**Welding, Cutting and Brazing*—*Work Procedures**

**29 CFR 1910.252-255—Welding, Cutting and Brazing**

***Scope/Application:***  *This standard applies to welding, cutting and brazing activities.*

*The following standard is referenced in 29 CFR 1910.252****—****Welding, Cutting and Brazing:*

* *29 CFR 1910.1200—Hazard Communication*

***Note:*** *29 CFR 1910.252****—****Welding, Cutting and Brazing requires that labels, safety data sheets and training be in accordance with 29 CFR 1910.1200—Hazard Communication.*

***Standard Requirements for*** [***29 CFR 1910.252-255***](https://www.osha.gov/laws-regs/regulations/standardnumber/1910#1910_Subpart_Q)***—Welding, Cutting and Brazing:***

* ***Programs:*** *Inspection Program*
* ***Procedures/Practices/Controls:*** *Work procedures, rescue procedures*
* ***Training:*** *Initially*
* ***Recordkeeping/Documentation:*** *Inspection records*

***Example Procedures:*** *The following example procedure should be modified to be site-specific to your organization. Please reference 29 CFR 1910.252-255—Welding, Cutting and Brazing to ensure that all requirements are being met.*

**Work Procedures**

**Introduction**

Welding, cutting and brazing are hazardous activities that pose a unique combination of both safety and health risks to employees.

**Hazards and Controls**

Health hazards from welding, cutting and brazing operations include exposures to metal fumes and to ultraviolet (UV) radiation. Safety hazards from these operations include burns, eye damage, electrical shock, cuts, and crushed toes and fingers. Many of these can be controlled with proper work practices and personal protective equipment (PPE).

**Safe Work Practices**

*Transporting, Moving and Storing Compressed Gas Cylinders*

Valve protection caps will be in place and secured. When cylinders are hoisted, they will be secured on a cradle, slingboard or pallet. They will not be hoisted or transported by means of magnets or choker slings.

Cylinders will be moved by tilting and rolling them on their bottom edges. They will not be intentionally dropped, struck or permitted to strike each other violently.

When cylinders are transported by powered vehicles, they will be secured in a vertical position.

Valve protection caps will not be used for lifting cylinders from one vertical position to another. Bars will not be used under valves or valve protection caps to pry cylinders loose when frozen. Warm, not boiling, water will be used to thaw cylinders loose.

Unless cylinders are firmly secured on a special carrier intended for this purpose, regulators will be removed and valve protection caps put in place before cylinders are moved.

A suitable cylinder truck, chain or other steadying device will be used to keep cylinders from being knocked over while in use.

When work is finished, when cylinders are empty, or when cylinders are moved at any time, the cylinder valve will be closed.

Compressed gas cylinders will be secured in an upright position at all times, if necessary, for short periods of time while cylinders are actually being hoisted or carried.

Oxygen cylinders in storage will be separated from fuel-gas cylinders or combustible materials (especially oil or grease), a minimum distance of 20 feet (6.1 m) or by a noncombustible barrier at least 5 feet (1.5 m) high having a fire-resistance rating of at least one-half hour.

Inside of buildings, cylinders will be stored in a well-protected, well-ventilated, dry location, at least 20 feet (6.1 m) from highly combustible materials such as oil or excelsior. Cylinders should be stored in definitely assigned places away from elevators, stairs or gangways. Assigned storage places will be located where cylinders will not be knocked over or damaged by passing or falling objects or subject to tampering.

The in-plant handling, storage and use of all compressed gases in cylinders, portable tanks, rail tank cars or motor vehicle cargo tanks will be in accordance with Compressed Gas Association Pamphlet P-1-1965.

*Placing Cylinders*

Cylinders will be kept far enough away from the actual welding or cutting operation so that sparks, hot slag or flame will not reach them. When this is impractical, fire resistant shields will be provided.

Cylinders will be placed where they cannot become part of an electrical circuit. Electrodes will not be struck against a cylinder to strike an arc.

