

**Material Safety Data Sheet**  
Carbon Steels

Ryerson Tull, Inc.  
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**Section 1 - Product Identification**

<b>Manufacturer's Name:</b> Various	<b>Date Prepared:</b> 12-Oct-01
<b>Product Name / Trade Name:</b> Carbon, Alloy and Tool Steels	<b>Common Alloy / Grade:</b> Bar, Sheet, Plate, Tubing, Pipe and Structural

**Section 2 - Hazardous Ingredients / Identity Information Product Identification**

*Note: Products under normal conditions do not represent an inhalation, ingestion, or contact Health Hazard*

Ingredient (1)		CAS No.	Wt. % (2)	Permissible Air Level (3)	
				OSHA PEL	ACGIH TLV
Aluminum (Al)	(dust, fume)	7429-90-5	.01-1.5	15	10, 5
Aluminum oxide	(fume)	1344-28-1		5	-
				Not established	10
Carbon (C)	(as carbon black)	1333-86-4	.05-2.5	3.5	3.5
Carbon monoxide		630-08-0		50 ppm, 55	25 ppm, 29
Carbon dioxide		124-38-9		5000 ppm, 9000	5000 ppm, 9000
Chromium (Cr)	(metals)	7440-47-3	.01-13	1	0.5
	(Cr II compounds)			0.5 as Cr	-
	(Cr III compounds)			0.5 as Cr	0.5 as Cr
	(Cr VI cmpds-soluble)			0.1 ceiling as CrO3	0.5 as Cr
	(Cr VI cmpds-insoluble)			0.1 ceiling as CrO3	0.1 as Cr
Cobalt (Co)	(metal, dust & fume)	7440-48-4	.01-5.0	0.1	0.02
Copper (Cu)	(dust & mist-inhalable particulate)	7440-50-8	.01-1.0	1	(1)
	(fume & respirable fraction)			0.1	(0.2)
Iron (Fe)		7439-89-6	Balance	Not established	Not established
Iron oxide	(dust & fume)	1309-37-1		10	5
Manganese (Mn)	(compounds and fume)	7439-96-5	.25-2.5	5 ceiling	0.2
Molybdenum (Mo)	(soluble compounds)	7439-98-7	.01-10.0	5	5
	(insoluble compounds/dust)			15	10
Nickel (Ni)	(metal)	7440-02-0	.01-5.0	1	0.5
	(soluble compounds)			1	0.5
	(insoluble compounds)			1	0.1
Nitrogen (N)		7727-37-9		Not established	Not established
Nitric oxide		10102-43-9		25 ppm, 30	25 ppm, 31
Nitrogen dioxide		10102-44-0		5 ppm, 9 ceiling	3 ppm, 5.6
Oil Mist, mineral		8012-95-1		5	5
Oil Mist, mineral	containing a total of 15 PAH's listed as carcinogens by the NTP			Not established	0.005
Oxygen (O)		7782-44-7		Not established	Not established
Ozone		10028-15-6		0.1 ppm, 0.2	0.1 ppm ceiling
Silicon (Si)	(dust and fume)	7440-21-3	.01-2.5	15	10
	(respirable fraction)			5	Not established
Vanadium (V)		7440-62-2	.01-5.0	Not established	Not established
Vanadium pentoxide	(respirable dust)	1314-62-1		0.5 ceiling	0.05
	(fume)			0.1 Ceiling	0.05
Zinc	(as Zinc Oxide dust)	7429-90-5	10.5 resp	10	10
	(as Zinc Oxide fume)			5, 10c	5, 10c
Titanium		7440-32-6	.008 max	10.5 resp 10	10.5 resp 10
Welding fumes				Not established	5

**Section 3 - Physical Data**

<b>Material Is (normal conditions):</b> Solid	<b>Appearance and Color:</b> Gray-Metallic, Odorless
<b>Melting Point (Base Metal):</b> ~2800 F	<b>Vapor Pressure (mm Hg):</b> N/A
<b>Boiling Point (Base Metal):</b> N/A	<b>Vapor Density (Air =1):</b> N/A
<b>Solubility in Water:</b> N/A	<b>Evaporation Rate:</b> N/A
<b>Specific Gravity (H<sub>2</sub>O=1):</b> ~7.6-7.8	

### Section 4 - Fire and Explosion Hazard Data

*Note: Products in the solid state present no fire or explosion hazard. Small chips, fines and dust may ignite readily.*

<b>Flash Point:</b> N/A	<b>Flammable Limits:</b> N/A	<b>LEL:</b> N/A	<b>UEL:</b> N/A
<b>Extinguishing Media:</b> Dry powdered dolomite, dry sand or dry graphite; DO NOT USE water on molten metal.			
<b>Special Fire Fighting Procedures:</b> Use self-contained NIOSH breathing apparatus in pressure and demand mode.			
<b>Unusual Fire and Explosion Hazards:</b> DO NOT USE water on molten metal. Use coarse water spray on chips, turnings, etc. DO NOT USE halogenated extinguishing agents on small chips or fines.			
<b>Additional Information:</b> Arc or spark generated when welding or burning could be a source of ignition for combustion and flammable materials. Dust clouds may be explosive; prevent formation. Molten aluminum may also react violently with rust and certain metal oxides (i.e. Cu, Fe, Pb).			

