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## 437-004-2310 General Requirements.

**(1) Scope.** This subdivision applies to agricultural welding, except the following types for which Subdivision 2/Q applies:

Production type or amount of welding.

Welding in confined spaces like tanks, vats, pits, or those defined in Subdivision 4/J, OAR 437-004-1250(1). This section (4/Q) covers some confined space welding topics. In those cases, follow this section in addition to the rules in Subdivision 2/Q.

Welding with toxic or dangerous coatings or fluxes. This includes manganese, lead, zinc, cadmium, mercury, beryllium, or fluorine compounds.

Welding or heating galvanized materials.

### **(2) Definition.**

**Welder and welding operator** is any operator of electric or gas welding and cutting equipment.

### **(3) Fire prevention and protection.**

**(a) Basic precautions.** The basic precautions for fire prevention in welding or cutting work are:

**(A) Fire hazards.** Move either the object you are welding or cutting or any movable fire hazards in the area to a safe place.

**(B) Guards.** If you can move neither of the above, then use guards to confine the heat, sparks and slag to protect the immovable fire hazards.

**(b) Special precautions.** When the work falls within the scope of **(3)(a)(B)** above, additional precautions may be necessary:

**(A) Combustible material.** Wherever there are floor openings or cracks in the flooring, close them or take precautions so that sparks will not drop through to combustible materials on the floor below. Use the same precautions with cracks or holes in walls, open doorways and open or broken windows.

**(B) Fire extinguishers.** Keep appropriate fire extinguishing equipment ready for use.

**(4) Before beginning.** Before beginning, block portable equipment to prevent accidental movement.

**(5) Welding or cutting containers.**

**(a) Clean first.** Do not weld, use a torch or do abrasive cutting or other hot work on drums, barrels, tanks or other containers until they have been cleaned so that there are no flammable materials present or any substances that when subjected to heat, might produce flammable or toxic vapors. Disconnect and/or blank any pipe lines or connections to the drum or vessel.

**(b) Test often.** Use testing equipment prior to and frequently during the welding, torch or abrasive cutting or other hot work to insure that the container is free and remains free of flammable or toxic vapors.

**(c) Vent and purge.** Vent all hollow spaces, cavities or containers to air or allow gases to escape before preheating, cutting or welding.

**(6) Protection of personnel.****(a) General.**

**(A) Cable.** Put welding cable and other equipment so that it is clear of passageways, ladders and stairways.

**(b) Eye protection.****(A) Selection.**

**(i)** Use helmets or hand shields when arc welding or arc cutting, excluding submerged arc welding. Helpers or attendants must use proper eye protection.

**(ii)** Use goggles or other suitable eye protection when gas welding or oxygen cutting. Spectacles without side shields, with suitable filter lenses are acceptable for gas welding on light work, for torch brazing or for inspection.

**(iii)** All operators and attendants of resistance welding or resistance brazing equipment must use transparent face shields or goggles, depending on the particular job, to protect their faces or eyes.

**(iv)** Provide suitable goggles for brazing work not covered in (6)(b)(A)(i) through (6)(b)(A)(iii) above.

**(B) Specifications for protectors.**

**(i)** Helmets and hand shields must be an insulator for heat and electricity. Helmets, shields and goggles must not be flammable and must withstand sterilization.

**(ii)** Wear helmets and hand shields to protect the face, neck and ears from direct radiant energy from the arc.

**(iii)** “Lift front” welders’ helmets must have a stationary safety glass on the inside of the frame next to the eyes to protect the welder from flying particles when the front is up. Where lens containers do not permit the use of safety glass, wear safety goggles.

**(iv)** When not using the “lift front” helmet with three glasses or when using the flat type helmet, wear other spectacle-type safety goggles in addition to the filter lens and cover glass.

**(v)** Use vented goggles to prevent fogging of the lenses as much as practicable.

**(vi)** Lenses must be tempered glass, substantially free from scratches, air bubbles, waves and other flaws.

**(vii)** Lenses must have permanent distinctive markings to show the source and shade.

**NOTE:** The following is a guide for the selection of the proper shade numbers. These recommendations may vary to meet the individual’s needs.

