

Lesson: Welding and Cutting

- Lesson Objectives:**
- Describe the three most frequently cited OSHA violations related to welding.
 - Define the general welding hazards that PPE should reduce or eliminate.
 - Describe ventilation methods used in welding and cutting work.
 - Describe general precautions for assuring safe handling of oxyfuel welding equipment
 - Describe plasma arc welding, air carbon arc welding and gas shielded arc welding.
 - Describe the five variables that can account for the amount of metal fumes and gases and risk to which a welder is exposed.

- Topics**
- General Information
 - Precautions for General Safety, Fire, and PPE
 - Health Protection and Ventilation
 - Safety Precautions in Oxyfuel Welding
 - Safety Precautions in Arc Welding and Gas Shielded Arc Welding

Topic: General Information

This topic introduces the numerous health hazards associated with exposure to fumes, gases, and ionizing radiation formed or released during welding, cutting, and brazing. These risks vary, depending upon the type of welding materials and welding surfaces, but include heavy metal poisoning, lung cancer, metal fume fever, flash burns, and others. It also introduces the health hazards found in welding and cutting operations. Having completed this topic, you should be able to:

- Define the three primary elements in welding operations that cause fires
- Describe the three most frequently cited OSHA violations related to welding
- Explain the primary control measures to prevent welding fires

Topic summary:

Please take a moment to review these major points before you continue with the next topic.

- Welding fires usually can be attributed to inadequate protection or no protection of the flammable material from flame and sparks.
- Fires from welding operations are started by sparks, hot slag, and flame from the torch.
- Arc welding cables improperly spliced or in need of repair are an electric shock hazard.
- Inadequate ventilation while welding within a confined space is an explosion or respiratory hazard.
- Regulators and gauges on compressed gas cylinders not in proper working order are a danger from the uncontrolled release of compressed gases.

Effective measures to control welding hazards specify to:

- Inspect welding cables daily before use and repair or replace, if needed. All cable splicing must maintain the insulated protection with no exposed metal parts. Cables needing repair must not be used until they are in safe serviceable condition.
- Confined spaces must be adequately ventilated while welding is underway to control hazardous welding fumes.
- Follow the OSHA standard that mandates that combustible materials must be located 35 feet from the worksite. Until they can be moved to that safe distance, cover them with a flameproof material.

Topic: Precautions for General Safety, Fire, and PPE

This topic contains information on general safety measures, fire safety and protection, and PPE for the welding industry. Having completed this topic, you should be able to:

- Discuss the general safety practices for welding and cutting
- Define the general welding hazards that PPE should reduce or eliminate
- List PPE devices that are recommending for use in welding
- Describe fire safety precautions for this work

Topic summary:

Please take a moment to review these key points before you continue with the next topic:

- Do not permit unauthorized persons to use welding or cutting equipment.
- Do not weld in a building with wooden floors, unless the floors are protected from hot metal by fire-resistant fabric and/or other fireproof material. Be sure that hot sparks or hot metal will not fall on the operator or on any welding equipment components.
- Remove all flammable material, such as cotton, oil, gasoline, etc. from the vicinity of welding.
- Before welding or cutting, warn those in close proximity to wear proper clothing or goggles.
- Remove any assembled parts from the component being welded that may become warped or damaged by the welding process.
- Remove hot rejected electrode stubs, steel scrap, or tools from the floor or near the welding equipment to prevent accidents and/or fires.
- Keep a suitable fire extinguisher nearby at all times. Ensure the fire extinguisher is in operable condition.
- Mark all hot metal after welding operations are completed.
- The welding arc should never be viewed with the naked eye within a distance of 50 feet.
- Operators, fitters, and those working nearby need protection against arc radiation. The intensity of the light from the arc increases with increasing current and arc voltage.
- The chief advantage of the helmet is that it leaves both hands free, making it possible to hold the work and weld at the same time.
- Protective clothing and other PPE should be used by anyone near the welding site.
- Clothing worn by those in the welding area should follow clothing guidelines to avoid burns, flammable substances, and flying or dropping debris that can ignite the material.

Topic: Health Protection and Ventilation

In this topic, you learned how ventilation is used to protect the health of workers performing welding, cutting, and brazing operations.

Ventilation refers to changing room air as often as necessary to prevent welders and other workers from breathing high levels of airborne contaminants. Ventilation provides adequate breathing air that is required for all welding, cutting, brazing, and related operations. Proper ventilation can be obtained either naturally or mechanically. Adequate ventilation depends on:

- Volume and configuration of the space where welding operations occur
- Number and type of operations generating contaminants
- Natural airflow rate where operations are taking place
- Locations of the welders' and other workers' breathing zones in relation to the contaminants or sources of room air

Having completed this lesson, you should be able to:

- Define ventilation
- Describe methods and equipment used to provide adequate ventilation in this type of work

Topic summary:

Please take a moment to review these key points before you continue with the next topic.