### Section 5 - Reactivity Data

<b>Stability:</b> Stable	<b>Conditions to Avoid:</b> Make certain any material to be re-melted is free of moisture.
<b>Incompatibility (Materials to Avoid):</b> Halogenated acids & solvents, bromates, iodates, aluminum nitrate.	
<b>Hazardous Decomposition or Byproducts:</b> Metallic dust or fumes may be produced during welding, burning, grinding and possibly machining. Refer to ANSI Z49.1.	
<b>Hazardous Polymerization:</b> Will not Occur	<b>Conditions to Avoid:</b> Aluminum particles coming into contact with copper, lead or iron oxides can react vigorously if source of ignition or intense heat.

### Section 6 - Health Hazard Data

*Note: Products in their usual physical form do not pose any health hazards. However, operations such as burning, welding, sawing, brazing, or grinding may result in the following effects if exposures exceed permissible limits.*

<b>Route(s) of Entry:</b>	<b>Inhalation:</b> Yes	<b>Skin Contact:</b> Yes	<b>Eye Contact:</b> Yes	<b>Ingestion:</b> No
<b>Health Hazards:</b>				
<b>Acute:</b> Excess exposure to all metallic fumes and dusts may result in irritation of eyes nose and throat. Also high concentrations of fumes and dusts of iron oxide, manganese and copper may result in metal fume fever.				
<b>Chronic:</b> Chronic and prolonged inhalation of high concentrations of fumes or dust of the following elements may lead to the conditions listed opposite the element:				
<b>Aluminum</b>	<p>May initiate fibrotic changes to lung tissue, irritation of the eyes, nose and throat. Particles Al deposited in the eye may cause irreversible tissue damage of the cornea. Al salts may cause dermatitis, eczema, conjunctivitis and irritation of the mucus membranes of the upper respiratory tract. Long-term inhalation exposure to <b>Al dusts or fumes</b> has been associated with a fibrotic lung condition known as Shaver's disease. <b>Al dust/fines and fumes</b> are a low health risk by inhalation. For standard operations (milling, cutting, grinding), aluminum dust should be treated as a nuisance dust as defined by the ACGIH. Welding aluminum, plasma arc cutting, and arc spray metalizing can generate ozone. Excessive exposure to aluminum fume and dust has been associated with lung disease, but this effect is probably due to simultaneous silica exposure.</p> <p><b>Carcinogenicity:</b> N/A      <b>NTP?</b> No      <b>IARC?</b> A4*      <b>OSHA Regulated?</b> No *(for aluminum oxide)</p>			
<b>Carbon</b>	<p>Elemental carbon, as it exists in this product, is of very low toxicity; no chronic debilitating symptoms indicated. Health hazard data presented here is based on exposures to carbon black, not carbon as it is found in this product. Chronic inhalation exposure to <b>carbon black</b> may result in temporary or permanent damage to lungs and heart. Pneumoconiosis has been found in workers engaged in the production of carbon black. Skin conditions such as inflammation of the hair follicles, and oral mucosal lesions have also been reported from skin exposure.</p> <p><b>Carcinogenicity:</b> N/A      <b>NTP?</b> No      <b>IARC?</b> A4*      <b>OSHA Regulated?</b> No *(for carbon black)</p>			
<b>Chromium</b>	<p><b>Cr fumes and dusts</b> can cause sensitization dermatitis, inflammation and/or ulceration of upper respiratory tract, lesions of the skin and mucus membranes, and possibly cancer of the nasal passages or lungs-bronchogenic carcinoma.</p> <p><b>Carcinogenicity:</b> N/A      <b>NTP?</b> No      <b>IARC?</b> A4      <b>OSHA Regulated?</b> No</p>			
<b>Hexavalent Chromium (Chromium VI)</b>	<p>Chromium VI can cause asthma, kidney damage, primary irritant dermatitis, sensitization dermatitis, skin ulceration, and pulmonary edema (fluid in the lungs). Chronic inhalation or overexposure has been associated with lung, nasal, and gastrointestinal cancer. Hexavalent chromium is listed as carcinogenic to humans by IARC. Chromium and some of its compounds are listed as carcinogenic by the NTP.</p> <p><b>Carcinogenicity:</b> Yes      <b>NTP?</b> 1      <b>IARC?</b> A1      <b>OSHA Regulated?</b> No</p>			

