



workers may be exposed include: coatings on the metal being welded (such as paint, plating, or galvanizing), the number of welders and the volume of the work area, the quality and the amount of ventilation, position of the welder's head with respect to the fume plume, as well as the presence of contaminants in the atmosphere (such as chlorinated hydrocarbon vapors from cleaning and degreasing activities). As the electrode is consumed, fume and gas decomposition products generated are different in percent and form from the ingredients listed in Section II. Fume and decomposition products, not the ingredients in the electrode, are important. Decomposition products include those originating from the volatilization, reaction, or oxidation of materials in Section II, plus those from the base metal and coating, etc., as noted above. These components are virtually always present as complex oxides and not as metals (Characterization of Arc Welding Fume: American Welding Society). Reasonably expected fume constituents of the fume could include: complex oxides of iron, manganese, silicon, sodium, and potassium. Fluorides, nickel, and chromium oxides may also be present. The Table below lists reasonably expected fumes that may be generated:

Substance	CAS No.	EXPOSURE LIMIT (mg <sup>3</sup> )	
		OSHA PEL	ACGIH TLV
Iron Oxide	1309-37-1	10	5
Manganese Dioxide #	1313-13-9	1	1
Nickel Oxide #	1313-99-1	1	1
Hydrogen Fluoride	7664-39-3	2.5 (as F)	2.5 (as F)
Nitric Oxide	10102-43-9	25 ppm	25 ppm
Nickel (soluble) #	7440-02-0	0.1 (as Ni)	0.1 (as Ni)
Chromium Oxide #	1308-38-9	0.5 (as Cr)	0.5 (as Cr)
Chromic Acid #	1333-82-0	0.1 CL (as CrO3)	0.05 (as Cr VI)
Titanium Oxide	13463-67-7	5	10

gaseous reaction products may include carbon monoxide and carbon dioxide. Ozone and nitrogen oxides may also be formed by radiation from the arc. Monitor fume levels. The fume limit for Cr VI (0.05 mg/m<sup>3</sup>) may be reached before general welding fumes of 5 mg/m<sup>3</sup> is reached. One recommended way to determine the composition and quantity of fumes and gas to which workers are exposed is to take an air sample inside the welder's helmet if worn, or in the worker's breathing zone (see ANSI/AWS F1.1 available from the "American Welding Society," P.O. Box 351040, Miami, FL 33135).

**SECTION VI (HEALTH HAZARD DATA)**

**Recommended Limit Value:** The ACGIH and OSHA have set the exposure level for welding fumes at 5 mg/m<sup>3</sup>. The ACGIH 1984-85 preface to the "TLV-TWA should be used as guides in the control of health hazards and should not be used as firm lines between safe and dangerous concentrations." See Section V for specific fume constituents which may modify the TLV.

**Effects of Over Exposure:** Electric arc welding may create one or more of the following health hazards:  
**FLUORIDES** can be dangerous to your health. **PRIMARY ROUTES OF ENTRY** are the respiratory system, eyes, and/or skin. **EXISTING** respiratory or allergic conditions may be aggravated in some individuals. **SHORT TERM (ACUTE) OVEREXPOSURE** to welding fumes may result in discomfort such as dizziness, nausea, or dryness or irritation of nose, throat, or eyes. **IRON, IRON OXIDE, MANGANESE** - Remove from overexposure and apply artificial respiration if needed. **FLUORIDES** - Fluoride compounds produced may cause eye and skin burns, pulmonary edema bronchitis. **NICKEL, NICKEL OXIDE** - Metallic taste, nausea, tightness in chest, fever, allergic reactions. **CHROMIUM**- Inhalation of chromium can cause irritation of nasal membranes and skin. **LONG TERM (CHRONIC) OVEREXPOSURE** may lead to siderosis (iron deposits in lungs) and is believed by some investigators to affect pulmonary functions. **PRIMARY ROUTE OF ENTRY** is the respiratory system. **IRON, IRON OXIDE** - Long term overexposure to iron fumes can cause deposits of iron in the lungs (siderosis). Lungs will clear in time when exposure to iron and its compounds ceases. **FLUORIDES** - Long term overexposure to fluorides can cause serious bone erosion. **MANGANESE** - Long term exposure may lead to "Manganism". Central nervous system is affected and symptoms include muscular weakness and tremors. Exposed workers should get quarterly medical examinations for manganism. **CHROMIUM**- Chromium VI is listed as a human carcinogen on IARC and NTP lists and is required by OSHA to be considered carcinogenic. **NICKEL, NICKEL OXIDE**- Long term overexposure to nickel products may cause lung fibrosis or pneumoconiosis. **Other** (not otherwise classified) are considered to be carcinogenic defined with no further categorization by NIOSH. Silicon dioxide is listed as a probable carcinogenic to humans. **ARC RAYS** can injure eyes. **ELECTRIC SHOCK** can kill. See Section VII.

**Emergency & First Aid Procedures:** Call for medical aid. Employ first aid techniques recommended by The American Red Cross.  
**INHALATION:** Remove to fresh air. If breathing is difficult, administer oxygen. If not breathing, begin artificial respiration. If no detectable pulse, begin external heart massage.  
**SKIN:** Wash affected area with soap and water. **EYES:** Flush with large amount of fresh water for at least 15 minutes.  
**INGESTION:** Seek medical attention.

**Warning:** This product contains or produces a chemical known to the State of California to cause cancer. (California Health & Safety Code Section 65 et seq.)

Carcinogenicity	NTP	NIOSH	IARC Monographs	OSHA Regulated
Present	Ni, Cr	Welding Fumes (n.o.c.)	Cr, Ni	

**SECTION VII (PRECAUTION FOR SAFE HANDLING AND USE/APPLICABLE CONTROL MEASURES)**

Read and understand the manufacturer's instructions and precautionary label on this product. See American National Standard Z49.1, Safety in Welding and Cutting, published by the American Welding Society, P.O. Box 351040, Miami, FL 33135 and OSHA Publication 3090 (29CFR 1910), U.S. Government Printing Office, Washington, D.C. 20402 for more detail on the following:

**Ventilation:** Use enough ventilation, local exhaust at the arc, or both, to keep the fumes and gases below the TLV's in the workers breathing zone and the general area. Train the welder to keep his head out of the fumes.

**Respiratory Protection:** Use respirable fume respirator or air supplied respirator when welding in confined space or where local exhaust or ventilation does not keep exposure below TLV.

**Eye Protection:** Wear helmet or face shield with filter lens. As a rule of thumb, start with a shade darker to see the weld zone. Then go to the next lighter shade which gives sufficient view of the weld zone. Provide screens and flash goggles to shield others.

**Protective Clothing:** Wear head, hand, and body protection which help to prevent injury from radiation, sparks, and electrical shock. See ANSI Z49.1. At a minimum, this includes welder's gloves and a protective face shield and may include arm protectors, aprons, hats, shoulder pads, and boots.

**Waste:** Dispose of any grinding dust and waste residues in accordance with EPA or local regulations.

**Storage:** Keep material sealed and dry before use.

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