

Welding and Cutting

Welding and Cutting

- Working with welding and cutting equipment can be extremely hazardous! Whether you are using gas or arc equipment, it is important that you follow the guidelines for safe usage.



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- According to the General Duty Clause, it is your company's responsibility to:
 - Make sure both the work that you do and your workplace itself are “free from recognized hazards that are causing or are likely to cause death or serious physical harm”
 - Comply with OSHA's standards

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Gas Cylinders

- The first step in knowing how to safely use gas welding and cutting equipment is knowing how to properly use, transport, move and store compressed gas cylinders according to OSHA's standards.
- The general guidelines for using gas cylinders cover:
 - Cylinder condition
 - Cylinder contents
 - Cylinder placement
 - Fire precautions

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Gas Cylinders (cont'd)

- **Cylinder Condition:**
 - Never use a damaged or defective cylinder.
 - Regardless of whether they are empty or full, cylinders should never be used as rollers or supports.
 - When a cylinder is in use a cylinder truck, chain, or other steadying device should be used to keep cylinders from being knocked over
 - When a cylinder is empty or not in use, or when a cylinder is being transported, the valve should be closed and the valve protection cap should be in place and secured.

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Gas Cylinders (cont'd)

- **Cylinder Contents:**
 - No person other than the gas supplier should attempt to mix gasses in a cylinder
 - No one other than the gas supplier or the person authorized by him should attempt to refill a cylinder
 - No one should use the cylinder's contents other than those people intended by the supplier.

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Gas Cylinders (cont'd)

- **Cylinder Placement:**

- Cylinders should be kept far enough away from the actual welding or cutting operation so that sparks or flame will not reach them. When this is impractical, fire resistant shields must be provided.
- Cylinders should be placed where they cannot become part of an electrical circuit.
- Fuel gas cylinders should be placed with the valve end up when in use, and they should never be used in a location where they would be subject to a heat source.
- Cylinders containing oxygen or acetylene shall not be placed in confined spaces.

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Gas Cylinders (cont'd)

- **Fire Precautions:**

- Buckets of water or sand, water hoses, or portable extinguishers need to be kept readily available.
- Fire watchers are required when combustible materials are within 35ft of welding and cutting. They are also required when combustible materials are on the opposite side of a metal structure from welding or cutting.
- Fire watchers need to be equipped with fire extinguishing equipment and be properly trained to use it.
- Fire watchers need to be able to sound the firm alarm if they are unable to extinguish the fire.
- Fire watch must be held for at least 30 minutes after completion of welding and cutting.

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Gas Cylinders (cont'd)

- Besides the general guidelines, there are also some more specific rules that apply to gas cylinders, including:
 - Transporting gas cylinders
 - Moving gas cylinders
 - Storing gas cylinders



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Gas Cylinders (cont'd)

- **Transporting Gas Cylinders:**
 - When cylinders are hoisted, they should be secured on a cradle, slingboard, or pallet. They should never be hoisted or transported by means of magnets or choker slings.
 - When cylinders are transported by powered vehicles, they should be secured in a vertical position.
 - Regulators should be removed and valve protection caps put in place before cylinders are transported, unless cylinders are firmly secured on a special carrier intended for this purpose.

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Gas Cylinders (cont'd)

- **Moving Gas Cylinders:**

- Cylinders shall be moved by tilting and rolling them on their bottom edges. They should never be intentionally dropped, struck, or allowed to strike each other violently.
- Valve protection caps should not be used for lifting cylinders from one vertical position to another, and bars should not be used under valves or valve protection caps to pry cylinders loose when frozen. Since cylinders are designed to accept valve protection caps, they should always be in place, hand-tight, except when in use or connected for use.
- Acetylene cylinders shall be stored valve up.
- Cylinder valves shall be closed before moving the cylinders.
- Before a regulator is removed from a cylinder valve, the cylinder valve shall be closed and the gas released from the regulator.

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Gas Cylinders (cont'd)

- **Storing Gas Cylinders:**
 - Oxygen cylinders in storage should be separated from fuel gas cylinders or combustible materials by a minimum distance of 20 ft. or by a non-combustible barrier at least 5 feet high with a fire-resistant rating of at least one-half hour.
 - Inside of buildings, cylinders should be stored in a well-protected, well-ventilated, dry location.