<b>Cobalt</b>	Inhalation of <b>Co dust</b> may cause an asthma-like disease with cough and dyspnea, respiratory tract irritation and hypersensitization dermatitis. Chronic overexposure to Co dust and fume may result in polythemia, hyperplasia of bone marrow and thyroid gland, pericardial effusion and damage to pancreas alpha cells. Animal studies have shown that particulate is an acutely irritating substance and industrial exposures, possibly combined with small amounts of silica, are reported capable of producing serious pneumoconiosis which is initially of an insidious nature. <b>Carcinogenicity: N/A</b> <b>NTP? No</b> <b>IARC? A3</b> <b>OSHA Regulated? No</b>
<b>Copper</b>	No chronic debilitating symptoms indicated. Inhalation of <b>Cu dusts, fumes and mists</b> may cause irritation of the eyes, nose and throat and a flu-like illness called metal fume fever. Early symptoms of metal fume fever include a metallic or sweet taste in the mouth, dryness and irritation of the throat and coughing. These symptoms may progress to shortness of breath, headache, fever, chills, muscle aches, nausea, vomiting, weakness, fatigue and profuse sweating. The attack may last 6-48 hours and is more likely to occur after a period away from the job. Chronic overexposure to copper fumes may result in blood disorders (anemia). Repeated or prolonged exposure to Cu fumes may cause discoloration of hair, hands, and soles of the feet (keratinization). <b>Carcinogenicity: N/A</b> <b>NTP? No</b> <b>IARC? No</b> <b>OSHA Regulated? No</b>
<b>Iron</b>	No chronic debilitating symptoms indicated. Subjecting Fe and alloys containing Fe to high temperatures (such as occurs during welding) will cause the formation of iron oxide. High exposures to <b>iron oxide dust or fumes</b> can cause x-ray changes (siderosis or iron pigmentation) in the lungs as a result of long-term exposure. Siderosis is a benign condition and is not associated with pulmonary fibrosis (scarring of the lung). Ingestion of high levels of iron oxide can cause gastrointestinal irritation, bleeding and systemic toxicity. <b>Carcinogenicity: N/A</b> <b>NTP? No</b> <b>IARC? A4*</b> <b>OSHA Regulated? No</b> *(for iron oxide)
<b>Lead</b>	Lead is an accumulated poison. Inhalation effects of exposure to <b>fumes or dust</b> of inorganic lead may not develop quickly. Symptoms may include decreased physical fitness, fatigue, sleep disturbance, headache, aching bones and muscles, constipation, abdominal pains and decreasing appetite. The effects are reversible and complete recovery is possible. Inhalation of large amounts of lead may lead to seizures, coma and death. Chronic or acute inhalation exposures to the fumes or dusts of inorganic lead compounds (such as lead oxide) can adversely affect several organ systems including the nervous system, the gastrointestinal system, the hematological system and renal system. The early effects are characterized by fatigue, constipation, muscle aches, abdominal pains, and decreased appetite. Later signs and symptoms can include anemia, pallor, a "lead Line" on the gums, and reduced hand-grip strength. Lead colic produces intense abdominal cramping which can be accompanied by constipation, nausea, and vomiting. A condition called "wrist drop" can develop if the peripheral nervous system is affected. Severe central nervous system effects (referred to as lead encephalopathy) usually only occur after heavy and rapid lead exposures. Signs and symptoms may include headache, dizziness, convulsions, delirium, coma, and possibly death. Long-term exposures can also produce kidney damage with possible decreased renal function leading to such conditions called stannosis. Alcohol ingestion and physical exertion may bring on symptoms. Continued exposure can result in decreased fertility and/or increased chances of miscarriage or birth defects. Lead inorganic dust and fume is listed as possibly carcinogenic by IARC. <b>Carcinogenicity: N/A</b> <b>NTP? No</b> <b>IARC? A3</b> <b>OSHA Regulated? No</b>
<b>Lead chromate</b>	Anemia, urinary dysfunction, weakness, constipation, nausea, nervous disorder, peripheral neuropathy and chromosomal changes. <b>Carcinogenicity: Yes</b> <b>NTP? No</b> <b>IARC? A2</b> <b>OSHA Regulated? No</b>
<b>Manganese</b>	Mn intoxication is usually due to the oxide or salts of Mn, elemental Mn exhibits very low toxicity. <b>Manganese oxide fumes</b> can act as minor irritants to the eyes and respiratory tract and metal fume fever. Both acute and chronic exposures may adversely affect the central nervous system (manganism), pneumonitis (inflammation of lung tissue), and may cause fibrosis (scarring of lung tissue), and reproductive disorders (impotence) in males. Early symptoms may include weakness in lower extremities, sleepiness, salivation, nervousness and apathy. Bronchitis, pneumonitis, lack of coordination resembling Parkinson's disease (apathy, weakness, etc.). The central nervous system is the chief site of the injury, and there may be adverse blood and kidney effects. Chronic manganese poisoning is not a fatal disease although it is extremely disabling. Some individuals may be hypersusceptible to manganese. Freshly formed manganese fume has caused fever and chills similar to metal fume fever. <b>Carcinogenicity: N/A</b> <b>NTP? No</b> <b>IARC? No</b> <b>OSHA Regulated? No</b>
<b>Molybdenum</b>	<b>Dust of metallic Mo</b> has caused difficulty breathing, general weakness, pain in chest, joints, hands and feet, expectoration, fatigue, headache, anorexia, possible liver and kidney damage and bone deformity. Mo has caused anemia and poor growth in experimental animals. Mo may also cause pneumoconiosis and irritation to lungs and eyes. In rats, dusts of metallic Mo have caused growth depression and thickening of intraalveolar septa, which contained connective tissue fibers. <b>Carcinogenicity: N/A</b> <b>NTP? No</b> <b>IARC? No</b> <b>OSHA Regulated? No</b>

