rate is around 20 cubic feet per hour. However, because all flow meters will have variations in calibration, you might need more or less.
- Ensure that you have the correct ventilation. Failure to do so can kill you.
- Wear long sleeves. Short sleeves are not recommended.
- Wear a respirator. Wearing one does not make you a weakling. Respirators will protect you from the harmful gasses that are used during the TIG welding process.
- Practice often. Run tests on scrap metal to ensure that your settings and technique will give you the results you're looking for.
- Ensure that your rig is putting off the correct sounds. When plasma cutting on a short circuit, the saying is to "hear bacon frying." Aim for a smoother sound than that, if possible. If performing aluminum MIG welding, you'll want to hear a humming sound rather than crackles and pops.
- Ensure that your weld surfaces are clean. Dirt, rust, oil, and grease will affect the quality of the weld.

- Maintain your gloves. These can be pricey, so when they become stiff and unyielding, treat them like a pair of hunting boots with boot grease and a blow dryer.
- Use a thin glove on the hand that feeds the filler rod. Some welders recommend using mechanics' gloves or goatskin TIG gloves.
- Use the smallest tungsten possible to get the task done. Using an electrode that is too large can result in erratic arcing and contamination of the weld. Worst-case scenarios will result in arcing inside the cup and out to the side of the tungsten, resulting in the destruction of thin edges and potential loss of expensive parts.
- Use moderate amounts of torch gas when operating as a TIG welder with aluminum. Unlike steel, which holds heat very well, aluminum conducts heat away from the weld puddle at a faster rate than you can maintain it.
- Consider using gasses other than argon for shielding. Although argon is by far the most common and versatile shielding gas used when TIG welding, you will get better results when using a helium/argon mix in certain circumstances.
- Use A fifty-fifty helium argon mix for thick aluminum and magnesium allows.
- Use a 3:1 ratio of helium and argon for thick aluminum castings. A 3:1 ratio of helium and argon puddles quickly and provides a cleaner weld than 100 percent argon.
- Ensure that there is a vent hole in any project that will end up airtight at the end. If you don't, the air inside will heat up and blow away your shielding gas. In some cases, it could blow out at the end of the weld bead and ruin your work.
- Ensure a safe ground connection before beginning. Electric shock can cause severe injury or death.
- Avoid holding two bare wires in each hand. An electric current can pass through the wires and the operator, resulting in potentially deadly shock.
- Remember to keep hands away from the electrode and metal parts of the electrode with your skin or clothing.
- Insulate yourself from the work area and the ground.
- Always wear dry gloves in good condition.
- Keep dry insulation between your body and the project and the ground.
- Use an industrial ventilation system when using a welding machine indoors for commercial applications. For hobbyists, ensure that you have sufficient ventilation with open windows and fans.
- Use an exhaust hood if possible. Exhaust hoods remove the gasses are they are produced from the work area to limit exposure.
- Wear proper PPE (personal protective equipment). This will protect from burns and exposure to arc rays.
- Avoid rolled sleeves or pant cuffs when working as a TIG welder. Sparks or hot metal could land in the folds and burn through the material to your skin.
- Wear good ear protection. This can save your hearing when working in noisy environments and will help prevent debris from entering your ear canal.

DON'TS IN WELDING MACHINE-

- Do not overload an electrical circuit while using a MIG welding machine. Doing so can create a fire hazard.
- Do not operate in an enclosed location. You could kill yourself from the inhalation of dangerous gasses.
- Do not operate a welder without sufficient eye protection. Although most eye injuries are temporary, you could end up permanently blind.
- Do not use cheap ground clamps if you can avoid it. Using cheap clamps will increase start times and will not provide a good ground connection.
- Do not use anything other than an approved anti-splatter spray in commercial applications.
- Do not operate a rig with a clogged liner. Operating with a clogged liner could result in poor wire feeding, bird-nesting and burn backs.
- Do not wear short sleeves or cuffed clothing when welding. You could end up with burns from sparks or hot metal.
- Do not allow hands to come in contact with sharp edges when opening cans of electrodes.
- Do not operate in an area with combustible materials.
- Do not operate in a location where sparks can escape from cracks in walls or windows and come in contact with combustible materials outside.
- Do not operate with flammable liquids or gasses in the area. A single spark can set off a huge explosion.
- Do not start a work where the floor is dirty. Dust and debris are an excellent medium for starting a fire.
- Do not weld a container that has contained or currently contains flammable materials without following the proper cleaning procedures.
- Do not be careless about the location of your hoses. Keep them a safe distance away from any machinery and from all heat sources.
- Do not operate with coiled hoses. Blockages could result in burst hoses and injury.
- Do not transport cylinders without their caps in place.
- Do not store cylinders sideways or upside down. The capped valves should always be facing upright.
- Do not exceed load limits for electrical circuits. All electrical equipment should be installed according to the manufacturer's specifications.
- Do not allow leads to come in contact with the welding surface. Keep them covered or suspended to prevent damage.
- Do not store your oxygen and acetylene tanks in the same area. Separate them by a distance of at least 20 feet.
- Do not begin work without a fire extinguisher readily available. Your success in preventing a fire from taking over is dependent on how quickly you can put it out.
- Do not take shortcuts. Shortcuts make long (and possibly dangerous) delays.

- Do not work in close proximity to other welders. There needs to be a sufficient amount of space between you and others to prevent injury.
- Do not begin working before you've double-checked all your connections and couplings. Any loose connections should be taken care of before you start.
- Do not operate a TIG welder without first ensuring that everything is properly configured.
- Do not use a rig rated for higher amps than your circuit and fuse are designed to handle.
- Do not skimp on parts for your welder.
- Do not use a welder without using a respirator. Breathing the gasses produced by the welding process can be harmful to your health.
- Do not attempt to use a welder without having had the proper training. If you don't know what you are doing, you can injure yourself and others.
- Do not continue operating your rig if it does not sound right. Both MIG and TIG welding techniques put off specific sounds when working with different metals.
- Do not wear weld gloves that are torn or stiff. Keep them supple with boot grease.
- Do not use mechanics gloves on the hands that feed the filler rod. They can be difficult to remove in the event that they become too hot to wear.
- Do not use tungsten larger than needed to get the job done. Using electrodes that are too large will contaminate the weld and may result in erratic arcing.
- Do not use an excessive shielding gas. Each type of metal has its own specified rate of torch gas usage.
- Do not use a gas mixture that is not recommended.
- Do not weld a project that will be airtight at the end without leaving a small vent hole. Otherwise, you could end up with a loss of shielding gas or a blown-out weld bead.
- Do not operate a rig without establishing a safe ground connection. Electric shocks can cause injury or death.
- Do not hold two bare wires in each hand while using a TIG welder. Doing so can result in your body becoming a conductor for the current between the wires.
- Do not allow the electrode to come in contact with your skin or clothing to avoid burns.
- Do not wear wet gloves or gloves that are fraying or tearing.
- Do not operate a welder on wet insulation.
- Do not weld without sufficient hearing protection. This will help prevent damage from noisy environments as well as keep debris from entering the ear canal.
- Do not weld without using approved PPE. Doing so exposes you to an increased risk of burns and injuries.
- Do not operate a welder without the recommended shielding gasses.
- Do not weld if you are unsure of something.
- Do not weld an entire long seam on thin sheet metal. Doing so can result in distortion of the piece.

- Do not use a shield gas flow rate above or below what your project requires for safety.
- Do not weld a container that previously held flammable liquids without filling it to a couple of inches below the project location with water.