Welding operation	Shade No.
Shielded metal-arc welding – 1/16-, 3/32-, 1/8-, 5/32-inch electrodes	11
Gas-shielded arc welding (nonferrous) – 1/16-, 3/32-, 1/8-, 5/32-inch electrodes	11
Gas-shielded arc welding (ferrous) – 1/16-, 3/32-, 1/8-, 5/32-inch electrodes	12
Shielded metal-arc welding:	
3/16-, 7/32-, 1/4-inch electrodes	12
5/16-, 3/8-inch electrodes	14
Atomic hydrogen welding	10-14
Carbon arc welding	14
Soldering	2
Torch brazing	3 or 4
Light cutting, up to 1-inch	3 or 4
Medium cutting, 1-inch to 6 inches	4 or 5
Heavy cutting, 6 inches and over	5 or 6
Gas welding (light) up to 1/8-inch	4 or 5
Gas welding (medium) 1/8-inch to 1/2-inch	5 or 6
Gas welding (heavy) 1/2-inch and over	6 or 8

**Note:** In gas welding or oxygen cutting where the torch produces a high yellow light, it is desirable to use a filter or lens that absorbs the yellow or sodium line in the visible light of the operation.

**(viii)** All filter lenses and plates must meet the test for transmission of radiant energy prescribed in ANSI Z87.1-1989 – American National Standard Practice for Occupational and Educational Eye and Face Protection.

**(c) Protective clothing.** Protect employees exposed to the hazards created by welding, cutting or brazing with personal protective equipment according to 4/I, OAR 437-004-1005.

**(A) Material.** Do not wear clothing that is easily ignited or highly flammable, like that made from synthetic materials.

**(d) Work in confined spaces.**

**(A) General.** Where a welder must enter a confined space, follow the rules for confined space work elsewhere in this Subdivision, 4/Q, and in 4/J, 437-004-1250.

**(B) Ventilation.** Ventilation is a prerequisite to work in confined spaces. For ventilation requirements see **OAR 437-004-2310(7)**.

**(C) Securing cylinders and machinery.** When welding or cutting is done in any confined space, the gas cylinders and welding machines must be left on the outside. Before starting, block heavy portable equipment wheels to prevent accidental movement.

**(D) Electrode removal.** When you stop arc welding for a period of time, like lunch or overnight, remove all electrodes from the holders and turn the machine off.

**(E) Gas cylinder shutoff.** When you stop gas welding or cutting for a period of time, like lunch or overnight, close the torch valves and shut off the gas supply to the torch at a point outside the confined area.

**(7) Health protection and ventilation.**

**(a) General.** Use general ventilation or a local exhaust system to keep the amount of toxic fumes, gases, or dusts below the limits in 4/Z, 437-004-9000.

**(b) Ventilation for general welding and cutting.**

**(A) General.** Use mechanical ventilation when welding or cutting on metals not covered in **(7)(e)** through **(7)(h)** below. (For specific materials, see the ventilation requirements of **(7)(e)** through **(7)(h)** below.)

**(i)** In a space of less than 10,000 cubic feet (284 m<sup>3</sup>) per welder.

**(ii)** In a room having a ceiling height of less than 16 feet (5 m).

**(iii)** In confined spaces or where the welding space contains partitions, balconies or other structural barriers to the extent that they significantly obstruct cross ventilation.

**(c) Local exhaust hoods and booths.** Mechanical local exhaust ventilation may be by means of either of the following:

**(A) Hoods.** Place movable hoods as close as practical to the work and with enough airflow for a velocity in the direction of the hood of 100 linear feet (30 m) per minute in the welding zone. The rates of ventilation to get this control velocity using a 3-inch (7.6 cm) wide flanged suction opening are in the following table:

Welding zone	Minimum air flow <sup>1</sup> cubic feet/minute	Duct diameter, inches <sup>2</sup>
4 to 6 inches from arc or torch	150	3
6 to 8 inches from arc or torch	275	3 1/2
8 to 10 inches from arc or torch	425	4 1/2
10 to 12 inches from arc or torch	600	5 1/2

<sup>1</sup> When brazing with cadmium bearing materials or when cutting on such materials you may need increased rates of ventilation.