**Nickel** Skin contact with nickel and its compounds may cause allergic dermatitis. The resulting skin rash is often referred to as "nickel itch," which usually occurs when the skin is moist. Ni metal is listed as a possibly carcinogenic to humans by IARC. Ni fumes and dusts can cause skin sensitization and allergic contact dermatitis. Ni and its compounds may also produce eye irritation, particularly on the inner surfaces of the eyelids (i.e. the conjunctiva). Chronic inhalation of high levels of Ni can cause irritation of airways and lungs, lung fibrosis (scarring of the lungs), nasal septum perforation, nasal sinusitis, respiratory sensitization and asthma. Ni compounds have caused cancer of the lungs, larynx, and paranasal sinuses in lab animals

**Carcinogenicity: Yes NTP? 2 IARC? No\* OSHA Regulated? No**

\*(ACGIH has published notice of intended change to A4 for soluble and A1 for insoluble compounds)

**Nitrogen** Oxides of nitrogen can cause irritation of the eyes, skin (when moist), and upper respiratory tract. Exposure to high levels of nitrogen oxides can cause delayed pulmonary edema (fluid in the lungs) which may be fatal. Nitric oxide can cause formation of methemoglobin which decreases the blood's ability to carry oxygen. Chronic overexposure can cause pulmonary fibrosis (scarring of the lungs).

**Carcinogenicity: N/A NTP? No IARC? No OSHA Regulated? No**

**Oil coating** Some products are supplied with an oil coating or have residual oil from the manufacturing process. Prolonged or repeated skin contact with oil may result in skin irritation, dermatitis, or both. Untreated mildly refined mineral oils have produced skin tumors on repeated applications to laboratory animals. They are listed as carcinogenic on the NTP and IARC. If the product is heated well above the ambient temperatures or machined, oil vapor or mist may be generated. Overexposure to oil mist or vapor may cause asthma, bronchitis, respiratory tract irritation and neurological effects such as headaches, dizziness, drowsiness and central nervous system depression.

**Carcinogenicity: N/A NTP? No IARC? No\* OSHA Regulated? No**

\*(ACGIH has published notice of intended change to A1 for oils containing a total of 15 polynuclear aromatic hydrocarbons (PAH's) listed as carcinogens by the U.S. NTP)

**Oxygen** Oxygen can cause irritation of the eyes, skin (when moist), and upper respiratory tract. Exposure to high levels of nitrogen oxides can cause delayed pulmonary edema (fluid in the lungs) which may be fatal. Nitric oxide can cause formation of methemoglobin which decreases the blood's ability to carry oxygen. Chronic overexposure can cause pulmonary fibrosis (scarring of the lungs).

**Carcinogenicity: N/A NTP? No IARC? No OSHA Regulated? No**

**Ozone** Overexposure to ozone can result in mucus membrane and respiratory tract irritation. Severe overexposures can cause pulmonary edema (fluid in the lungs).

**Carcinogenicity: N/A NTP? No IARC? No OSHA Regulated? No**

**Silicon** No chronic debilitating symptoms indicated. Chronic exposure to inert dusts of silicon can cause increased airways resistance and contribute to chronic bronchitis. Accumulation in lungs may be responsible for benign pneumoniosis, but is not considered to be responsible for pulmonary functional impairment or respiratory symptoms. Intracheal administration of silicon in rabbits produced significant pulmonary lesions.

**Carcinogenicity: N/A NTP? No IARC? No OSHA Regulated? No**

**Vanadium** V compounds (especially vanadium pentoxide) are irritants to the eyes, respiratory tract, and to a less frequent extent, the skin. Eye symptoms may include excessive tearing and a burning sensation. Skin rashes, which may be allergic in nature, resemble eczema and may itch intensely. Excessive inhalation exposures even after brief periods may result in inflammation of the nasal passages, sore throat, cough, tracheitis, bronchitis, wheezing and chest pain. Chronic and prolonged inhalation of high concentrations of fumes or dust may lead to emphysema or pneumonia.

