

Introduction

During welding and metal cutting operations very small particles, known as fumes, can be generated. Depending upon the components involved in the operation, these small particles can contain hazardous metals such as: arsenic, beryllium, cadmium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, vanadium or zinc.

What are the primary health effects from exposure to welding fume?

Exposure to welding fume can cause metal fume fever that can include flu-like symptoms, breathing difficulty, cough, muscle pain, fever and chills. Exposure to very high levels can result in eye, nose and throat irritation, headaches, nausea, or a metallic taste in the mouth. Long-term exposure to low levels of welding fume may also cause wheezing, decreased lung function, pneumonia, infertility, or cancer. These health effects may vary depending upon the specific metals in the welding fume.

What are the occupational exposure limits for welding fume?

Title 30 CFR §§ 57.5005 states that exposure shall not exceed the Threshold Limit Values Adopted by the American Conference of Governmental Industrial Hygienists in 1973. These Threshold Limit Values depend upon the specific metals in the welding fume profile.

Metal	Full Shift (mg/m ³)	Short Term Exposure Limit (mg/m ³)
Arsenic	0.5	1.5 (15 min)
Beryllium	0.002	0.025 (5 min)
Cadmium	0.1	0.1 (ceiling)
Chromium (chromate)	0.1	0.3 (15 min)
Cobalt	0.1	0.5 (30 min)
Copper	0.1	0.1 (30 min) 1986 PA Rules
Iron (oxide)	10	20 (15 min)
Lead	0.15	0.45 (15 min)
Manganese	5	5 (ceiling)
Magnesium (oxide)	10	20 (15 min)
Molybdenum	10	20 (15 min)
Nickel	1	3 (15 min)
Vanadium	0.05	0.05 (ceiling)
Zinc (oxide)	5	10 (30 min)

While not required by the Mining Safety and Health Administration, it is highly recommended to comply with the most current recommended airborne concentration standards.

How often shall I complete exposure monitoring for welding fume?

30 CFR Part 56.5002 requires that dust, mist, and fume surveys be conducted as frequently as necessary to determine the adequacy of control measures. Standard industrial hygiene practice dictates a baseline evaluation to determine potential exposure concentrations and routine monitoring (usually annually). An increased survey frequency may be required as processes and tasks change, if engineering controls change, or if monitoring results indicate concentrations 50% of the TLV or nearing/exceeding the TLV.

How do I measure potential exposures to welding fume?

To assess welding fume exposures you should conduct air sampling and in some cases where contamination is suspected, wipe sampling. Samples should be analyzed for a variety of metals paying close attention to the constituents of the source metal and welding rod/wire. Air sampling can be completed for the entire shift to compare with the 8-hr limit or for 15 minutes to compare with the short-term exposure limit. According to NIOSH

method 7300, a sampling pump is calibrated to 1.7 liters per minute. A 37 mm diameter mixed cellulose ester (MCE) filter with a 0.8 µm pore size is placed in a cassette and connected to the pump. The pump is placed on the worker with the cassette in their breathing zone for the appropriate duration. Upon completion the filter should be sent to certified laboratory for analysis. At least one blank filter should also be sent. This filter should go through all the same processes except that the pump is not turned on. Sampling can also be conducted according to OSHA ID-121, where the pump is calibrated to 2.0 liters per minute.

Wipe samples should be completed while wearing clean disposable gloves to avoid contamination. A piece of Whatman filter paper (41 or 42) or smear tabs moistened with distilled water is used to wipe a 10 cm x 10 cm area. Then the paper is folded in half and transported in a plastic bag or jar to the laboratory for analysis. A clean piece of filter paper should also be submitted to the laboratory as a blank.

Certified laboratories that can assist with measuring welding fume:

Galson <http://www.galsonlabs.com/>

Analytics Corporation <http://www.analyticscorp.com/>

How do I control exposures to welding fume?

Local ventilation is recommended for controlling welding fume exposures whenever possible. There are some portable systems that may be helpful at your site. General ventilation should also be used to reduce exposures. Appropriate administrative controls should also be used to ensure adequate maintenance for the ventilation system. Housekeeping policies should be developed and used for surface decontamination. If welding fumes are present at any detectable concentration is recommended by NIOSH that a self contained breathing apparatus or supplied air respirator (with an auxiliary self-contained positive pressure apparatus) that has a full facepiece operated in pressure-demand or other positive-pressure mode (APF=10,000) be utilized. Appropriate gloves, sleeves, encapsulating suits, and other protective clothing should be provided to prevent skin contact with welding fumes.

References:

MSHA. 2007. Metal Nonmetal Health Inspection Procedures Handbook. PH06-IV-1(1).

<http://www.msha.gov/readroom/handbook/PH09-IV-1.pdf>

MSHA Code of Federal Regulations (<http://www.msha.gov/30cfr/0.0.htm>).

OSHA. Occupational Safety and Health Guideline for Welding Fumes

<http://www.osha.gov/SLTC/healthguidelines/weldingfumes/recognition.html>