



# Welding Hazards and the Law-In Plain English

A guide to complying with OSHA, NIOSH and other air quality standards with regards to welding

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Do you understand the laws and regulations regarding weld fume exposure? After reading through the OSHA standards and others, it is easy to see where most Plant Managers or those responsible for employee safety get confused. In an effort to clear some of the confusion, Micro Air developed this guide to welding that explains these laws and regulations in plain English so that they are easily understood.

## The Basics:

Welding metal emits three major groups of contaminants that inspired regulations from OSHA:

- 1) **Metal Fumes**-Fumes are formed when metal is vaporized and then condenses into very small particles. The chemical components of the Metal Fumes vary greatly depending on what type metal is being welded, what filler, flux, electrode, and / or wire is being used.

**OSHA Regulation:** See *Metal Fumes Chart*

- 2) **Carbon Monoxide-CO** results from using Carbon Dioxide as a shielding gas or to a lesser extent the incomplete combustion of the electrode covering or flux. In high enough concentrations, CO can cause death by asphyxiation.

## OSHA Regulation:

CO-Permissible exposure limit of 50ppm on an 8-hour time weighted average (TWA).

**Note:** Typically the only time concentrations would be high enough to exceed the OSHA regulations would be welding in an enclosed area, such as a tank.

- 3) **Ozone and Nitrogen Dioxide**-These two compounds are produced from the ultraviolet light produced from the welding arc and it's reaction with the ambient air surrounding the operation. It is typically present in much higher concentrations when Nitrogen is used as the shielding gas. Both compounds can cause fluid in the lungs and other long-term pulmonary type illnesses.

**OSHA Regulation:**

Ozone-0.1 ppm on an 8 HR TWA

Nitrogen Dioxide-No more than 5 ppm at any

**MAJOR CONCERN – Welding Fumes and the Regulated Substances Within**

*Welding fumes cause the most confusion where OSHA regulations are concerned.* Weld fume is a mixture of a lot of small particles and gases. Within a sampling of weld smoke there are a number of extremely toxic substances and while there is not an OSHA permissible exposure limit or PEL for weld fume, there are permissible exposure limits for almost all of the fume's components.

**See Table below for relative PEL for each component.**

<b>Metal Fumes Chart</b>	
<b>Substance</b>	<b>Permissible Exposure Limit (PEL)</b>
Chromium	.5 mg/cubic meter
Nickel	1 mg/cubic meter
Arsenic	.5mg/cubic meter
Asbestos	See OSHA PEL notes
Manganese	5mg/cubic meter
Silica	See OSHA PEL notes
Beryllium	See OSHA PEL notes
Cadmium	0.1 mg/cm on 8 hr TWA or .3mg/cm Max.
Nitrogen Oxides	N/A
Phosgene	0.1 ppm or 0.4 mg/cubic meter
Acrolein	1 ppm or 0.25 mg/cubic meter
Flourine Compounds	.1 ppm or 0.2 mg/ cubic meter
Carbon Monoxide	50 ppm or 55 mg/cubic meter
Cobalt	0.1 mg/cubic meter
Copper	0.1 mg/cubic meter
Lead	See OSHA PEL notes
Ozone	0.1 ppm or 0.2 mg/ cubic meter
Selenium	0.2 mg/cubic meter
Zinc Oxide	5 mg/cubic meter

**Source: U.S. Department of Labor, OSHA Std 29CFR.**

The concentrations of each of the compounds in the table vary greatly by types of metal, filler, and gases being used. They are also greatly affected by any sort of paint or coating that is present on the material being welded. These could include degreasers, anti-spatter spray, and / or many other chemicals routinely used to prepare metal for welding.

In short term, exposure to welding fumes can cause “metal fume fever”, coughing, respiratory and gastrointestinal issues. **Short-term exposure to Cadmium can be fatal.**

Long term effects are an increased risk of a multitude of respiratory problems such as lung

cancer, cancer of the larynx and urinary tract, bronchitis, asthma, decreased lung capacity, many other respiratory problems, heart disease, skin disease, hearing loss, kidney damage, ulcers, and even reproductive risks. This is not real surprising given the list above contains so many known carcinogens and toxins.



**Problem Identified...How do you rid yourself of the problem?**

**There are two ways to make sure the levels of the contaminants stay within the OSHA PEL's**

**1. Change the materials used.**

This is not usually real practical and will not remove all the hazards, but going with a cadmium free silver solder can definitely be a good way to get rid of some of the most hazardous components such as cadmium.

