

City of Newport News

Welding/Hot Work Program



29 CFR 1910 Subpart Q – Welding, Cutting & Brazing

29 CFR 1926 Subpart J – Welding & Cutting

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I. Purpose

The Welding/Hot Work Program is to establish guidelines for adherence to all employees of the City of Newport News performing any type of welding, cutting, or brazing work.

II. Scope

All affected employees shall familiarize themselves with the program as well as all state, federal, and local regulations including but not limited to 29 CFR 1910 Subpart Q – Welding, Cutting & Brazing, and 29 CFR 1926 Subpart J – Welding & Cutting. The Safety Program Administrator shall evaluate the Welding/Hot Work Program annually to ensure compliance, effectiveness, and to account for any applicable regulatory changes.

III. Responsibilities

A. Department Directors

Management recognizes its responsibility for the safe use of welding and cutting equipment on city property. Department directors shall:

1. Establish safe designated areas for cutting and welding.
2. Provide suitable training in the safe use and operation of equipment to both employees and supervisors.
3. Advise all contractors performing hot work about flammable materials or hazardous conditions within the area.

B. Supervisors

Supervisors shall be responsible for ensuring the following:

1. Safe handling of equipment and safe use of cutting or welding process.
2. Determine the combustible materials and other workplace hazards present or likely to be present that affect welding and cutting operations.
3. Have work moved to a location free from dangerous combustibles.
4. Facility operations that may expose combustibles to ignition are not started during welding or cutting.
5. Secure authorization for cutting or welding operations from the designated management representative.
6. Fire protection and extinguishing equipment are properly located on site and fire watchers are available when necessary.

C. Affected Departments

1. Adult Corrections (City Farm Maintenance Shop)
2. Engineering (Traffic Operations)
3. Fire Department

4. Parks & Recreation (Grounds Maintenance/Landscape Services, Golf Course Maintenance Shop)
5. Waterworks
6. Public Works
7. Vehicle and Equipment Services

IV. Construction Industry Requirements

A. Gas Welding and Cutting

1. Cylinder Safety

- a. When transporting, moving, and storing compressed gas cylinders, valve protection caps shall be in place and secured.
- b. When cylinders are hoisted, they shall be secured on a cradle, slingboard, or pallet, and shall not be hoisted or transported by means of magnets or choker slings.
- c. Cylinders shall be moved by tilting and rolling them on their bottom edges, and shall not be intentionally dropped, struck, or permitted to strike each other violently.
- d. When cylinders are transported by powered vehicles, they shall be secured in a vertical position.
- e. 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.
- f. Unless cylinders are secured firmly on a special carrier intended for this purpose, regulators shall be removed and valve protection caps put in place before cylinders are moved.
- g. A suitable cylinder truck, chain, or other steadying device shall be used to keep cylinders from being knocked over while in use.
- h. When work is finished, when cylinders are empty, or when cylinders are moved at any time, the cylinder valves shall be kept closed.
- i. Compressed gas cylinders shall be secured in an upright position at all times, if necessary, for short periods of time while cylinders are actually being hoisted or carried.
- j. Oxygen cylinders in storage shall be separated from fuel-gas cylinders or combustible materials (particularly oil and grease), a minimum distance of 20 ft. or by a noncombustible barrier at least 5 feet in height having a fire-resistance rating of at least one-half hour.
- k. Inside buildings, cylinders shall be stored in a labeled, well-protected, well-ventilated, dry location, at least 20 feet from highly combustible materials such as oil or excelsior. Cylinders should be stored in assigned places away from elevators, stairs, or gangways.

Assigned storage areas shall be located where cylinders will not be knocked over or damaged by passing or falling objects, or subject to tampering.

- l. 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 impractical, fire resistant shields shall be provided.
- m. 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.
- n. Fuel gas cylinders shall be placed with valve end up whenever they are in use, and shall not be placed in a location where they would be subject to open flame, hot metal, or other sources of artificial heat.
- o. Cylinders containing oxygen or acetylene or other fuel gas shall not be taken into confined spaces.
- p. Cylinders shall not be used as rollers or supports, whether full or empty.
- q. The gas supplier is the only individual who may mix gases in a cylinder. No one except the owner of the cylinder or person the owner authorizes shall refill a cylinder. No employee is to use a cylinder's contents for purposes than those intended by the supplier. It is the supplier's responsibility to ensure all cylinders shall meet the Department of Transportation's requirements published in **49 CFR Part 148, Subpart C**, Specification for Cylinders.
- r. No damaged or defective cylinder shall be used.