\*(for vandium pentoxide)

**Carcinogenicity: N/A NTP? No IARC? A4\* OSHA Regulated? No**

**Welding fumes -** Welding fumes cannot be classified simply. The composition and quantity of both are dependent on the alloy being welded and the process and electrodes used. Reliable analysis of fumes cannot be made without considering the nature of the welding process and system being examined; reactive metals and alloys such as aluminum and titanium are arc-welded in a protective, inert atmosphere such as argon. These arcs create relatively little fume, but they do create an intense radiation which can produce ozone. Similar processes are used to arc-weld steels, also creating a relatively low level of fumes. Ferrous alloys also are arc-welded in oxidizing environments that generate considerable fume and can produce carbon monoxide instead of ozone. Such fumes generally are composed of discrete particles of amorphous slags containing iron, manganese, silicon, and other metallic constituents depending on the alloy system involved. Chromium and nickel compounds are found in fumes when stainless steels are arc-welded. Some coated and flux-cored electrodes are formulated with flourides and the fumes associated with them can contain significantly more flourides than oxides. Because of the above factors, arc-welding fumes frequently must be tested for individual constituents that are likely to be present to determine whether specific TLV's are exceeded.

Conclusions based on inhalable concentration are generally adequate if no toxic elements are present in welding rod, metal, or metal coating and conditions are not conducive to the formation of toxic gases. Are listed as possibly carcinogenic to humans by IARC.

**Carcinogenicity: See above NTP? No IARC? No OSHA Regulated? No**

**Additional Information:**

In welding, precautions should be taken for airborne contaminants which may originate from components of the welding rod. Recent epidemiological studies of workers melting and working alloys containing nickel and chromium have found no increased risk of cancer. Chromium and nickel and their components are listed in the 3rd Annual Report on carcinogens, as prepared by the National Toxicology Program (NTP) and by the International Agency for Research on Cancer (IARC).

Since lead is a cumulative toxic metal by inhalation or ingestion, appropriate industrial precautions to guard against these two routes of exposure need to be taken when handling these alloys. Sampling to establish the lead level exposure to airborne particulate or fumes is possible. Consult OSHA Lead standard 29 CFR 1910.1025 for specific health/industrial hygiene precautions and requirements to follow when handling lead compounds.

**NTP (National Toxicology Program) Classifications:**

Group 1: Known to be carcinogenic; sufficient evidence from human studies.

Group 2: Reasonably anticipated to be a carcinogen; limited evidence from studies in humans or sufficient evidence from studies in experimental animals.

**IARC (International Agency for Research on Cancer) Classifications:**

Group A1 - *Confirmed Human Carcinogen*: The agent is carcinogenic to humans based on the weight of evidence from epidemiologic studies of, or convincing clinical evidence in, exposed humans.

Group A2 - *Suspected Human Carcinogen*: The agent is carcinogenic in experimental animals at dose levels, by route(s) of administration, at site(s), of histologic type(s), or by mechanism(s) that are considered relevant to worker exposure. Available epidemiologic studies are conflicting or insufficient to confirm an increased risk of cancer in exposed humans.

Group A3 - *Animal Carcinogen*: The agent is carcinogenic in experimental animals at dose levels, by route(s) of administration, at site(s), of histologic type(s), or by mechanism(s) that are not relevant to worker exposure. Available epidemiologic studies do not confirm an increased risk of cancer in exposed humans. Available evidence suggests that the agent is not likely to cause cancer in humans except under uncommon or unlikely routes or levels of exposure.

Group A4 - *Not Classifiable as a Human Carcinogen*: There are inadequate data on which to classify the agent in terms of its carcinogenicity in humans and/or animals.

Group A5 - *Not Suspected as a Human Carcinogen*: The agent is not suspected to be a human carcinogen on the basis of properly conducted epidemiologic studies in humans.

**Signs and Symptoms of Exposure:**

Typical symptoms consist of a metallic taste in the mouth, dryness of the throat, chills, fever and influenza-like symptoms, usually lasting from 12 to 48 hours.

**Medical Conditions Generally Aggravated by Exposure:**

Individuals with chronic respiratory disorders (i.e. asthma, chronic bronchitis, emphysema, etc.) may be adversely affected by fume or airborne particulate matter exposure.

**Emergency and First Aid Procedures:**

**Inhalation:** Remove to fresh air; if condition continues, consult a physician.

**Eye Contact:** Flush thoroughly with running water for 15 minutes to remove particulate; take care to rinse under eyelids. Obtain medical attention.

**Skin Contact:** Remove particulate by washing thoroughly with soap and water. Seek medical attention if condition persists. For minor burns, apply cold water. For severe burns, seek immediate medical attention.

**Ingestion:** Does not represent a hazard, if significant amounts of metal are ingested, consult physician.

**Section 7 - Precautions for Safe Handling and Use****Steps to be taken in Case Material Is Released or Spilled:**

Fine turnings and small chips should be swept or vacuumed. Scrap metal can be reclaimed for re-use.

**Waste Disposal Method:**

Used or unused product should be tested to determine hazard status and disposal requirements under federal, state or local laws and regulations.

**Precautions to Be Taken in Handling and Storing:**

See Section 4.

**Other Precautions:**

Not requested by USA Department of Transportation.

