

9.1: Introduction to Welding and Cutting

Welding in Construction

Welding and cutting on construction sites is a common task which is often performed by several different trades. OSHA investigations into accidents related to welding and cutting discovered that the most frequent accidents resulted from the ignition of fumes/vapors or other explosive materials in the vicinity of the welding or cutting operation. These types of fire related accidents may be attributed to improper material handling and storage.

Another hazard that workers encounter is the long-term effects of welding and cutting. These effects include damage to the eyes, lungs, and skin. Other hazards include falls from elevations, electrocutions, caught between, and explosions as welding activity can occur during all phases of construction.

To address these safety issues Subpart J of the 1926 OSHA standards covers welding and cutting requirements for construction sites. This subpart includes requirements for gas welding and cutting, Arc welding and cutting, fire prevention, ventilation and health concerns when heating treated metals.

Welding produces toxic vapors and fumes such as beryllium, chromium, and fuel gases for welding are considered hazardous materials. Because the production of toxic vapors during welding may create confined space conditions or if the welding activity is occurring in a confined space it is important to ensure proper ventilation and when appropriate air supplied respirators.

Gas Welding and Cutting

General

When transporting, moving, and storing compressed gas cylinders, valve protection caps shall be in place and secured. When cylinders are hoisted, they shall be secured on a cradle, sling board or pallet. They shall not be hoisted or transported by means of magnets or choker slings. A suitable cylinder truck, chain, or other steadying device shall be used to keep cylinders from being knocked over while in use.

Transporting

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

Moving

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

Compressed gas cylinders shall be secured in an upright position at all times except, if necessary, for short periods of time while cylinders are actually being hoisted or carried. This is the most frequently cited welding and cutting violation.

Cylinders shall be moved by tilting and rolling them on their bottom edges. They shall not be intentionally dropped, struck, or permitted to strike each other violently. Valve protection caps shall not be used for lifting cylinders from one vertical position to another. Bars shall not be used under valves or valve protection caps to pry cylinders loose when frozen. Warm, not boiling, water shall be used to thaw cylinders loose.

Storage

When work is finished, when cylinders are empty, or when cylinders are moved at any time, the cylinder valve shall be closed. Oxygen cylinders in storage shall 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 shall 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 shall be located where cylinders will not be knocked over or damaged by passing or falling objects, or subject to tampering by unauthorized persons. Cylinders shall not be kept in unventilated enclosures such as lockers and cupboards.

Cylinder Placement

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

Fuel gas cylinders shall be placed with valve end up whenever they are in use. They shall not be placed in a location where they would be subject to open flame, hot metal, or other sources of artificial heat. Cylinders containing oxygen or acetylene or other fuel gas shall not be taken into confined spaces.

Cylinders, whether full or empty, shall not be used as rollers or supports. No damaged or defective cylinder shall be used.

Use of Fuel Gas

Training

Employers shall instruct employees in the safe use of fuel gas, as follows:

1. Before a regulator is connected to a cylinder valve, the valve shall 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 shall stand to one side of the outlet, not in front of it. The valve of a fuel gas cylinder shall not be cracked where the gas would reach welding work, sparks, flame, or other possible sources of ignition.
2. The cylinder valve shall always be opened slowly to prevent damage to the regulator. For quick closing, valves on fuel gas cylinders shall not be opened more than 1 ½ turns. When a special wrench is required, it shall 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 shall always be available for immediate use. Nothing shall be placed on top of a fuel gas cylinder when in use, which may damage the safety device or interfere with the quick closing of the valve.
3. Fuel gas shall not be released from cylinders through torches or other devices, which are equipped with shutoff valves without reducing the pressure through a suitable regulator, attached to the cylinder valve or manifold.
4. Before a regulator is removed from a cylinder valve, the cylinder valve shall always be closed and the gas released from the regulator.
5. If, when the valve on a fuel gas cylinder is opened, and a leak is found around the valve stem, the valve shall be closed and the gland nut tightened. If this action does not stop the leak, the use of the cylinder shall be discontinued, and it shall 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 shall 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.
6. If a leak should develop at a fuse plug or other safety device, the cylinder shall be removed from the work area.

Fuel Gas and Oxygen Manifold

Marking

Fuel gas and oxygen manifolds shall bear the name of the substance they contain in letters at least 1-inch high which shall be either painted on the manifold or on a sign permanently attached to it.

Location

Fuel gas and oxygen manifolds shall be placed in safe, well ventilated, and accessible locations. They shall not be located within enclosed spaces.

Connections

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

Storage

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

Fuel Hoses

Identification

Fuel gas hoses and oxygen hoses shall 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 shall not be interchangeable. A single hose having more than one gas passage shall not be used.

Maintenance, inspection, and testing

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

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

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

Couplings

Hose couplings shall 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 shall be ventilated. Hoses, cables, and other equipment shall be kept clear of passageways, ladders and stairs.

Torches

Clogged torch tip openings shall be cleaned with suitable cleaning wires drills, or other devices designed for such purpose. Torches in use shall be inspected at the beginning of each working shift for leaking shutoff valves, hose couplings, and tip connections. Defective torches shall not be used. Torches shall be lighted by friction lighters or other approved devices, and not by matches or from hot work.

Oil and grease hazards

Oxygen cylinders and fittings shall be kept away from oil or grease. Cylinders, cylinder caps and valves, couplings, regulators, hose, and apparatus shall be kept free from oil or greasy substances and shall not be handled with oily hands or gloves. Oxygen shall 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 which 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, shall be used.

Any current-carrying parts passing through the portion of the holder, which the arc welder or cutter grips in his hand, and the outer surfaces of the jaws of the holder, shall be fully insulated against the maximum voltage, encountered to ground.

Welding cables and connectors

All arc welding and cutting cables shall 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.

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

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 shall be used. If connections are effected by means of cable lugs, they shall be securely fastened together to give good electrical contact and the exposed metal parts of the lugs shall be completely insulated.

Cables in need of repair shall not be used. When a cable, other than those with acceptable splices, becomes worn to the extent of exposing bare conductors, the portion thus exposed shall be protected by means of rubber and friction tape or other equivalent

insulation.

Ground returns and machine grounding

A ground return cable shall have a safe current carrying capacity equal to or exceeding the specified maximum output capacity of the arc welding or cutting unit, which it services. When a single ground return cable services more than one unit, its safe current-carrying capacity shall equal or exceed the total specified maximum output capacities of all the units, which it services. Pipelines containing gases or flammable liquids, or conduits containing electrical circuits, shall not be used as a ground return.

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

When a structure or pipeline is continuously employed as a ground return circuit, all joints shall be bonded, and periodic inspections shall 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 shall be grounded either through a third wire in the cable containing the circuit conductor or through a separate wire which is grounded at the source of the current. Grounding circuits, other than by means of the structure, shall 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 shall be inspected to ensure that they are mechanically strong and electrically adequate for the required current.

Training

Employers shall instruct employees in the safe means of arc welding and cutting as follows:

1. When electrode holders are to be left unattended, the electrodes shall be removed and the holders shall be so placed or protected that they cannot make electrical contact with employees or conducting objects.
2. Hot electrode holders shall not be dipped in water; to do so may expose the arc welder or cutter to electric shock.
3. When the arc welder or cutter has occasion to leave his 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 shall be opened.
4. Any faulty or defective equipment shall be reported to the supervisor.

Shielding

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

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