2. Use of Fuel Gas

- a. Fuel gas shall not be used 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.
- b. Before a regulator to a cylinder valve is connected the valve shall be opened slightly and closed immediately. The person performing this operation 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.
- c. The cylinder valve shall always be opened slowly to prevent damage to the regulator. Valves of 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 manifold or coupled cylinders, at least one such wrench shall always be available for immediate use.

- d. 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.
- e. Before a regulator is removed from a cylinder valve, the cylinder valve shall always be closed and the gas released from the regulator.
- f. If, when the valve on a fuel gas cylinder is opened, there is found to be a leak 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 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.
- g. If a leak should develop at a fuse plug or other safety device, the cylinder shall be removed from the work area.

3. Fuel Gas and Oxygen Manifolds

- a. 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. These manifolds shall be placed in safe, well-ventilated, and accessible locations and not be located within enclosed spaces.
- b. 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.
- c. When not in use, manifold and header hose connections shall be capped.
- d. 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.

4. Hoses

- a. Fuel gas and oxygen hose 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.

- b. When parallel sections of oxygen and fuel gas hoses are taped together, not more than 4 inches out of 12 inches shall be covered by tape.
- c. All hose 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 work shift.
- d. Defective hose shall not be used and shall be removed from service immediately.
- e. 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 no less than 300 p.s.i.
- f. Hose couplings shall be of the type that cannot be unlocked or disconnected by means of a straight pull without rotary motion.
- g. Boxes used for the storage of gas hose shall be ventilated.
- h. Hoses, cables, and other equipment shall be kept clear of passageways, ladders, and stairs.

5. Torches

- a. Clogged torch tip openings shall be cleaned with suitable cleaning wires, drills, or other devices designed for such purpose.
- b. 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 and shall be removed from service.
- c. Torches shall be lighted by friction lighters or other approved devices, and not by matches or from hot work.

6. Regulators and Gauges

- a. Oxygen and fuel gas pressure regulators, including their related gauges, shall be in proper working order while in use.
- b. Gauges on oxygen regulators shall be marked "Use No Oil."

7. Oil and Grease Hazards

- a. 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.

B. Arc Welding and Cutting

1. Manual Electrode Holders

- a. 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.
- b. 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 the ground.

2. Welding Cables and Connectors

- a. 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. The duty cycle under which the arc welder or cutter is working will be taken into account.
- b. Cable free from repair or splices for a minimum distance of 10 feet from the cable end to which the electrode holder is connected shall be used. The exception is cable with standard insulated connectors or with splices whose insulating quality is equal to that of the cable.
- c. Cables in need of repair shall not be used and shall be removed from service. When a cable other than a lead cable becomes worn to the extent of exposing bare conductors, the exposed portion shall be protected by means of rubber and friction tape or other equivalent insulation.
- d. 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. The exposed metal parts of the lugs shall be completely insulated.

3. Ground Returns and Machine Grounding

- a. 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 shall exceed the total specified maximum output capacities of all the units which it services.
- b. Pipelines containing gases or flammable liquids, or conduits containing electrical circuits, shall not be used as a ground return.

- c. 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.
- d. When a structure or pipeline is continuously employed as a ground return circuit, all joints shall be bonded. Periodic inspections shall be conducted to ensure that no condition of electrolysis or fire hazard exists by virtue of such use.
- e. 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 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, causing the fuse or circuit breaker to interrupt the current.
- f. All ground connections shall be inspected to ensure that they are mechanically strong and electrically adequate for the required current.

4. Operator Instructions (Training)

All employees who are welding operators shall receive training. Training shall include instruction in the safe means of arc welding and cutting. The following concepts will be addressed in employee training:

- a. When electrode holders are to be left unattended, the electrodes shall be removed. The holders shall be placed or protected so that they cannot make electrical contact with employees or conducting objects.
- b. Hot electrode holders shall not be dipped in water to reduce the risk of electric shock and employee injury.
- c. The power supply switch to the equipment shall be opened when:
 - The arc welder or cutter must leave his/her work or stop work for any appreciable length of time
 - The arc welding or cutting machine is to be moved
- d. Any faulty or defective equipment shall be reported to the supervisor.
- e. A disconnecting means shall be provided in the supply circuit for:
 - Each motor generated arc welder
 - Each AC transformer and DC rectifier arc welder not equipped with a disconnect
- f. A switch or circuit breaker shall 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 shall not be less than the supply conductor ampacity.