<sup>2</sup> Nearest half-inch duct diameter based on 4,000 feet per minute velocity in pipe.

#### (d) Ventilation in confined spaces.

**(A) Air replacement.** Ventilate all welding and cutting in confined spaces to prevent the build-up of toxic materials or possible oxygen deficiency. This applies not only to the welder but also to helpers and other people in the area. Air replacing the withdrawn air must be clean and respirable.

**(B) Airline respirators.** Where it is impossible to provide such ventilation, use airline respirators or hose masks approved by the Mine Safety and Health Administration and the National Institute for Occupational Safety and Health.

**(C) Self-contained units.** In areas immediately dangerous to life or health (IDLH), use self-contained breathing equipment. Use breathing equipment approved by the National Institute for Occupational Safety and Health.

**(D) Outside helper.** When welding in confined spaces and where welders and helpers use hose masks, hose masks with blowers or self-contained breathing equipment approved by the Mine Safety and Health Administration and the National Institute for Occupational Safety and Health, a worker must be on the outside of the confined space to insure the safety of those working within.

**(E) Oxygen for ventilation.** Never use oxygen for ventilation.

#### (e) Cleaning compounds.

**(A) Manufacturer's instructions.** In the use of cleaning materials, because of their possible toxicity or flammability, follow appropriate precautions such as manufacturer's instructions.

**(B) Degreasing.** Degreasing and other cleaning involving chlorinated hydrocarbons must be where no vapors will reach or be drawn into the atmosphere surrounding any welding operation. In addition, keep trichloroethylene and perchlorethylene out of atmospheres penetrated by the ultraviolet radiation of gas-shielded welding operations.

**(f) Preservative coatings.**

**(A) Test first.** Before welding, cutting or heating on any surface covered by a preservative coating whose flammability is unknown, a competent person must test to determine its flammability.

**(B) Strip if needed.** Prevent ignition of highly flammable hardened preservative coatings. When coatings are known to be highly flammable, strip them from the area to be heated to prevent ignition.

**(g) Toxic preservative coatings.**

**(A) Enclosed spaces.** In enclosed spaces, strip all surfaces covered with toxic preservatives of all toxic coatings for a distance of at least 4 inches from the area of heat application or the employees must use a respirator that protects them from toxic vapors.

**(B) Strip if needed.** Remove the preservative coatings a sufficient distance from the area to be heated to ensure that the temperature of the unstripped metal will not increase appreciably. Artificial cooling of the metal surrounding the heated area is acceptable to limit the size of the area you must clean.

**(h) Cutting of stainless steels.** Oxygen cutting, using either a chemical flux or iron powder or gas-shielded arc cutting of stainless steel, must include mechanical ventilation adequate to remove the fumes.

**Stat. Auth.:** ORS 654.025(2) and 656.726(4).

**Stats. Implemented:** ORS 654.001 through 654.295.

**Hist:** OR-OSHA Admin. Order 4-1998, 1/8/28/98, ef. 10/1/98.

**437-004-2350 Oxygen-fuel Gas Welding and Cutting.**

**(1) Scope.** This subdivision applies to agricultural welding, except the following types for which Subdivision 2/Q applies:

Production type or amount of welding.

Welding in confined spaces like tanks, vats, pits, or those defined in 4/J, OAR 437-004-1250(1). This section (4/Q) covers some confined space welding topics. In those cases, follow this section in addition to the rules in 2/Q.

Welding with toxic or dangerous coatings or fluxes. This includes manganese, lead, zinc, cadmium, mercury, beryllium, or fluorine compounds.

Welding or heating galvanized materials.

## (2) General requirements.

**(a) Flammable mixture.** Do not use any device or attachment, not approved for the purpose, that allows air or oxygen to mix with flammable gases prior to consumption, except at the burner or in a standard torch.

