

Personal Protective Equipment

Welding operations in general dictate face, neck, and eye protection against sparks, molten metal splatters, and the radiations (ultraviolet, infrared, and intense visible) of the arc or flame. Normally, this means that a welder will wear a welding hood or helmet (though in some cases, gas welding may properly be done with appropriate goggles), gloves, and other protective clothing for neck and arms.

When personal respiratory protection is required, this should be provided by a half- or full-face respirator with a supplied-air system, or – when the components and concentration of the fumes and gases are known – by a respirator with filters for protection against fumes and gases. As stated in the 30 CFR, engineering controls must be provided, and respirators can be used while engineering controls are being installed or repaired or after all other controls are found to be unfeasible.

For additional information and assistance, contact:

- » Your local MSHA office
- » **Metal/Nonmetal Mine Safety and Health**
Arlington, Virginia
202-693-9630
- » **Coal Mine Safety and Health**
Arlington, Virginia
202-693-9510
- » **Pittsburgh Safety and Health
Technology Center**
Pittsburgh, Pennsylvania
412-386-6902

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Welding Hazards



Health Hazard Information Card HH-18

Welding processes – which include cutting, brazing, and burning, as well as some soldering methods – generate a variety of irritants and toxic components. Potential contaminants associated with welding operations include fumes, acid, toxic gases, and ultraviolet and infrared radiations.

Fumes

Fume particles are formed from vaporization of molten metal. The size of the particles is generally one micron or less, and they may clump together to form larger particles. Because of this extremely small size, fumes behave like gases, that is, they become airborne with the ability to spread over a wide area if not controlled. Fumes may cause harm on contact with skin and other body tissues. Extremely fine particles can reach the lowest part of the lungs and cannot be expelled. From there they can enter the bloodstream.

The fumes produced depend primarily on the composition of the materials being welded and the welding rods' coating or flux. When the base metal is iron or steel, with welding rods of similar composition, the main component of the fume will be iron oxide. When welding on stainless steel, fumes containing nickel and chromium may be created. Welding on plated, galvanized, or painted surfaces may generate fumes containing cadmium, zinc oxide, or lead. In addition, welding rods can release fluoride in the fume, as well as free silica, depending on the composition of the rod's coating.

Toxic Gases

Toxic gases identified with welding include carbon monoxide, nitrogen oxides, and ozone. If welding or cutting operations are conducted in the presence of chlorinated hydrocarbons, such as in solvents used in a degreasing station, hazardous concentrations of phosgene and hydrogen chloride – highly toxic irritant gases – can be formed.

Radiation Hazards

Ultraviolet radiation commonly occurs in electric arc welding, and infrared radiation is a result of thermal applications with metals.

Adverse Health Effects

Systemic poisoning – poisoning of an entire body system or target organ caused by fumes, gases, and radiation – falls into two categories:

- ✓ **acute** (usually a high concentration of a fast-acting substance which causes an immediate or traumatic reaction), for example:
 - » metal-fume fever (a brief painful ailment with fever and chills)
 - » respiratory tract irritation
 - » “flash” eye burns
- ✓ **chronic** (low concentrations accumulating over a longer period of time), for example:
 - » pneumoconiosis (lung disease due to the accumulation of mineral or metal particles)
 - » permanent eye damage
 - » cancer (different types)

Other Hazards

In addition to the health hazards of metal fumes and toxic gases, welding operations involve the danger of burns from flame, arc, molten metal, heated surfaces, and metal splatter.

Sampling for Fumes and Gases

Fumes are sampled by drawing air through a special filter at a controlled rate. The inspector uses a filter cassette attached to a pump placed on the worker. The cassette is placed under the worker's welding hood or as close to the welder's breathing zone as possible. Short-term samples may be taken to evaluate toxic substances which have short-term limits (usually 15 to 30 minutes). In addition, there are other means (for example, a multi-gas detector with tubes) to test for toxic gases such as ozone, nitrogen oxides, or phosgene. It is important that the worker carry out all welding operations in a normal way, so that an accurate evaluation of the exposure can be made.

Controls

Good local or general ventilation is required to control exposures to metal fumes and gases. The most effective indoor fume control is local exhaust ventilation in which an exhaust hood is placed near the welding arc or flame, and contaminants are drawn away from the welder's breathing zone. Ventilation systems may consist of moveable exhaust hoods, flexible and stationary ducts, a powered fan, and a fume or dust collector that exhausts air to the outdoors. During the welding operation, exhaust hoods must be placed or set so that fumes and gases are not drawn across the worker's breathing zone. Barriers such as curtains help protect other workers in the area where welding or related processes are being performed.

Welding in confined spaces such as tanks, mills, cabs of mobile equipment, and large shovels are especially dangerous and require additional ventilation and safeguards. Good housekeeping practices reduce the risk of hazards such as fires, explosions, tripping, and falling.