5. Shielding

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

C. Fire Prevention

1. Operational Controls

- a. When practical, objects to be welded, cut, or heated shall be moved to a designated safe location. If these objects cannot be readily moved, all movable fire hazards in the vicinity shall be taken to a safe place, or otherwise protected. If these objects cannot be moved and if all the fire hazards cannot be moved, positive means shall be taken to confine the heat, sparks, and slag, and to protect the immovable fire hazards from them.
- b. No welding, cutting or heating shall be done where the application of flammable paints, or the presence of other flammable compounds, or heavy dust concentrations creates a hazard.
- c. Suitable fire extinguishing equipment shall be immediately available in the work area and shall be maintained in a state of readiness for instant use.
- d. When welding, cutting or heating is performed on walls, floors, and ceilings, the same precautions shall be taken on the opposite side as are taken on the side which the welding is being performed.
- e. To eliminate the risk 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 shall be positively shut off at a 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 break. The torch and hose shall be removed from the confined space overnight and at the change of shifts. Open end fuel gas and oxygen hoses shall be immediately removed from enclosed spaces when they are disconnected from the torch or other gas-consuming device.
- f. Drums, pails, and other containers which contain or have contained flammable liquids shall be kept closed except when the contents are being removed or transferred. Empty containers shall be removed to a safe area away from hot work operations or open flames.
- g. Drums, containers, or hollow structures which have contained toxic or flammable substances shall either be filled with water or thoroughly cleaned of such substances, and ventilated and tested before welding, cutting or heating is undertaken on them.

- h. A vent or opening shall be provided for the release of any built-up pressure during the application of heat before the heat is applied to a drum, container, or hollow structure.

2. Fire Watch

- a. When the welding, cutting or heating operation is such that normal fire prevention precautions are not sufficient, additional personnel shall 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 shall be instructed to anticipate specific fire hazards and be trained in the use of portable fire extinguishers.

D. Ventilation and Protection in Welding, Cutting and Heating

1. Mechanical Ventilation

- a. Mechanical ventilation shall consist of either general mechanical ventilation systems or local exhaust systems.
- b. Ventilation shall be deemed adequate if it is of sufficient capacity and so arranged as to remove fumes and smoke at the source and keep their concentration in the breathing zone within safe limits as defined in **Subpart D of 29 CFR 1926**, Occupational Health and Environmental Controls.
- c. Contaminated air exhausted from a working space shall be discharged clear of the intake air source.
- d. All air replacing that withdrawn from the welding area shall be clean and respirable.
- e. Compressed oxygen shall not be used for ventilation purposes, comfort cooling, blowing dust from clothing, or for cleaning the work area.

2. Personal Protective Equipment

- a. Welding, cutting or heating not involving conditions or toxic materials may normally be done without mechanical ventilation or respiratory protective equipment. However, these protections shall be provided where an unsafe accumulation of contaminants exists because of unusual physical or atmospheric conditions.
- b. Employees performing any type of welding, cutting or heating shall be protected by suitable protective equipment in accordance with the requirements of **29 CFR 1926 Subpart E** and the City of Newport News Personal Protective Equipment Program.

3. Confined Spaces

- a. Adequate mechanical ventilation shall be provided whenever welding, cutting or heating is performed in a confined space, except where air line respirators are required or allowed.
- b. When sufficient ventilation cannot be obtained without blocking the means of access, employees in the confined space shall be protected by air line respirators in accordance with the requirements of **Subpart E of 29 CFR 1926**, Personal Protective and Life Saving Equipment. An employee on the outside of the confined space shall be assigned to maintain communication with those working within it and to aid them in an emergency.
- c. Where an employee must enter a confined space through a small opening, means shall be provided for quickly removing him/her in case of emergency. When safety belts and lifelines are used for this purpose they shall be so attached to the welder's body that his body cannot be stuck in the small exit opening. An attendance with a pre-planned rescue procedure shall be stationed outside to observe the welder at all times and be capable of putting rescue operations into effect. For more information, see the City of Newport News Confined Space Program.