- Ventilation is done to prevent the accumulation of toxic materials, combustible gases, or possible oxygen deficiency.
- Monitoring instruments should be used to detect harmful atmospheres.
- Where it is impossible to provide adequate ventilation, air-supplied respirators or hose masks approved for this purpose must be used.
- In these situations, lookouts must be used on the outside of the confined space to ensure the safety of those working within the confined space.
- Arc and gas welding and cutting requirements govern the amount of contamination to which welders may be exposed.
- In all cases, the required health protection, ventilation standards, and standard operating procedures for new and old welding operations should be coordinated and cleared through the safety inspector and the industrial hygienist responsible for the safety and health aspects of the work area.
- When a helmet is worn during welding, samples must be collected under the helmet.
- Respiratory protective equipment must not be transferred from one individual to another without being disinfected and fit tested.
- The suppliers of welding materials must determine the hazard associated with using their materials in welding, cutting, etc.
- Smoke exhaust systems incorporated in semiautomatic guns provide the most economical exhaust system.
- Mechanical ventilation must be provided when welding or cutting is done on metals:
 - In a space of less than 10,000 cubic feet per welder
 - A ceiling height of less than 16 feet
 - In confined spaces or where the welding space contains partitions, balconies, or other structural barriers that significantly obstruct cross-ventilation

Topic: Safety Precautions in Oxyfuel Welding

This topic describes the general and specific safety precautions in oxyfuel welding and the proper steps for lighting and extinguishing torches. The topic also describes the proper use and storage of four types of cylinders and hazards and proper care of hoses. Having completed this topic, you should be able to:

- Describe general precautions for assuring safe handling of oxyfuel welding equipment
- Define the characteristics of the four gases that determine how they can be used in welding

Topic Summary

Please take a moment to review these major points before you continue with the next topic.

- Acetylene cylinders must be stored upright in a well-ventilated, well-protected, dry location at least 20 feet from highly combustible materials such as oil, paint, or excelsior.
- Never use acetylene at pressures in excess of 15 psi. Higher pressure can cause an explosion.
- Never test for an acetylene leak with an open flame; test all joints with soapy water.
- Never interchange acetylene regulators, hose, or other apparatus with similar equipment intended for oxygen.
- If an acetylene cylinder should catch fire, it usually can be extinguished with a wet blanket. A burlap bag wet with calcium chloride solution is effective for such an emergency. If these fail, spray a stream of water on the cylinder to keep it cool.
- Oxygen cylinders in storage must be separated from fuel gas cylinders or combustible materials (especially oil or grease) by a minimum distance of 20 feet or by a noncombustible barrier at least 5 feet high and having a fire-resistance rating of at least one-half hour.
- MAPP gas is a mixture of stabilized methylacetylene and propadiene. Store liquid MAPP gas around 70°F and under 94 psig pressure.
- Escaping fuel gas can be a fire or explosion hazard.
- A wet glove, wet heavy cloth, or mud slapped on the flame will frequently extinguish a fire on a cylinder if it is a small flame around the hose connection, the valve stem, or the fuse plug.
- MAPP gas has advantages which include:
 - Cylinders will not detonate when dented, dropped, or incinerated.
 - It can be used safely at the full cylinder pressure of 94 psig.
 - Liquified fuel is insensitive to shock.
 - Explosive limits of MAPP gas are low compared to acetylene.
 - The strong smell of MAPP gas makes detecting leaks easy.
 - Cylinders are lightweight and easy to handle.

Topic: Safety Precautions in Arc Welding and Gas Shielded Arc Welding

In the arc cutting process, intense heat of the electric arc melts away the metal. This topic explains safety precautions in arc welding and cutting by covering hazards in electric currents, welding machines, and the use of protective screens. This topic also covers plasma arc cutting and welding and air carbon arc cutting and welding. Having completed this topic, you should be able to:

- Describe plasma arc welding, air carbon arc welding and gas shielded arc welding
- List the three causes of hazardous radiation and lighted welding
- Define hazard evaluation and control methods for physical agents
- Describe the five variables that can account for the amount of metal fumes and gases and risk to which a welder is exposed

Topic Summary

Please take a moment to review these key points before you continue with the next topic.

- Metal cutting in welding is the severing or removing of metal by a flame or arc. The most common cutting processes are:
 - Arc cutting in which intense heat of electric arc melts away the metal.
 - Oxygen cutting in which metal is heated by gas flame and an oxygen jet does the cutting.
- Screens can be used to:
 - Protect eyes of other personnel from the arc or reflected glare.
 - Prevent drafts of air from interfering with the stability of the arc.
 - Cover the windows of the welding truck to provide protection when welding at night.
- The output voltage of a conventional arc welding machine is lower than ordinary household voltage (115 V).
- Plasma arc welding is a process in which coalescence is produced by heating with a constricted arc between an electrode and the work piece (transfer arc) or the electrode and the constricting nozzle (nontransfer arc).
- Air carbon arc cutting is an arc cutting process in which metals to be cut are melted by the heat of a carbon arc and the molten metal removed by a blast of air. The process is widely used for back gouging, preparing joints, and removing defective metal.
- In shielded metal arc welding, shielding from the air is accomplished by gases produced by the disintegration of the coating in the arc.
- With gas shielded arc welding, shielding from the air is accomplished by surrounding the arc area with a localized gaseous atmosphere throughout the welding operation at the molten puddle area.
- Gas shielded arc welding is associated with certain dangers, including:
 - Arc gases
 - Radiant energy
 - Radioactivity from thoriated tungsten electrodes
 - Metal fumes
- Welding and cutting may produce metal fumes and gases that can make you very sick. The risk depends on: the welding method (such as MIG, TIG, or stick); what the welding rod (electrode) is made of; filler metals and base metals (such as mild steel and stainless steel); paints and other coatings on the metals being welded, and ventilation.
- Most welders protect themselves from IR and UV radiation with a welder's helmet (or glasses) and protective clothing.
- To avoid retinal damage, never observe the welding arc without eye protection.
- OSHA has limits for exposure to metals, gases, and total fumes during welding, but these limits may not protect you enough, because they are out of date. NIOSH says welding fumes may cause cancer, so selecting fume reduction methods is important to your health.
- Stick welding makes much less fume than flux core welding.