Fuel gas cylinders will be placed with **valve end up** whenever they are in use. They will not be placed in a location where they would not be subject to open flame, hot metal or other sources of artificial heat.

Cylinders containing oxygen or acetylene or other fuel gas will not be taken into confined spaces.

*Treatment of Cylinders*

Cylinders, whether full or empty, will not be used as rollers or supports.

No person other than the gas supplier will attempt to mix gases in a cylinder. No one except the owner of the cylinder or person authorized by the owner will refill a cylinder. No one will use a cylinder’s contents for purposes than those intended by the supplier. All cylinders used will meet the Department of Transportation requirements published in 49 CFR Part 178, Subpart C.

*Specification for Cylinders.*

No damaged or defective cylinder will be used.

*Use of Fuel Gas*
The employer will thoroughly instruct employees in the safe use of fuel gas, as follows:

* Fuel gas will not be used from cylinders through torches or other devices that are equipped with shutoff valves without reducing the pressure through a suitable regulator attached to the cylinder valve or manifold.
* Before a regulator to a cylinder valve is connected, the valve will be opened slightly and closed immediately. (This action is generally termed “cracking” and is intended to clear the valve of dust or dirt that might otherwise enter the regulator.) The person cracking the valve will stand to one side of the outlet, not in front of it. The valve of a fuel gas cylinder will not be cracked where the gas would reach welding work, sparks, flame or other possible sources of ignition.
* The cylinder valve will always be opened slowly to prevent damage to the regulator. For quick closing, valves of fuel gas cylinders will not be opened more than 1½ turns. When a special wrench is required, it will be left in position on the stem of the valve while the cylinder is in use so that the fuel gas flow can be shut off quickly in case of an emergency. In the case of manifolded or coupled cylinders, at least one such wrench will always be available for immediate use. Nothing will be placed on top of a fuel gas cylinder, when in use, that may damage the safety device or interfere with the quick closing of the valve.
* Before a regulator is removed from a cylinder valve, the cylinder valve will always be closed and the gas released from the regulator.
* If, when the valve on a fuel gas cylinder is opened, there is found to be a leak around the valve stem, the valve will be closed and the gland nut tightened. If this action does not stop the leak, the use of the cylinder will be discontinued, and it will be properly tagged and removed from the work area. In the event that fuel gas should leak from the cylinder valve, rather than from the valve stem, and the gas cannot be shut off, the cylinder will be properly tagged and removed from the work area. If a regulator attached to a cylinder valve will effectively stop a leak through the valve seat, the cylinder need not be removed from the work area.
* If a leak should develop at a fuse plug or other safety device, the cylinder will be removed from the work area.

*Fuel Gas and Oxygen Manifolds*
Fuel gas and oxygen manifolds will bear the name of the substance they contain in letters at least 1-inch high, which will be either painted on the manifold or on a sign permanently attached to it. These manifolds will be placed in safe, well-ventilated and accessible locations and not be located within enclosed spaces.

Manifold hose connections, including both ends of the supply hose that lead to the manifold, will be such that the hose cannot be interchanged between fuel gas and oxygen manifolds and supply header connections. Adapters will not be use to permit the interchange of hose. Hose connections will be kept free of grease and oil.

When not in use, manifold and header hose connections will be capped. Nothing will be placed on top of a manifold, when in use, which will damage the manifold or interfere with the quick closing of the valves.

*Hose*
Fuel gas and oxygen hose will be easily distinguishable from each other. The contrast may be made by different colors or by surface characteristics readily distinguishable by the sense of touch. Oxygen and fuel gas hoses will not be interchangeable. A single hose having more than one gas passage will not be used.

When parallel sections of oxygen and fuel gas hose are taped together, not more than 4 inches out of 12 inches will be covered by tape.

All hose in use, carrying acetylene, oxygen, natural or manufactured fuel gas, or any gas or substance that may ignite or enter into combustion, or be in any way harmful to employees, will be inspected at the beginning of each working shift. Defective hose will be removed from service.