4. Welding, Cutting and Heating Metals of Toxic Significance

- a. Welding, cutting or heating in any enclosed spaces involving the following metals shall be performed with adequate local exhaust ventilation, or employees shall be protected by air line respirators in accordance with the requirements of **29 CFR 1926 Subpart E**.
 - 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 shall be done with both local exhaust ventilation and air line respirators.)
- a. Welding, cutting or heating in any enclosed spaces involving the following metals shall be performed with adequate mechanical ventilation:
 - Zinc-bearing base or filler metals, or metals coating with zinc-bearing materials
 - Lead-base metals
 - Cadmium-bearing filler materials
 - Chromium-bearing metals, or metals coating with chromium-bearing materials

- c. Employees performing such operations in the open air shall be protected by filter-type respirators in accordance with the requirements of **29 CFR 1926 Subpart E**, except those employees performing such operations on beryllium-containing base or filler metals, who shall be protected by air line respirators in accordance with the previously mentioned Subpart.
- d. Employees exposed to the same atmosphere as the welders or burners shall be protected in the same manner as the welder or burner.

5. Inert Gas Metal Arc Welding

- a. The use of chlorinated solvents shall be kept at least 200 feet, from the exposed arc unless shielded. Surfaces prepared with chlorinated solvents shall be thoroughly dry before welding is permitted on such surfaces.
- b. Employees in the area not protected from the arc by screening shall be protected by filter lenses meeting the requirements of **29 CFR 1926 Subpart E**. Reference the City of Newport News Personal Protective Equipment Program for specific information regarding the appropriate required filter lens shade numbers. When two or more welders are exposed to each other's arc, filter lens goggles of a suitable type that meets the requirements of Subpart E shall be worn under welding helmets. Hand shields to protect the welder against flashes and radiant energy shall be used when either the helmet is lifted or the shield is removed.
- c. Welders and other employees who are exposed to radiation shall be suitably protected so that the skin is covered completely to prevent burns or other damage by ultraviolet rays. Welding helmets and hand shields shall be free of leaks and opening, and highly reflective surfaces.
- d. When inert-gas metal-arc welding is being performed on stainless steel, adequate local exhaust ventilation as described above or air line respirators in accordance with the requirements of **29 CFR 1926 Subpart E** shall be used to protect against dangerous concentrations of nitrogen dioxide.

6. Welding, Cutting and Heating in Way of Preservative Coatings

- a. A test shall be made by a competent person to determine flammability before welding, cutting or heating is performed on any surface covered by a preservative coating whose flammability is not known. Preservative coatings shall be considered to be highly flammable when scrapings burn with extreme rapidity.
- b. When coatings are determined to be highly flammable, they shall be stripped from the area to be heated to prevent ignition.

- c. In enclosed spaces, all surfaces covered with toxic preservatives shall be stripped of all toxic coatings for a distance of at least 4 inches from the area of heat application, or the employees shall be protected by air line respirators meeting the requirements of **29 CFR 1926 Subpart E**.
- d. In open air, employees shall be protected by a respirator in accordance with the requirements of **29 CFR 1926 Subpart E**.
- e. Preservative coatings shall be removed a sufficient distance from the area to be heated to ensure that the temperature of the unstripped metal will not be appreciably raised. Artificial cooling of the metal surrounding the heating area may be used to limit the size of the area required to be cleaned.

7. Pipelines

- a. The welded construction of transmission pipelines shall be conducted in accordance with the Standard for Welding Pipe Lines and Related Facilities, **API Std. 1104-1968**.
- b. The connection, by welding, of branches to pipelines carrying flammable substances shall be performed in accordance with Welding or Hot Tapping on Equipment Containing Flammables, **API Std. PSD No. 2201-1963**.
- c. The use of X-rays and radioactive isotopes for the inspection of welded pipeline joints shall be carried out in conformance with the American National Standard Safety Standard for Non-Medical X-ray and Sealed Gamma-Ray Sources, **ANSI Z54.1-1963**.