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Safe Use of Fuel Gas Cylinders

- While all cylinders should be handled carefully according to OSHA standards, there are a few extra guidelines that deal specifically with fuel gas cylinders. These extra guidelines cover:
 - Using Regulators
 - Cracking
 - Using Valve Wrenches
 - Leaks

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Safe Use of Fuel Gas Cylinders (cont'd)

- **Using Regulators:**
 - When using fuel gas through torches or other devices which are equipped with shutoff valves, you should always reduce the pressure by using a suitable regulator attached to the cylinder valve or manifold.
 - Before removing a regulator from a cylinder valve, always close the valve and release it from the regulator.

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Safe Use of Fuel Gas Cylinders (cont'd)

- **Cracking:**
 - Before a regulator or cylinder valve is connected, you should open the valve slightly and close it immediately. This is generally referred to as “cracking”, and is intended to clear the valve of dust or dirt that might otherwise enter the regulator.
 - When cracking the valve, stand to one side of the outlet, never in front of it.
 - Never crack a fuel gas valve where the gas could reach welding work, sparks, flame, or other possible sources of ignition.

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Safe Use of Fuel Gas Cylinders (cont'd)

- **Using Valve Wrenches:**
 - Always open the cylinder valve slowly, to prevent damage to the regulator.
 - For quick closing, never open a fuel gas valve more than 1= turns.
 - When a special wrench is required, it should 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 should always be available for immediate use.

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Safe Use of Fuel Gas Cylinders (cont'd)

- **Leaks:**
 - If, when the valve on a fuel gas cylinder is opened, a leak is found around the valve stem, close the valve and tighten the gland nut. If this action does not stop the leak, discontinue use of the cylinder, properly tag it, and remove it from the work area, unless a regulator attached to a cylinder valve stops the leak.
 - If a leak should develop at a fuse plug or other safety device, discontinue use of the cylinder and remove it from the work area.

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Gas Welding and Cutting Equipment

- There are a lot of other pieces of equipment that you'll need to use when gas welding and cutting. It is important that you understand how to properly use:
 - Fuel gas and oxygen hoses
 - Torches
 - Regulators

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Gas Welding and Cutting Equipment (cont'd)

- **Fuel Gas and Oxygen Hoses:**
 - Each hose type should be easily distinguishable from each other.
 - Oxygen and fuel gas hoses are not interchangeable, and a single hose having more than one gas passage should not be used.
 - When parallel sections of oxygen and fuel gas hose are taped together, not more than 4 inches out of every 12 should be covered in tape.
 - At the beginning of each working shift, all hose in use carrying a substance that could ignite, enter into combustion, or be in any way harmful to employees should be inspected.
 - Do not use a defective hose or one in poor condition.

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Gas Welding and Cutting Equipment (cont'd)



- **Torches:**

- Clean clogged torch tip openings with suitable cleaning wires, drills, or other devices designed for this purpose.
- At the beginning of each working shift, torches in use should be inspected for leaking shutoff valves and clogged tip connections.
- Never use a defective torch.
- Only light torches using friction lighters or other approved devices.

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Gas Welding and Cutting Equipment (cont'd)

- **Regulators:**
 - Oxygen and fuel gas regulators, including their related gauges, must be in proper working order and, therefore, must be inspected regularly.
 - Do not use defective regulators.

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Arc Welding and Cutting Equipment

- There are also specific guidelines for using arc welding and cutting equipment. These guidelines cover:
 - Manual electrode holders
 - Cables and connectors
 - Machine grounding
 - Shielding

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Arc Welding and Cutting Equipment (cont'd)

- **Manual Electrode Holders:**
 - You should only use manual electrode holders which are specifically designed for arc welding and cutting, and are capable of safely handling the maximum rated current required by the electrodes.
 - Also, any current-carrying parts passing through the portion of the holder which the welder or cutter grips in his hand should be fully insulated against the maximum voltage encountered to ground.

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Arc Welding and Cutting Equipment (cont'd)

- **Cables and Connectors:**
 - All cables used for arc welding and cutting should be completely insulated and flexible, capable of handling the maximum current requirements of the work in progress.
 - You should only use cables that are free from repair or splices for a minimum distance of 10 feet from the cable end to which the holder is connected, unless the insulating quality of the splice or connector is equal to that of the cable itself.
 - Never use a cable that is in need of repair.

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Arc Welding and Cutting Equipment (cont'd)

- **Machine Grounding:**
 - A ground return cable should have a safe current-carrying capacity equal to or exceeding the specified maximum capacity of the arc welding or cutting unit it services.
 - Never use pipelines containing gases or flammable liquids, or conduits containing electrical circuits, as ground returns.
 - When a structure or pipeline that is employed as a ground return circuit generates an arc, sparks, or generates heat at any time, discontinue use of the structure as a circuit.