Hose that has been subject to flashback or shows evidence of severe wear or damage will be tested to twice the normal pressure to which it is subject, but in no case less than 300 p.s.i. Defective hose, or hose in doubtful condition, will not be used.

Hose couplings will be of the type that cannot be unlocked or disconnected by means of a straight pull without rotary motion.

Boxes used for the storage of gas hose will be ventilated.

Hoses, cables and other equipment will be kept clear of passageways, ladders and stairs.

*Torches*
Clogged torch tip openings will be cleaned with suitable cleaning wires, drills or other devices designed for such purpose.

Torches in use will be inspected at the beginning of each working shift for leaking shutoff valves, hose couplings and tip connections. Defective torches will not be used.

Torches will be lighted by friction lighters or other approved devices and not by matches or from hot work.

*Regulators and Gauges*
Oxygen and fuel gas pressure regulators, including their related gauges, will be in proper working order while in use.

Oil and Grease Hazards

Oxygen cylinders and fittings will be kept away from oil or grease. Cylinders, cylinder caps and valves, couplings, regulators, hose, and apparatus will be kept free from oil or greasy substances and will not be handled with oily hands or gloves. Oxygen will not be directed at oily surfaces, greasy clothes, or within a fuel oil or other storage tank or vessel.

**Arc Welding and Cutting***Manual Electrode Holders*
Only manual electrode holders that are specifically designed for arc welding and cutting and are of a capacity capable of safely handling the maximum rated current required by the electrodes will be used.

*Welding Cables and Connectors*
All arc welding and cutting cables will be of the completely insulated flexible type, capable of handling the maximum current requirements of the work in progress, taking into account the duty cycle under which the arc welder or cutter is working.

Only cable free from repair or splices for a minimum distance of 10 feet from the cable end to which the electrode holder is connected will be used, except that cables with standard insulated connectors or with splices whose insulating quality is equal to that of the cable are permitted.

Cables in need of repair will not be used. When a cable, other than the cable lead referred to above, becomes worn to the extent of exposing bare conductors, the portion thus exposed will be protected by means of rubber and friction tape or other equivalent insulation.

When it becomes necessary to connect or splice lengths of cable one to another, substantial insulated connectors of a capacity at least equivalent to that of the cable will be used. If connections are effected by means of cable lugs, they will be securely fastened together to give good electrical contact, and the exposed metal parts of the lugs will be completely insulated.

*Ground Returns and Machine Grounding*
A ground return cable will have a safe current-carrying capacity equal to or exceeding the specified maximum output capacity of the arc welding or cutting unit that it services. When a single ground return cable services more than one unit, its safe current-carrying will exceed the total specified maximum output capacities of the all the units that it services.

Pipelines containing gases or flammable liquids or conduits containing electrical circuits will not be used as a ground return.

When a structure or pipeline is employed as a ground return circuit, it will be determined that the required electrical contact exists at all joints. The generation of an arc, sparks or heat at any point will cause rejection of the structures as a ground circuit.

When a structure or pipeline is continuously employed as a ground return circuit, all joints will be bonded, and periodic inspections will be conducted to ensure that no condition of electrolysis or fire hazard exists by virtue of such use.

The frames of all arc welding and cutting machines will be grounded either through a third wire in the cable containing the circuit conductor or through a separate wire that is grounded at the source of the current. Grounding circuits, other than by means of the structure, will be checked to ensure that the circuit between the ground and the grounded power conductor has resistance low enough to permit sufficient current to flow to cause the fuse or circuit breaker to interrupt the current.

All ground connections will be inspected to ensure that they are mechanically strong and electrically adequate for the required current.

*Operating Instructions*
Employers will instruct employees in the safe means of arc welding and cutting as follows:

* When electrode holders are to be left unattended, the electrodes will be removed and the holders will be so placed or protected that they cannot make electrical contact with employees or conducting objects.
* Hot electrode holders will not be dipped in water; to do so may expose the arc welder or cutter to electric shock.

When the arc welder or cutter has occasion to leave the work or to stop work for any appreciable length of time or when the arc welding or cutting machine is to be moved, the power supply switch to the equipment will be opened.