VII. General Industry Requirements

A. General Requirements for Welding, Cutting and Brazing

1. Fire Prevention

- a. Welding and cutting shall not be performed if the following requirements are not met:
 - If the object to be welded or cut cannot readily be moved, all movable fire hazards in the vicinity shall be taken to a safe place.
 - If an object to be welded or cut cannot be moved and if all the fire hazards cannot be removed, then guards shall be used to confine the heat, sparks and slag, and to protect the immovable fire hazards.
- b. When guards or shields are used, additional precautions may be necessary:

- Care shall be taken so that no readily combustible materials on the floor below will be exposed to sparks when there are floor openings or cracks that cannot be closed.
 - Suitable fire extinguishing equipment shall be maintained in a state of readiness at all times.
- c. Fire watchers shall be required whenever welding or cutting is performed in locations where other than a minor fire might develop:
- Appreciable combustible material is closer than 35 ft. to the point of operation.
 - Appreciable combustible material is more than 35 ft. from the point of operation but is easily ignited by sparks.
 - Wall or floor openings within a 35 ft. radius expose combustible material in adjacent areas.
 - Combustible materials are adjacent to the opposite side of metal partitions, walls, ceilings or roofs and are likely to be ignited by conduction or radiation.
- d. Fire watchers will:
- Have extinguishing agents ready at all times
 - Receive training in the use of these agents (ex. Portable fire extinguishers)
 - Be familiar with the facility fire alarm system
 - Watch for fires in all exposed areas
 - Try to extinguish fires to the extent the extinguishing equipment allows and sound the fire alarm
 - Maintain the fire watch for at least one half hour after completion of welding or cutting operations
- e. The floor should be swept clean of all combustible material and kept wet, covered with damp sand, or protected by fire-resistant shields. Where floors have been wet, employees operating arc welding or cutting equipment shall be protected from possible shock.

2. Authorization and Prohibited Areas

- a. Before welding or cutting is permitted, the area shall be inspected by a supervisor responsible for authorizing such operations. The

supervisor shall designate precautions to be followed in granting authorization to proceed.

- b. Cutting or welding shall not be permitted in the following situations:
 - Areas not authorized by management
 - In sprinklered buildings if the sprinkler system is not operational
 - In the presence of explosive atmospheres
 - In areas near storage of large quantities of exposed, readily ignitable materials
- c. Where field shop operations are involved for fabrication of fittings, river crossings, road crossings, and pumping and compressor stations, the requirements of paragraphs (a), (b), and (c) of the standard and **1910.253** and **1910.254** shall be observed.

3. Containers

- a. No welding, cutting or other hot work shall be performed on used drums, barrels, tanks or other containers until they have been cleaned so thoroughly as to make absolutely certain that there are no flammable materials present or substances such as greases, tars, acids or other materials which when subjected to heat, might product flammable or toxic vapors.
- b. All hollow spaces, cavities or containers shall be vented to permit the escape of air or gases before preheating, cutting or welding.

4. Confined Space

- a. When arc welding is to be suspended for any substantial period of time (during lunch or overnight), all electrodes shall be removed from the holders and the holders carefully located so that accidental contact cannot occur. The machine will be disconnected from the power source.
- b. Torch valves shall be closed and the gas supply shut off upon exiting the confined space whenever the torch is not to be used for a substantial period of time.
- c. Compressed gas cylinders shall be left outside the confined space at all times.
- d. Lifelines will be provided for welders entering confined spaces through small openings such as manholes. A pre-planned rescue procedure is required. An attendant will be stationed outside to observe the employee welding at all times.
- e. All welding and cutting operations done in confined spaces shall be adequately ventilated.

- f. When welding with materials that contain fluorine compounds, zinc or lead in a confined space, a supplied-air respirator shall be used.

5. Protective Measures and Personal Protective Equipment

- a. Employees working on platforms, scaffolds or runways shall be protected against falling through the use of railings, safety belts or life lines.
- b. Keep passageways, ladders and stairways clear of welding cables at all times.
- c. Proper eye protection shall be worn at all times when performing gas welding or oxygen cutting operations. Employees assisting the welder will be provided with proper eye protection.
- d. Helmets or hand shields shall be used during all arc welding or arc cutting operations, excluding submerged arc welding.
- e. Operators and assistants of resistance welding or resistance brazing equipment shall use transparent face shields or goggles depending on the particular job.
- f. Employees will protect themselves from arc welding rays by enclosing the work area with noncombustible screens or shields.
- g. When welding operations are completed, the employee shall mark the hot metal or provide some other means of warning other workers.
- h. Where sufficient mechanical ventilation cannot be achieved, airline (supplied-air) respirators or hose masks must be used. These respirators must be approved by NIOSH under **42 CFR Part 84**.
- i. In areas Immediately Dangerous to Life and Health (IDLH), a NIOSH-approved self-contained breathing apparatus shall be used.