**Section 8 - Control Measures****Respiratory Protection:**

Appropriate dust/mist/fume respirator should be used to avoid excessive inhalation of particulates. If exposure limits are reached or exceeded, use NIOSH/MSHA approved equipment.

**Ventilation:** Use with adequate ventilation to meet exposure limits listed in Section 2.

**Eye Protection:** Safety glasses/face shields should be worn when grinding, cutting, or welding.

**Protective Gloves:** Should be worn as required for welding, burning or handling operations.

**Other Protective Clothing/Equipment:** As required depending on operations and safety codes.

**Work / Hygienic Practices:** Wash with soap and water.

**Lead** Lead is an accumulated poison. Inhalation effects of exposure to **fumes or dust** of inorganic lead may not develop quickly. Symptoms may include decreased physical fitness, fatigue, sleep disturbance, headache, aching bones and muscles, constipation, abdominal pains and decreasing appetite. The effects are reversible and complete recovery is possible. Inhalation of large amounts of lead may lead to seizures, coma and death. Chronic or acute inhalation exposures to the fumes or dusts of inorganic lead compounds (such as lead oxide) can adversely affect several organ systems including the nervous system, the gastrointestinal system, the hematological system and renal system. The early effects are characterized by fatigue, constipation, muscle aches, abdominal pains, and decreased appetite. Later signs and symptoms can include anemia, pallor, a "lead Line" on the gums, and reduced hand-grip strength. Lead colic produces intense abdominal cramping which can be accompanied by constipation, nausea, and vomiting. A condition called "wrist drop" can develop if the peripheral nervous system is affected. Severe central nervous system effects (referred to as lead encephalopathy) usually only occur after heavy and rapid lead exposures. Signs and symptoms may include headache, dizziness, convulsions, delirium, coma, and possibly death. Long-term exposures can also produce kidney damage with possible decreased renal function leading to such conditions called stannosis. Alcohol ingestion and physical exertion may bring on symptoms. Continued exposure can result in decreased fertility and/or increased chances of miscarriage or birth defects. Lead inorganic dust and fume is listed as possibly carcinogenic by IARC.

**Carcinogenicity:** N/A      **NTP?** No      **IARC?** A3      **OSHA Regulated?** No

**Lead chromate** Anemia, urinary dysfunction, weakness, constipation, nausea, nervous disorder, peripheral neuropathy and chromosomal changes.

**Carcinogenicity:** Yes      **NTP?** No      **IARC?** A2      **OSHA Regulated?** No

**Manganese** Mn intoxication is usually due to the oxide or salts of Mn, elemental Mn exhibits very low toxicity. **Manganese oxide fumes** can act as minor irritants to the eyes and respiratory tract and metal fume fever. Both acute and chronic exposures may adversely affect the central nervous system (manganism), pneumonitis (inflammation of lung tissue), and may cause fibrosis (scarring of lung tissue), and reproductive disorders (impotence) in males. Early symptoms may include weakness in lower extremities, sleepiness, salivation, nervousness and apathy. Bronchitis, pneumonitis, lack of coordination resembling Parkinson's disease (apathy, weakness, etc.). The central nervous system is the chief site of the injury, and there may be adverse blood and kidney effects. Chronic manganese poisoning is not a fatal disease although it is extremely disabling. Some individuals may be hypersusceptible to manganese. Freshly formed manganese fume has caused fever and chills similar to metal fume fever.

**Carcinogenicity:** N/A      **NTP?** No      **IARC?** No      **OSHA Regulated?** No

**Nickel** Skin contact with nickel and its compounds may cause allergic dermatitis. The resulting skin rash is often referred to as "nickel itch," which usually occurs when the skin is moist. Ni metal is listed as a possibly carcinogenic to humans by IARC. **Ni fumes and dusts** can cause skin sensitization and allergic contact dermatitis. Ni and its compounds may also produce eye irritation, particularly on the inner surfaces of the eyelids (i.e. the conjunctiva). Chronic inhalation of high levels of Ni can cause irritation of airways and lungs, lung fibrosis (scarring of the lungs), nasal septum perforation, nasal sinusitis, respiratory sensitization and asthma. Ni compounds have caused cancer of the lungs, larynx, and paranasal sinuses in lab animals

**Carcinogenicity:** Yes      **NTP?** 2      **IARC?** No\*      **OSHA Regulated?** No  
 \*(ACGIH has published notice of intended change to A4 for soluble and A1 for insoluble compounds)

**Nitrogen** Oxides of nitrogen can cause irritation of the eyes, skin (when moist), and upper respiratory tract. Exposure to high levels of nitrogen oxides can cause delayed pulmonary edema (fluid in the lungs) which may be fatal. Nitric oxide can cause formation of methemoglobin which decreases the blood's ability to carry oxygen. Chronic overexposure can cause pulmonary fibrosis (scarring of the lungs).