Arc Welding and Cutting Equipment (cont'd)

- **Shielding:**

- All arc welding and cutting operations should be protected by noncombustible or flammable shields to protect people from the direct rays of the arc.
- When practical, objects to be welded, cut, or heated should be moved to a designated safe location. If the object cannot readily be moved, all moveable fire hazards in the vicinity should be taken to a safe place.
- No welding, cutting, or heating should be done in an area where the application of flammable paints or the presence of flammable compounds could create a hazard. Suitable fire extinguishing equipment should be immediately available in the work area, and should be maintained in a state of readiness for instant use.
- Before welding, cutting, or heating a drum, container, or hollow structure which has contained a toxic or flammable substance, you should either fill the structure with water or thoroughly clean it of such hazardous substances. Also, before applying heat to a drum, container, or hollow structure, be sure to open a vent to provide an escape route for any pressure built up during the application of heat.

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Proper Ventilation

- In typical welding, cutting, and heating situations not involving toxic materials, either mechanical ventilation or respiratory protective equipment are considered sufficient.
 - Mechanical ventilation consists of either general mechanical ventilation systems or local exhaust systems. It shall be considered adequate if it is of sufficient capacity and properly placed so as to remove fumes from the source and keep their concentration in the breathing zone within the same limits.
 - Contaminated air from a working space should be discharged well clear of the intake source, so that all air replacing that withdrawn will be clean and breathable.

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Proper Ventilation (cont'd)

- There are also welding, cutting, or heating situations in which additional ventilation is required, including:
 - Work in confined spaces
 - Work with or near toxic metals
 - Work with or near preservative coatings

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Proper Ventilation (cont'd)

- **Confined Spaces:**
 - When sufficient ventilation cannot be obtained without blocking the means of access, employees must be protected by air line respirators.
 - An employee on the outside of the confined space should be assigned to maintain communication with those within and aid them in case of an emergency.

Proper Ventilation (cont'd)

- **Toxic Metals:**

- Welding, cutting, or heating in any enclosed spaces involving the following metals should be performed with local exhaust ventilation, or employees should be provided with air line respirators:
 - Lead-bearing or lead-coated metals
 - Cadmium-bearing or cadmium-coated metals
 - Metal coated with mercury-bearing metals
 - Beryllium-bearing base or coating metals

Proper Ventilation (cont'd)

- **Preservative Coatings:**

- In enclosed spaces, all surfaces must be stripped of toxic coating a distance of at least 4 inches from the area of heat application, or the employee must be protected by a respirator.
- In the open air, employees must be protected by a respirator.

Welding Health Hazards

- It is also important to understand the various chemical and physical agents that can pose a health hazard when welding and cutting.

Chemical Hazards	
Zinc	Lead
Cadmium	Chlorinated Hydrocarbon Solvents
Beryllium	Phosgene
Iron Oxide	Carbon Monoxide
Mercury	Ozone
Fluorides	Nitrogen Oxides

Physical Hazards	
Ultraviolet Radiation	Intense Visible Light
Infrared Radiation	

Chemical Hazards

- **Zinc:** Zinc is used in large quantities in the manufacturing of brass, galvanized metals, and various other alloys.
 - Zinc Oxide fumes can occur when welding or cutting zinc-coated metals, and exposure to these fumes is known to cause metal fume fever.
 - Symptoms of metal fume fever are very similar to those of common influenza, and rarely, if ever, last beyond 24 hours.
- **Cadmium:** Cadmium is used frequently as a rust-preventative coating on steel and also as an alloying element.
 - Acute exposure to high concentrations of cadmium fumes can produce severe lung irritation, pulmonary edema, and in some cases even death.
 - Long-term exposure to low levels of cadmium in the air can result in emphysema and kidney damage.

Chemical Hazards (cont'd)

- **Beryllium:** Beryllium is sometimes used as an alloying element with copper and other base metals.
 - Acute exposure to high concentrations of beryllium can result in chemical pneumonia.
 - Long-term exposure can result in shortness of breath, chronic cough, and significant weight loss, accompanied by fatigue and general weakness.
- **Iron Oxide:** Iron is the principle alloying element in steel manufacture.
 - During the welding process, iron oxide fumes can be emitted from both the base metal and the electrode.
 - The primary acute effect of this exposure is irritation of the nasal passages and the lungs.
 - Although long-term exposure to iron oxide fumes may result in iron pigmentation of the lung tissue, authorities agree that these iron deposits in the lung are not dangerous.