6. Ventilation

- a. The amount of contamination to which welders may be exposed is established by the following:
 - Dimensions of the space in which welding is to be done (special regard to ceiling height)
 - Number of welders in the area
 - Possible evolution of hazardous fumes, gases or dust according to the metals involved
- b. Screens will be positioned so as not to hinder ventilation in the welding area.
- c. Local exhaust or general ventilating systems shall be provided and arranged to keep the amount of toxic fumes, gases and dusts

below the maximum allowable concentration as specified in **29 CFR 1910.1000**.

- d. Mechanical ventilation shall be provided when welding and cutting is performed. When welding is done on metals other than fluorine compounds, zinc, lead, beryllium, cadmium, mercury or cleaning compounds containing chlorinated hydrocarbons, mechanical ventilation shall be provided if:
 - There is less than 10,000 cubic feet of space per welder
 - The room's ceiling height is less than 16 feet
 - It is a confined space, or
 - The welding space contains partitions, balconies or other structural barriers to the extent that they significantly obstruct cross ventilation.
- e. Ventilation shall be at the minimum rate of 2000 cubic feet per minute per welder except where approved local exhaust hoods and booths or airline respirators are provided.
- f. Mechanical local exhaust ventilation may be achieved by local exhaust hoods and booths (fixed enclosure) provided the rate of airflow is sufficient to maintain a velocity away from the welder of not less than 100 linear feet per minute.
- g. Compressed oxygen shall never be used for ventilation.
- h. When welding indoors with materials containing zinc, a supplied-air respirator shall be used.
- i. Local exhaust ventilation or airline respirators shall be used when welding or cutting with metals containing lead or coated with lead-bearing materials. When such operations are performed outdoors, employees will use respirators approved for this purpose by NIOSH under **42 CFR Part 84**. In all cases, employees in the immediate vicinity shall be protected by local exhaust ventilation or airline respirators.
- j. When welding or cutting indoors, outdoors or in confined spaces with beryllium or cadmium-containing base or filler metals, local exhaust ventilation or airline respirators shall be used. When welding or cutting operations involve metals coated with mercury-bearing materials, these precautions will also be taken. The exception is if atmospheric tests under the most adverse conditions have established that the employees' exposure is within the acceptable concentrations defined by **29 CFR 1910.1000**. Employees in the immediate vicinity will be protected as necessary by local exhaust ventilation or airline respirators.
- k. Degreasing and other cleaning operations involving chlorinated hydrocarbons shall be so located that no vapors from these operations will reach or be drawn into the atmosphere surrounding

any welding operation. Trichloroethylene and perchloroethylene should be kept out of atmospheres penetrated by the ultraviolet radiation of gas-shielded welding operations.

- I. The cutting of stainless steels shall be done using mechanical ventilation adequate to remove the fumes generated.

B. Arc Welding and Cutting

1. General Requirements

- a. Welding equipment shall be chosen for safe application to the work to be done.
- b. Welding equipment shall be installed safely.
- c. Employees designated to operate arc welding equipment as part of their job duties shall have been properly instructed and qualified to operate such equipment.