**Carcinogenicity:** N/A      **NTP?** No      **IARC?** No      **OSHA Regulated?** No

**Oil coating** Some products are supplied with an oil coating or have residual oil from the manufacturing process. Prolonged or repeated skin contact with oil may result in skin irritation, dermatitis, or both. Untreated mildly refined mineral oils have produced skin tumors on repeated applications to laboratory animals. They are listed as carcinogenic on the NTP and IARC. If the product is heated well above the ambient temperatures or machined, **oil vapor or mist** may be generated. Overexposure to oil mist or vapor may cause asthma, bronchitis, respiratory tract irritation and neurological effects such as headaches, dizziness, drowsiness and central nervous system depression.

**Carcinogenicity:** N/A      **NTP?** No      **IARC?** No\*      **OSHA Regulated?** No  
 \*(ACGIH has published notice of intended change to A1 for oils containing a total of 15 polynuclear aromatic hydrocarbons (PAH's) listed as carcinogens by the U.S. NTP)

**Oxygen** Oxygen can cause irritation of the eyes, skin (when moist), and upper respiratory tract. Exposure to high levels of nitrogen oxides can cause delayed pulmonary edema (fluid in the lungs) which may be fatal. Nitric oxide can cause formation of methemoglobin which decreases the blood's ability to carry oxygen. Chronic overexposure can cause pulmonary fibrosis (scarring of the lungs).

**Carcinogenicity:** N/A      **NTP?** No      **IARC?** No      **OSHA Regulated?** No

**Ozone** Overexposure to ozone can result in mucus membrane and respiratory tract irritation. Severe overexposures can cause pulmonary edema (fluid in the lungs).

**Carcinogenicity:** N/A      **NTP?** No      **IARC?** No      **OSHA Regulated?** No

**Tin** The toxicity of inorganic tin compounds is generally low. Chronic high level exposure to the dust or fumes of tin oxides can result in a benign pneumoconiosis called stannosis, which is reported not to be disabling. No tissue reaction or pulmonary dysfunction has been associated with this lung condition.

**Carcinogenicity:** N/A      **NTP?** No      **IARC?** No      **OSHA Regulated?** No

**Welding fumes -** Welding fumes cannot be classified simply. The composition and quantity of both are dependent on the alloy being welded and the process and electrodes used. Reliable analysis of fumes cannot be made without considering the nature of the welding process and system being examined; reactive metals and alloys such as aluminum and titanium are arc-welded in a protective, inert atmosphere such as argon. These arcs create relatively little fume, but they do create an intense radiation which can produce ozone. Similar processes are used to arc-weld steels, also creating a relatively low level of fumes. Ferrous alloys also are arc-welded in oxidizing environments that generate considerable fume and can produce carbon monoxide instead of ozone. Such fumes generally are composed of discrete particles of amorphous slags containing iron, manganese, silicon, and other metallic constituents depending on the alloy system involved. Chromium and nickel compounds are found in fumes when stainless steels are arc-welded. Some coated and flux-cored electrodes are formulated with flourides and the fumes associated with them can contain significantly more flourides than oxides. Because of the above factors, arc-welding fumes frequently must be tested for individual constituents that are likely to be present to determine whether specific TLV's are exceeded. Conclusions based on inhalable concentration are generally adequate if no toxic elements are present in welding rod, metal, or metal coating and conditions are not conducive to the formation of toxic gases. Are listed as possibly carcinogenic to humans by IARC.

**Carcinogenicity:** See above      **NTP?** No      **IARC?** No      **OSHA Regulated?** No

**Zinc** No chronic debilitating symptoms indicated. Exposure to dust or fines presents a low health risk by inhalation. Subjecting zinc or alloys containing zinc to high temperatures (such as occurs during welding) will cause the formation of zinc oxide. Exposure to **zinc oxide fumes** subsequent to burning, welding and molten metal can result in "zinc chills," a flu-like illness (metal fume fever). Onset of symptoms may be delayed 4-12 hours. Early symptoms of metal fume fever include a metallic or sweet taste in the mouth, dryness and irritation of the throat and coughing. These symptoms may progress to shortness of breath, headache, fever, chills, muscle aches, nausea, vomiting, weakness, fatigue and profuse sweating. The attack may last 6-48 hours, leaves no effect, and is more likely to occur after a period away from the job. Gastrointestinal inflammation has been reported in animal studies.

**Carcinogenicity:** N/A      **NTP?** No      **IARC?** A1\*      **OSHA Regulated?** No

\*(for zinc chromates)

**Additional Information:**

**Aluminum dust/fines and fumes** are low health risk by inhalation. For standard operations (i.e. machining, cutting, grinding), aluminum should be treated as a nuisance dust and is so defined by the American Conference of Government Industrial Hygienists (ACGIH).

In welding, precautions should be taken for airborne contaminants which may originate from components of the welding rod. Recent epidermiological studies of workers melting and working alloys containing nickel and chromium have found no increased risk of cancer. Chromium and nickel and their components are listed in the 3rd Annual Report on carcinogens, as prepared by the National Toxicology Program (NTP) and by the International Agency for Research on Cancer (IARC).