**2. Use Ventilation.**

There are two types of ventilation:

- a. Local exhaust ventilation, or source capture, is the best way to ensure the particulate does not enter the welder's breathing zone. Utilizing hoods or source capture arms connected or ducted to a Micro Air dust collector, air cleaner or even exhausted outdoors will eliminate the contaminants from entering the breathing zone when sized properly.

- b. General ventilation through roof vents, open doors, floor fans, etc. removes a lot of the particulate, but has three major drawbacks. First, in most cases, the air still passes through the workers breathing zone. Second, the method tends to scatter or spread the particulate to other areas of the facility before they eventually dissipate in the air stream or settle out on equipment, personnel, or others. Third, if the ventilated air is heated or cooled, it can be much cheaper to clean the air rather than exhaust the air and spend the additional dollars to heat or cool the new air coming in.

**Different Materials Produce Different Contaminants**

Material	Toxin /Carcinogens Produced When Welding
Stainless Steel & High Alloys	Nickel, Chromium, Cadmium
Galvanized, Painted, or Plated Metals	Cadmium, Zinc Oxide, Lead
Steel	Iron Oxide
Welding Rods (In Processes using them)	Fluorine Compounds, Silica
Most Welding Processes	Manganese, Carbon Monoxide, Nitrogen Oxide, Ozone
Brass alloys, Bronze alloys, Monel	Copper, lead
Magnesium, Copper, aluminum alloys	Beryllium

## OSHA Requirements for Ventilation

### ***Welding with materials that produce Fluorine Compounds, Lead, Zinc***

**Indoors**- Mechanical exhaust can be accomplished in either of two ways, but ***must*** be provided.

1. **Hoods**-Freely moving hoods shall be placed by the welder as near as practical to the work being welded. Another mandatory provision is a rate of air-flow sufficient to maintain a velocity in the direction of the hood of 100 linear feet per minute in the zone of welding when the hood is at its most remote distance from the point of welding. **(All Micro Air products with Arms meet this spec).**
2. **Fixed Enclosure**-A fixed enclosure with a top and not less than two sides, which surrounds the welding or cutting operations, and with a rate of airflow sufficient to maintain a velocity away from the welder of not less than 100 linear feet per minute. **The Micro Air Clean Air Booth is a perfect example of this method.**

**In confined areas**-Air Replacement shall be provided. "All welding and cutting operations carried on in confined spaces shall be adequately ventilated to prevent the accumulation of toxic materials or possible oxygen deficiency. This applies not only to the welder but also to helpers and other personnel in the immediate vicinity. All air replacing that withdrawn shall be clean and respirable. .... In circumstances for which it is impossible to provide such ventilation, airline respirators or hose masks approved for this purpose by the National Institute for Occupational

safety and Health (NIOSH) under 42 CFR part 84 must be used..."

### ***Welding with materials that produce Beryllium, Cadmium, or Mercury-***

**Indoors, outdoors, or Confined space**-Local Exhaust ventilation or airline respirators must be used unless under your worst, most adverse conditions, you do not exceed the PEL limit for the contaminant in question.

### ***Cutting of Stainless Steels-***

"Oxygen cutting, using either a chemical flux or iron powder or gas-shielded arc cutting of stainless steel, shall be done using mechanical ventilation adequate to remove the fumes generated."

### ***All other welding or cutting-***

Mechanical ventilation shall be provided in any of the following cases:

1. "In a space of less than 10,000 cubic feet per welder".
2. "In a room having a ceiling height of less than 16 feet.
3. "In confined spaces or where the welding space contains partitions, balconies, or other structural barriers to the extent that they significantly obstruct cross ventilation."

This ventilation shall be at a minimum rate of 2000 CFM per welder except where local exhaust hoods and booths are used. If none of the above three cases exist, natural ventilation is deemed sufficient.

***Other Standards or Groups with  
Applicable Recommendations***

While OSHA regulations are law, you probably hear about other “standards” from organizations such as the National Institute for Occupational Safety and Health or NIOSH. NIOSH makes the recommendation that welding emissions be reduced to the “lowest feasible concentrations”. Although not exactly a black and white type of statement, it does show that they feel everything possible should be done to reduce the exposure of employees to Welding Smoke.

Contact your local Micro Air Distributor for any Questions you may have...for expert advice, or Quotations. Let us know how we can help you comply with OSHA regulations in your welding operations through the utilization of one of our Micro Air Clean Sir Systems.

Notes:

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