2. Environmental Conditions

- a. The supervisor will ensure the welding machine is specially designed to meet the requirements of the service safely when working under any of the following conditions:
 - Exposure to unusually corrosive fumes
 - Exposure to steam or excessive humidity
 - Exposure to excessive oil vapor
 - Exposure to flammable gases
 - Exposure to abnormal vibration or shock
 - Exposure to excessive dust
 - Exposure to weather
 - Exposure to unusual seacoast conditions
- b. When special welding and cutting processes require values of open circuit voltages higher than those listed below, means shall be provided to prevent the operator from making accidental contact with the high voltage by adequate insulation or other means. The following voltage limits shall not be exceeded:
 - Manual arc welding and cutting: 80 volts
 - Automatic (Machine or Mechanized) arc welding and cutting: 100 volts
 - Direct-current manual arc welding and cutting: 100 volts
 - Direct-current automatic arc welding and cutting: 100 volts

- c. The use of reliable automatic controls for reducing no load voltage is recommended to reduce the risk of electric shock when a.c. welding under wet conditions or in warm surroundings where perspiration is a factor.
- d. A disconnecting switch or controller shall be provided at or near each welding machine which is not equipped with such a switch or controller. Overcurrent protection shall be provided. A disconnect switch with overload protection shall be provided for each outlet intended for connection to a portable welding machine.

3. Operation and Maintenance

- a. Employees designated to operate or maintain arc welding equipment shall be familiar with the requirements of **29 CFR 1910.154** and **1910.252**.
- b. All connections to the machine shall be checked before starting operations. Prior to starting the welding operation, welders shall ensure the following:
 - The work lead is firmly attached to the work.
 - Magnetic work clamps are freed from adherent metal particles of spatter on contact surfaces.
 - Coiled welding cable is spread out before use to avoid serious overheating and damage to insulation.
 - The welding machine frame is grounded. The safety ground connections of portable machines shall be checked before use.
 - No leaks of cooling water, shielding gas or engine fuel are noted.
 - Proper switching equipment to shut down the machine is provided before use.
 - Cables with damaged insulation or exposed bare conductors are removed from the work area and replaced.
 - Any equipment defect or safety hazard is reported to the supervisor immediately. Defective or damaged equipment will be tagged "Out of Service" and repaired by qualified personnel only.
- c. Manufacturer's instructions shall be followed at all times. The instruction manual shall be kept in a central location and made available to employees.
- d. When electrode holders are not in use, they shall be placed so that they cannot make electrical contact with persons, conducting objects, fuel or compressed gas tanks.
- e. Cables with splices within 10 ft. of the holder shall not be used.

- f. Employees will not coil or loop welding electrode cable around parts of the body.
- g. Machinery that has become wet will be allowed to thoroughly dry and tests will be conducted before use.

C. Resistance Welding

1. General

- a. All equipment shall be installed by a qualified electrician in conformance with the OSHA Electrical Standard, **Subpart S of 29 CFR 1910**. A safety disconnect switch, circuit breaker, or circuit interrupter shall be located at or near the machine so power can be shut off when the machine or its controls are to be serviced.
- b. Ignition tubes used in resistance welding equipment shall be equipped with a thermal protection switch.
- c. Supervisors shall ensure employees designated to operate resistance welding equipment receive instruction before operating such equipment. It is the responsibility of the supervisor to deem these employees competent to perform the required job duties.
- d. The controls of all automatic or air and hydraulic clamps shall be arranged or guarded to prevent accidental activation.

2. Portable Welding Machines

- a. All portable welding guns shall have a suitable counterbalance device.
- b. All portable welding guns, transformers and related equipment that are suspended from overhead structures, eye beams, trolleys etc., shall be equipped with safety chains or cables capable of supporting the total shock load in the event of failure of any component of the supporting system.
- c. Each clevis shall be capable of supporting the total shock load of the suspended equipment in the event of trolley failure.
- d. All initiating switches located on the portable welding gun shall be equipped with suitable guards capable of preventing accidental initiation through contact with fixturing, operator's clothing, etc. Initiating switch voltage shall not exceed 24 volts.
- e. The part of the movable holder that enters the gun frame shall have sufficient clearance to prevent finger amputation.
- f. The secondary and case of all portable welding transformers shall be grounded.

3. Flash Welding Equipment

- a. Flash welding machines shall be equipped with a hood to control flying flash. In incidents where materials may contain a film of oil and where toxic element and metal fumes are given off, ventilation shall be provided in accordance with **29 CFR 1910.252(c)**.
- b. Qualified maintenance personnel will periodically inspect equipment. A certification record shall be maintained by the supervisor. The certification record shall contain:
 - The date of inspection
 - The signature of the person who performed the inspection
 - The serial or other identifying number for the equipment inspected
- c. Supervisors shall instruct employees to report any equipment defects and discontinue use of equipment until repairs have been completed.