**(b) Maximum pressure.** Never generate (except in approved cylinder manifolds), pipe or use acetylene at a pressure in excess of 15 psig (103 kPa gauge pressure) or 30 psia (206 kPa absolute). (The 30 psia (206 kPa absolute) limit is to prevent unsafe use of acetylene in pressurized chambers such as caissons, underground excavations or tunnel construction.) This requirement does not apply to storage of acetylene dissolved in a suitable solvent in cylinders manufactured and maintained according to U.S. Department of Transportation requirements, or to acetylene for chemical use. Never use liquid acetylene for any purpose.

**(c) Apparatus.** Use only approved apparatus such as torches, regulators or pressure-reducing valves.

## (3) Cylinders and containers.

### (a) Approval and marking.

**(A) DOT.** All portable cylinders used for the storage and shipment of compressed gases must meet regulations of the U.S. Department of Transportation, 49 CFR parts 171-179.

**(B) Markings.** Compressed gas cylinders must have legible markings that identify the gas content. They must show either the chemical or the trade name of the gas. These markings must not be easily removable. If possible, the marking must be on the shoulder of the cylinder and conform to the American National Standard Method for Marking Portable Compressed Gas Containers to Identify the Material Contained, ANSI/CGA C-4, 1990.

**(C) Connections.** Compressed gas cylinders must have connections that comply with the American National Standard Compressed Gas Cylinder Valve Outlet and Inlet Connections, ANSI/CGA V-1, 1987.

**(D) Protection cap.** All cylinders with a water weight capacity of more than 30 pounds (13.6 kg) must have a means of connecting a valve protection cap or a collar or recess to protect the valve.

### (b) Storage of cylinders, General.

**(A) No heat.** Keep cylinders away from radiators and other sources of heat.

**(B) Inside storage.** Inside buildings, store cylinders in a well-protected, well-ventilated, dry location, at least 20 feet (6.1 m) from highly combustible materials such as oil or excelsior. Locate storage spaces where cylinders will not be knocked over or damaged by passing or falling objects. Do not keep cylinders in unventilated enclosures such as lockers and cupboards.

**(C) Empties.** Empty cylinders must have their valves closed.

**(D) Caps.** Valve protection caps must always be in place, hand-tight, except when cylinders are in use or connected for use.

**(E) Secure.** Securely lash cylinders in place when necessary to prevent them from falling.

**(c) Fuel-gas cylinder storage.** Store acetylene cylinders valve end up.

**(d) Oxygen cylinder storage.**

**(A) Oxygen storage.** Do not store oxygen cylinders:

(i) Near highly combustible material, especially oil and grease;

(ii) Near reserve stocks of carbide and acetylene or other fuel-gas cylinders, or any other substance likely to cause or accelerate fire;

**(B) Not near fuel cylinders.** Separate stored oxygen cylinders from fuel-gas cylinders or combustible materials (especially oil or grease), by at least 20 feet (6.1 m) or by a noncombustible barrier at least 5 feet (1.5 m) high with a fire-resistance rating of at least 1/2-hour.

**(e) Operating procedures.**

**(A) No oil or grease.** Cylinders, cylinder valves, couplings, regulators, hose, and apparatus must be free from oily or greasy substances. Do not handle oxygen cylinders or apparatus with oily hands or gloves. Never allow a jet of oxygen to strike an oily surface, greasy clothes, or enter a fuel oil or other storage tank.

**(B) Handling cylinders.**

(i) Do not drop cylinders or allow them to strike each other.

(ii) Do not use valve-protection caps to lift cylinders from one vertical position to another. Do not use bars under valves or valve-protection caps to pry cylinders loose when frozen to the ground or otherwise fixed.

(iii) Unless cylinders are secured on a special truck, remove regulators and install valve-protection caps, when provided, before cylinders are moved.

**(iv)** Cylinders without fixed hand wheels must have keys, handles or non-adjustable wrenches on valve stems while they are in service. In multiple cylinder installations a single key or handle is acceptable for each manifold.

**(v)** Close cylinder valves before moving cylinders.

**(vi)** Close cylinder valves when work is done.

**(vii)** Close valves of empty cylinders.

**(viii)** Keep cylinders far enough away from the actual welding or cutting operation so that sparks, hot slag, or flame will not reach them. Otherwise, provide fire-resistant shields.

**(ix)** Do not set cylinders where they might become part of an electric circuit. Never tap an electrode against a cylinder to strike an arc.