* Any faulty or defective equipment will be reported to the supervisor.
* A disconnecting means will be provided in the supply circuit for each motor generated arc welder and for each AC transformer and DC rectifier arc welder that is not equipped with a disconnect mounted as an integral part of the welder.
* A switch or circuit breaker will be provided by which each resistance welder and its control equipment can be isolated from the supply circuit. The ampere rating of this disconnecting means will not be less than the supply conductor ampacity.

*Shielding*
Whenever practicable, all arc welding and cutting operations will be shielded by noncombustible or flameproof screen that will protect employees and other persons working in the vicinity from the direct rays of the arc.

**Fire Prevention**

When practical, objects to be welded, cut or heated will be moved to a designated safe location or, if these objects cannot be readily moved, all movable fire hazards in the vicinity will be taken to a safe place or otherwise protected. If these objects cannot be moved and if all the fire hazards cannot be removed, positive means will be taken to confine the heat, sparks and slag and to protect the immovable fire hazards from them.

No welding, cutting or heating will be done where the application of flammable paints or the presence of other flammable compounds or heavy dust concentrations creates a hazard.

Suitable fire extinguishing equipment will be immediately available in the work area and will be maintained in a state or readiness for instant use.

When the welding, cutting or heating operation is such that normal fire prevention precautions are not sufficient, additional personnel will be assigned to guard against fire while the actual welding, cutting or heating operation is being performed and for a sufficient period of time after completion of the work to ensure that no possibility of fire exists. Such personnel will be instructed as to the specific anticipated fire hazards and how the firefighting equipment provided is to be used.

When welding, cutting or heating is performed on walls, floors and ceilings, since direct penetration of sparks or heat transfer may introduce a fire hazard to an adjacent area, the same precautions will be taken on the opposite side as are taken on the side on which the welding is being performed.

For the elimination of possible fire in enclosed spaces as a result of gas escaping through leaking or improperly closed torch valves, the gas supply to the torch will be positively shut off at some point outside the enclosed space whenever the torch is not to be used or whenever the torch is left unattended for a substantial period of time, such as during the lunch period. Overnight and at the change of shifts, the torch and hose will be removed from the confined space. Open end fuel gas and oxygen hoses will be immediately removed from enclosed spaces when they are disconnected from the torch or other gas-consuming device.

Except when the contents are being removed or transferred, drums, pails and other containers that contain or have contained flammable liquids will be kept closed. Empty containers will be removed to a safe area apart from hot work operations or open flames.

**Mechanical Ventilation**

Mechanical ventilation will consist of either general mechanical ventilation systems or local exhaust systems.

**Occupational Health and Environmental Controls**

Contaminated air exhausted from a working space will be discharged clear of the source of intake air.

All air replacing that withdrawn will be clean and respirable.

Oxygen will not be used for ventilation purposes, comfort cooling, blowing dust from clothing or cleaning the work area.

**Welding, Cutting and Heating in Confined Spaces**

Except where air line respirators are required or allowed as described below, adequate mechanical ventilation meeting the requirements described above will be provided whenever welding, cutting or heating is performed in a confined space.

When sufficient ventilation cannot be obtained without blocking the means of access, employees in the confined space will be protected by air line respirators. An employee on the outside of the confined space will be assigned to maintain communication with those working within it and to aid them in an emergency.

Where a welder must enter a confined space through a small opening, means will be provided for quickly removing him or her in case of emergency. When safety belts and lifelines are used for this purpose, they will be so attached to the welder’s body that his or her body cannot be jammed in a small exit opening. An attendant with a preplanned rescue procedure will be stationed outside to observe the welder at all times and be capable of putting rescue operations into effect.

**Welding, Cutting or Heating of Metals of Toxic Significance**

Welding, cutting or heating in any enclosed spaces involving the following metals will be performed with adequate mechanical ventilation as described above:

* Zinc-bearing base or filler metals or metals coated with zinc-bearing materials.
* Lead base metals.
* Cadmium-bearing filler materials.
* Chromium-bearing metals or metals coated with chromium-bearing materials.