Chemical Hazards (cont'd)

- **Mercury:** Mercury compounds are used to coat metals to prevent rust or inhibit foliage growth.
 - Under the intense heat of the arc or gas flame, mercury vapors will be produced.
 - Exposure to these vapors may produce stomach pain, diarrhea, kidney damage, or respiratory failure.
 - Long-term exposure may produce hearing damage.
- **Fluorides:** Fluoride compounds are found in the coatings of several types of fluxes used in welding.
 - Exposure can irritate the eyes, nose, and throat, and can eventually result in pulmonary edema and bone damage.

Chemical Hazards (cont'd)

- **Lead:** The welding and cutting of lead-bearing alloys or metals whose surfaces have been painted with lead-based paint can generate lead oxide fumes.
 - Inhalation and ingestion of lead oxide fumes and other lead compounds will cause lead poisoning.
 - Symptoms include metallic taste in the mouth, loss of appetite, nausea, and abdominal cramps. In time, anemia and general weakness, chiefly in the wrist, develop.
 - Lead adversely affects the central nervous system, circulatory system, reproductive system, kidneys, and muscles.

Chemical Hazards (cont'd)

- **Chlorinated Hydrocarbon Solvents:** Various chlorinated hydrocarbons are used in degreasing or other cleaning operations.
 - The vapors of such solvents are a concern when welding and cutting because the heat and ultraviolet radiation from the arc will decompose and form highly toxic and irritating phosgene gas (see Phosgene).
- **Phosgene:** Phosgene is formed when chlorinated hydrocarbon solvents are decomposed by ultraviolet radiation, such as that produced by arc welding and cutting.
 - It causes moisture in the lungs to form hydrogen chloride, which in turn destroys lung tissue.
 - For this reason, chlorinated solvents should be kept well away from welding operations or any operations in which ultraviolet radiation or intense heat is generated.

Chemical Hazards (cont'd)

- **Carbon Monoxide:** Carbon monoxide is a gas usually formed by the incomplete combustion of various fuels.
 - Welding and cutting produce significant amounts of carbon monoxide.
 - In addition, welding operations that use carbon dioxide gas shield may produce hazardous concentrations of carbon monoxide in poorly ventilated areas. This is called a “breakdown” of shielding gas. Carbon monoxide is colorless, odorless and tasteless, and cannot be readily identified by the senses.
 - Common symptoms of overexposure include pounding of the heart, a dull headache, flashes behind the eyes, dizziness, ringing in the ears, and nausea.

Chemical Hazards (cont'd)

- **Ozone:** Ozone is produced by ultraviolet light from the welding arc.
 - Ozone is a highly active form of oxygen that can cause great irritation to all mucous membranes.
 - Symptoms of ozone exposure include headache, chest pain, and dryness of the upper respiratory tract.
 - Excessive exposure can cause long-term damage to the lungs (pulmonary edema).
- **Nitrogen Oxides:** The ultraviolet light of the arc can produce nitrogen oxides from the nitrogen and oxygen in the air.
 - Nitrogen oxides, especially nitrogen dioxide, are irritating to the eyes and throat, but dangerous concentrations can be inhaled without any immediate discomfort.
 - High concentrations can cause shortness of breath, chest pain, and fluid in the lungs (pulmonary edema).

Physical Hazards

- **Ultraviolet Radiation:** Ultraviolet radiation (UV) is generated by the electric arc in the welding process.
 - Skin exposure to UV can cause severe burns, in many cases without prior warning. UV radiation can also damage the lens of the eye, causing what is commonly known as “arc-eye”, a sensation of sand in the eyes.
 - Exposure to UV rays may also increase the effects of some chemical agents.

Physical Hazards (cont'd)

- **Infrared Radiation:** Exposure to infrared radiation (IR), produced by the electric arc and other flame cutting equipment, may harm skin surface and the tissues immediately below the surface.
 - Except for this effect, which can sometimes progress to thermal burns in some situations, infrared radiation is not dangerous to welders.
 - Most welders protect themselves from IR with a welder's helmet or glasses and protective clothing.

Physical Hazards (cont'd)

- **Intense Visible Light:** Exposure of the human eye to intense visible light can produce adaptation, papillary reflex, and shading.
 - Such actions are protective mechanisms to prevent excessive light from being focused on the retina.
 - In the welding process, eye exposure to visible light is prevented for the most part by the welder's helmet, but some individuals have sustained retinal damage due to careless viewing of the arc.
 - At no time should the arc be observed without eye protection.