**(x)** Do not use cylinders as rollers or supports, whether full or empty.

**(xi)** Do not use cylinders with altered or defaced numbers and markings.

**(xii)** Only the gas supplier may mix gases in a cylinder. Only the owner of the cylinder or person authorized by them, may refill a cylinder.

**(xiii)** Do not allow anybody to tamper with safety devices in cylinders or valves.

**(xiv)** Do not drop or roughly handle cylinders.

**(xv)** Unless connected to a manifold, do not use oxygen from a cylinder without first attaching an oxygen regulator to the cylinder valve. Before connecting the regulator to the cylinder valve, open the valve slightly for an instant and then close it. Always stand to one side of the outlet when opening the cylinder valve.

**(xvi)** Do not use a hammer or wrench to open cylinder valves. If opening the valve by hand does not work, notify the supplier.

**(xvii)**

**(I)** Do not repair or tamper with cylinder valves. Notify the supplier if you have trouble with a cylinder and follow their instructions as to its disposition.

**(II)** Do not remove the stem from a diaphragm-type cylinder.

## **(C) Attachments and use.**

**(i)** Fuel-gas cylinders must have the valve end up when they are in use. Store and ship liquefied gases with the valve end up.

- (ii) Before connecting a regulator to a cylinder valve, open the valve slightly and then close it immediately. Never crack a fuel-gas cylinder valve near other welding work or near sparks, flame, or other possible sources of ignition.
  - (iii) Before removing a regulator from a cylinder valve, close the cylinder valve and release the gas from the regulator.
  - (iv) There can be nothing on top of an acetylene cylinder when in use that may damage the safety device or interfere with the quick closing of the valve.
  - (v) If closing the valves will not stop leaks in cylinders and attachments, take them outdoors away from sources of ignition and allow them to slowly empty.
  - (vi) Put a warning near cylinders with leaking fuse plugs or other leaking safety devices. It must warn employees not to approach them with a lighted cigarette or other source of ignition. Plainly tag the cylinder and notify the supplier. Follow their instructions.
  - (vii) Do not tamper with safety devices.
  - (viii) Never use fuel-gas from cylinders through torches or other devices with shutoff valves without reducing the pressure through a suitable regulator attached to the cylinder valve or manifold.
  - (ix) Always open the cylinder valve slowly.
  - (x) Do not open an acetylene cylinder valve more than one and one-half turns of the spindle, and preferably no more than three-fourths of a turn.
  - (xi) If a cylinder takes a special wrench, leave it in position on the stem of the valve while the cylinder is in use. For manifolded or coupled cylinders, at least one such wrench must always be available for immediate use.
  - (xii) Do not use regulators with cracked, broken, or defective parts.
  - (xiii) Inspect union nuts and connectors on regulators before use. Do not use those with faulty seats.
  - (xiv) Before attaching the regulator to a cylinder, fully release the regulator's pressure adjusting screw.
  - (xv) Close the cylinder valve and release the gas from the regulator before removing it from the cylinder.
- (D) Blowpipes and torches.**
- (i) Approved backflow preventer or flashback preventers must be between the blowpipe or torch and the hoses.

**(ii)** Use only friction lighters, stationary pilot flames or other recognized sources of ignition to ignite torches. Do not use matches or other hand held open flames.

**(iii)** When welding or cutting stops for an extended period of time, for example, during the lunch break, overnight or longer:

**(I)** Close the oxygen and fuel-gas cylinder or manifold valves;

**(II)** Open torch valves momentarily to release all gas pressure from the hoses and then close them;

**(III)** Release the regulator pressure adjusting screws; and

**(IV)** When the welding or cutting stops for a few minutes, closing only the torch valves is acceptable.

**(iv)** Follow the manufacturer's procedures for the sequence of operations in lighting, adjusting, and extinguishing blowpipe flames and connecting to the gas supply.

**(v)** Use a suitable cylinder truck, chain or steadying device to secure cylinders while in use.

**(vi)** Post signs conspicuously in fuel-gas storage areas. They must say, "DANGER – NO SMOKING, MATCHES OR OPEN LIGHTS," or equivalent wording.