Welding, cutting or heating in any enclosed spaces involving the following metals will be performed with adequate local exhaust ventilation as described above or employees shall be protected by air line respirators:

* Metals containing lead, other than as an impurity, or metals coated with lead-bearing materials.
* Cadmium-bearing or cadmium-coated base metals.
* Metal coated with mercury-bearing metals.
* Beryllium-containing base or filler metals. Because of its high toxicity, work involving beryllium will be done with both local exhaust ventilation and air line respirators.

Employees performing such operations in the open air will be protected by filter-type respirators except that employees performing such operations on beryllium-containing base or filler metals will be protected by air line respirators.

Other employees exposed to the same atmosphere as the welders or burners will be protected in the same manner as the welder or burner.

**Inert-Gas Metal-Arc Welding**

Since the inert-gas metal-arc welding process involves the production of ultraviolet radiation of intensities of 5 to 30 times that produced during shielded metal-arc welding, the decomposition of chlorinated solvents by ultraviolet rays, and the liberation of toxic fumes and gases, employees will not be permitted to engage in or be exposed to the process until the following special precautions have been taken:

* The use of chlorinated solvents will be kept at least 200 feet, unless shielded, from the exposed arc, and surfaces prepared with chlorinated solvents will be thoroughly dry before welding is permitted on such surfaces.
* Employees in the area not protected from the arc by screening will be protected by filter lenses. When two or more welders are exposed to each other’s arc, filter lens goggles of a suitable type will be worn under welding helmets. Hand shields to protect the welder against flashes and radiant energy will be used when either the helmet is lifted or the shield is removed.
* Welders and other employees who are exposed to radiation will be suitably protected so that the skin is covered completely to prevent burns and other damage by ultraviolet rays. Welding helmets and hand shields will be free of leaks and openings, and highly reflective surfaces.
* When inert-gas metal-arc welding is being performed on stainless steel, adequate local exhaust ventilation as described above or air line respirators will be used to protect against dangerous concentrations of nitrogen dioxide.

**General Welding, Cutting and Heating**

Welding, cutting or heating not involving conditions or toxic materials described above may normally be done without mechanical ventilation or respiratory protective equipment. These protections will be provided, however, where an unsafe accumulation of contaminants exists because of unusual physical or atmospheric conditions.

Employees performing any type of welding, cutting or heating will be protected by suitable eye protective equipment.

**Free Outreach Resources:**

[*Safety and Health Programs and Plans*](https://www.labor.nc.gov/safety-and-health/publications/example-programs) *(i.e., Example Programs to be Made Site-Specific)*

[*A - Z Safety and Health Topics*](https://www.labor.nc.gov/safety-and-health/occupational-safety-and-health/occupational-safety-and-health-topic-pages) *(i.e., Learn More About Safety and Health Topics)*

[*Which Standards Apply?*](https://www.labor.nc.gov/which-osha-standards-apply) *(Identify the Standards Applicable to Your Worksite)*

[*Safety and Health Presentations*](https://www.labor.nc.gov/document-collection/osh-presentations) *(Downloadable Presentations to be Made Site-Specific)*

[*OSH Training Calendar*](https://www.labor.communications.its.state.nc.us/OSHPublic/ETTA/class_regist/calendar.cfm) *(i.e., Register for Webinars, In-Person Classroom Training, Virtual Events)*

[*Streaming Video Services*](https://www.labor.nc.gov/safety-and-health/library/how-borrow-dvds-and-videos#are-your-videos-online) *(On-Demand Training)*

[*Request Outreach Services*](https://www.labor.communications.its.state.nc.us/OSHPublic/ETTA/Outreach/Outreach_Request_Form.html) *(i.e., Request Training, Booths, Guest Speaker)*

[*AskOSH*](https://www.labor.nc.gov/safety-and-health/occupational-safety-and-health/ask-osh) *(Interpretations)*