Welding of **aluminum alloys** may generate carbon monoxide, carbon dioxide, ozone nitrogen oxides, infrared radiation and ultraviolet radiation.

Since **lead** is a cumulative toxic metal by inhalation or ingestion, appropriate industrial precautions to guard against these two routes of exposure need to be taken when handling these alloys. Sampling to establish the lead level exposure to airborne particulate or fumes is possible. Consult OSHA Lead standard 29 CFR 1910.1025 for specific health/industrial hygiene precautions and requirements to follow when handling lead compounds.

**NTP (National Toxicology Program) Classifications:**

Group 1: Known to be carcinogenic; sufficient evidence from human studies.

Group 2: Reasonably anticipated to be a carcinogen; limited evidence from studies in humans or sufficient evidence from studies in experimental animals.

**IARC ( International Agency for Research on Cancer) Classifications:**

Group A1 - Confirmed Human Carcinogen: The agent is carcinogenic to humans based on the weight of evidence from epidemiologic studies of, or convincing clinical evidence in, exposed humans.

Group A2 - Suspected Human Carcinogen: The agent is carcinogenic in experimental animals at dose levels, by route(s) of administration, at site(s), of histologic type(s), or by mechanism(s) that are considered relevant to worker exposure. Available epidemiologic studies are conflicting or insufficient to confirm an increased risk of cancer in exposed humans.

Group A3 - Animal Carcinogen: The agent is carcinogenic in experimental animals at dose levels, by route(s) of administration, at site(s), of histologic type(s), or by mechanism(s) that are not relevant to worker exposure. Available epidemiologic studies do not confirm an increased risk of cancer in exposed humans. Available evidence suggests that the agent is not likely to cause cancer in humans except under uncommon or unlikely routes or levels of exposure.

Group A4 - Not Classifiable as a Human Carcinogen: There are inadequate data on which to classify the agent in terms of its Carcinogenicity in humans and/or animals.

Group A5 - Not Suspected as a Human Carcinogen: The agent is not suspected to be a human carcinogen on the basis of properly conducted epidemiologic studies in humans.

**Signs and Symptoms of Exposure:**

Typical symptoms consist of a metallic taste in the mouth, dryness of the throat, chills, fever and influenza-like symptoms, usually lasting from 12 to 48 hours.

**Medical Conditions Generally Aggravated by Exposure:**

Individuals with chronic respiratory disorders (i.e. asthma, chronic bronchitis, emphysema, etc.) may be adversely affected by fume or airborne particulate matter exposure.

**Emergency and First Aid Procedures:**

**Inhalation:** Remove to fresh air; if condition continues, consult a physician.

**Eye Contact:** Flush thoroughly with running water for 15 minutes to remove particulate; take care to rinse under eyelids. Obtain medical attention.

**Skin Contact:** Remove particulate by washing thoroughly with soap and water. Seek medical attention if condition persists. For minor burns, apply cold water. For severe burns, seek immediate medical attention.

**Ingestion:** Does not represent a hazard; if significant amounts of metal are ingested, consult physician.

**Section 7 - Precautions for Safe Handling and Use****Steps to be taken in Case Material Is Released or Spilled:**

Fine turnings and small chips should be swept or vacuumed. Scrap metal can be reclaimed for re-use.

**Waste Disposal Method:**

Used or unused product should be tested to determine hazard status and disposal requirements under federal, state or local laws and regulations.

**Precautions to Be Taken in Handling and Storing:**

See Section 4.

**Other Precautions:**

Not requested by USA Department of Transportation.



## Section 8 - Control Measures

**Respiratory Protection:**

Appropriate dust/mist/fume respirator should be used to avoid excessive inhalation of particulates. If exposure limits are reached or exceeded, use NIOSH/MSHA approved equipment.

**Ventilation:** Use with adequate ventilation to meet exposure limits listed in Section 2.

**Eye Protection:** Safety glasses/face shields should be worn when grinding, cutting, or welding.

**Protective Gloves:** Should be worn as required for welding, burning or handling operations.

**Other Protective Clothing/Equipment:** As required depending on operations and safety codes.

**Work / Hygienic Practices:** Wash with soap and water.

### Disclaimer

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The conditions or methods of handling, storage, use and disposal of the product are beyond our control and may be beyond our knowledge. For this and other reasons, we do not assume responsibility and expressly disclaim liability for loss, damage or expense arising out of or in any way connected with the handling, storage, use or disposal of the product.

This document has been prepared solely for the intent of compliance with the provisions of Subpart 2 of Part 1910 of title 29 of the Code of Federal Regulations, paragraph 1910.1200.

**Footnotes:**

- (1) Common names if applicable, appear in parentheses following the chemical names.
- (2) Concentrations may vary somewhat between batches or lots. Where possible, a concentration range is indicated. Occasionally, however, levels may even fall outside of the usual concentration ranges.
- (3) All values, unless otherwise specified, refer to 8-hour time-weighted average concentrations and units are in mg/M3.