**(vii)** Acetylene gas must not contact unalloyed copper except in a blowpipe or torch.

**(viii)** Do not use oxygen in pneumatic tools, in oil preheating burners, to start internal-combustion engines, to blow out pipelines, to "dust" clothing or work, to create pressure, or for ventilation.

**(ix)** After connecting welding or cutting apparatus to oxygen and fuel-gas cylinders, or when starting to reuse the apparatus after 1/2-hour or more, let each gas flow through its respective hose separately for a few seconds to purge the hose of any mixture of gases.

**(x)** Never put down a torch unless the oxygen and fuel-gas have been completely shut off at the torch.

**NOTE:** Regulation of manifolds, piping systems, acetylene generators and calcium carbide are found in Division 2, 1910.253.

**Stat. Auth.:** ORS 654.025(2) and 656.726(4).

**Stats. Implemented:** ORS 654.001 through 654.295.

**Hist:** OR-OSHA Admin. Order 4-1998, 1/8/28/98, ef. 10/1/98.

**437-004-2400 Arc Welding and Cutting.**

**(1) Scope.** This subdivision applies to agricultural welding, except the following types for which Subdivision 2/Q applies:

Production type or amount of welding.

Welding in confined spaces like tanks, vats, pits, or those defined in 4/J, OAR 437-004-1250(1). This section (4/Q) covers some confined space welding topics. In those cases, follow this section in addition to the rules in 2/Q.

Welding with toxic or dangerous coatings or fluxes. This includes manganese, lead, zinc, cadmium, mercury, beryllium, or fluorine compounds.

Welding or heating galvanized materials.

**(2) Instruction.** Only trained and qualified workers will be allowed to run arc welding equipment.

**(3) Application of arc welding equipment.**

**(a) General.** Equipment that complies with the Requirements for Electric Arc-Welding Apparatus, NEMA EW-1-1983, National Electrical Manufacturers Association or the Safety Standard for Transformer-Type Arc-Welding Machines, ANSI/UL 551, 1993, Underwriters' Laboratories assures consideration of safety in design.

**(b) Voltage.** Do not exceed the following limits:

**(A) Alternating-current machines.**

**(i)** Manual arc welding and cutting – 80 volts.

**(ii)** Automatic (machine or mechanized) arc welding and cutting – 100 volts.

**(B) Direct-current machines.**

**(i)** Manual arc welding and cutting – 100 volts.

**(ii)** Automatic (machine or mechanized) arc welding and cutting – 100 volts.

**(C) Special processes.** When special welding and cutting processes require higher open circuit voltages than those above, there must be a way to prevent the operator from making accidental contact with the high voltage.

**(4) Installation of arc welding equipment.**

**(a) General.** Installation including power supply must be according to the requirements of Subdivision 4/S.

**(b) Grounding.** Ground the frame or case of the welding machine (except engine-driven machines) according to Subdivision **4/S**.

**(5) Operation and maintenance.**

**(a) Machine hook up.** Before starting operations check all connections to the machine to make certain they are properly made. The work lead must be firmly attached to the work; magnetic work clamps must be free from adherent metal particles of spatter on contact surfaces. Coiled welding cable must be spread out before use to avoid serious overheating and damage to insulation.

**(b) Grounding.** Check the grounding of the welding machine frame. Give special attention to safety ground connections of portable machines.

**(c) Manufacturers' instructions.** Follow the printed rules and instructions supplied by the manufacturer.

**(d) Electrode holders.** When not in use place electrode holders so they cannot make electrical contact with persons, conducting objects, fuel or compressed gas tanks.

**(e) Electric shock.** Do not use cables with splices within 10 feet (3 m) of the holder.

**(f) Damage.** Do not use work lead cables or electrode lead cables with damaged insulation or exposed conductors.

**(g) Cable.** Do not coil or loop the electrode cable around your body.

**Stat. Auth.:** ORS 654.025(2) and 656.726(4).

**Stats. Implemented:** ORS 654.001 through 654.295.

**Hist:** OR-OSHA Admin. Order 4-1998, 1/8/28/98, ef. 10/1/98.

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