

# CROWN ALLOYS

## COMPANY

### MATERIAL SAFETY DATA SHEET

#### Section 1 – COMPANY AND MATERIAL IDENTIFICATION

<b>PRODUCT TYPE:</b>	Stainless steel coated electrodes for shielded metal arc welding (SMAW).		
<b>TRADE NAME:</b>	CROWN EXXX(X)-15, CROWN EXXX(X)-16 and CROWN EXXX(X)-17		
<b>SPECIFICATION:</b>	AWS A5.4		
<b>CLASSIFICATION:</b>	E308-15, E308L-15, E308-16, E308L-16, E308L-17, E309-15, E309L-15, E309-16, E309L-16, E309L-17, E310-15, E310-16, E312-15, E312-16, E316-15, E316L-15, E316-16, E316L-16, E316L-17, E320-15, E330-16, E347-16, E410-16		
<b>VENDOR:</b>	Crown Alloys Company	<b>DATE:</b>	December 20, 2006
<b>ADDRESS:</b>	30105 Stephenson Hwy. Madison Heights, MI. 48071		
<b>TELEPHONE:</b>	(248) 588-3790	Emergency 24 hour telephone #	
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#### Section 2 - HAZARDOUS INGREDIENTS

**IMPORTANT!** This section covers the material from which these products are manufactured. The fumes and gases produced when welding with normal use of these products are covered in Sections 5 & 6.

Ingredient	CAS No.	OSHA – TWA PEL,mg/m <sup>3</sup>	(ACGIH – TWA) <sup>6</sup> TLV,mg/m <sup>3</sup>	IDLH <sup>1</sup> mg/m <sup>3</sup>	Wt. %
Calcium Carbonate <sup>2</sup>	1317-65-3	15.0 (Total Dust) 5.0 (Respirable Fraction)	10.0	NE	5.0 - 15.0
Calcium Fluoride <sup>2✓</sup>	14542-23-5	2.5 (as F)	2.5 (as F)	NE	2.0 - 10.0
Chromium <sup>3✓</sup>	7440-47-3	1 (Metal) 0.005 (5 micrograms) [Cr(VI) inorganic compounds as Cr(VI), water soluble] 0.1 (as CrO <sub>3</sub> )	0.5 (Metal) 0.05 [Cr(VI) inorganic compounds as Cr, water soluble] 0.01 [Cr(VI) inorganic compounds as Cr, water insoluble]	250	11.0 - 32.0
Chromium Oxide <sup>2✓</sup>	1308-38-9	0.05 (Chromium VI)	0.05 (Chromium VI)	250	1.0 max.
Columbium <sup>3</sup>	7440-03-1	5 (Respirable Dust)	5.0	NE	2.0 max.
Copper <sup>3</sup>	7440-50-8	0.1(fume), 1.0 (Dust/Mist)	0.2(fume), 1.0 (dust/mist)	NE	4.0 max.
Cryolite <sup>2✓</sup>	15096-52-3	2.5 (Fume)	2.5 (Fume)	NE	1.0 max.
Feldspar <sup>2</sup>	68476-25-5	Not Registered	2.0	NE	1.0 max.
Iron <sup>3✓</sup>	7439-89-6	10 as Fe (Oxide dust & Fume)	5 as Fe (oxide dust & fume)	2500	30.0 - 50.0
Manganese <sup>3✓</sup>	7439-96-5	1.0 Fume & Inorganic Compounds (Vacated 1989 PEL) 5.0 Fume & Inorganic Compounds (ceiling, STEL) 3.0 Fume & Inorganic Compounds (STEL, Vacated 1989 PEL)	0.2 Fume, Inorganic Compounds & Elemental Manganese	500	0.5 - 2.5
Molybdenum <sup>3</sup>	7439-98-7	5 (soluble) 10 (insoluble compounds, total dust)	5 (soluble) 10 (insoluble & metal compounds)	5000	0.75-3.0
Nickel <sup>3✓</sup>	7440-02-0	1.0 (metal and insoluble compounds as Ni) 0.1 (as Ni soluble)	1.5 as metal (inhalable fraction) 0.1 (as Ni soluble)	10	0.7 max. <sup>4</sup> 8.0 - 37.0 <sup>5</sup>
Potassium Hydroxide <sup>2</sup>	1310-58-3	2 (Vacated 1989 PEL)	2.0 (ceiling, STEL)	NE	1.5 max.
Potassium Silicate <sup>2</sup>	1312-76-1	Not Registered	5.0	NE	2.2 max.
Potassium Titanate <sup>2✓</sup>	12030-97-6	Not Registered	10.0	NE	2.0 max.
Silicon <sup>3</sup>	7440-21-3	15.0 (Total Dust) 5.0 (Respirable Fraction) 10.0 (Total Dust) (vacated 1989 PEL)	10.0 (total dust) 3.0 (oxide fume)	NE	0.90 max.
Sodium Silicate <sup>2</sup>	1344-09-8	Not Registered	5.0	NE	1.0 - 5.0
Titanium Dioxide <sup>2✓</sup>	13463-67-7	15.0 (Total Dust) 10.0 (vacated 1989 PEL)	10.0	5000	1.0 - 15.0

<sup>1</sup> Immediately Dangerous to Life and Health – This level represents a concentration from which one can escape within 30 minutes without suffering escape-preventing or permanent injury.

<sup>2</sup> Flux Constituent.

<sup>3</sup> Core Wire or Rod Constituent.

<sup>4</sup> E410-16 Only.

<sup>5</sup> 300 series stainless steel

NE – Not Established

<sup>6</sup> The ACGIH has an established exposure limit for Welding Fumes, Not Otherwise Classified. That Threshold Limit Value is 5 mg/m<sup>3</sup>.

NIOSH classifies welding fumes as carcinogens.

<sup>✓</sup> Substance identified by other sources as a suspected or confirmed human carcinogen.

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### Section 2 - HAZARDOUS INGREDIENTS (continued)

<b>HMIS RATING (Hazardous Materials Information System)</b>			
<b>Health (blue) - 2</b>	<b>Flammability (red) - 0</b>	<b>Reactivity (yellow) - 0</b>	<b>Protective Equipment - X</b> (See Section 7)

**Health Hazard:** 0 (minimal acute or chronic exposure hazard); 1 (slight acute or chronic exposure hazard); 2 (moderate acute or significant chronic exposure hazard); 3 (severe acute exposure hazard; one time overexposure can result in permanent injury and may be fatal); 4 (extreme acute exposure hazard; onetime overexposure can be fatal).

**Flammability Hazard:** 0 (minimal hazard); 1 (materials that require substantial pre-heating before burning); 2 (combustible liquid or solids; liquids with a flash point of 38-93°C [100-200°F]); 3 (Class IB and IC flammable liquids with flash points below 38°C [100°F]); 4 (Class IA flammable liquids with flash points below 23°C [73°F] and boiling points below 38°C [100°F]).

**Reactivity Hazard:** 0 (normally stable); 1 (material that can become unstable at elevated temperatures or which can react slightly with water); 2 (materials that are unstable but do not detonate or which can react violently with water); 3 (materials that can detonate when initiated or which can react explosively with water); 4 (materials that can detonate at normal temperatures or pressures).

### Section 3 - PHYSICAL and CHEMICAL CHARACTERISTICS

**APPEARANCE AND COLOR:** These products consist of solid chrome-nickel core wire or rod which are flux-coated and are odorless.

**The following information is for elemental iron, a main component of these products:**

**SPECIFIC GRAVITY @20°C (water = 1):** 7.86 g/cc

**FREEZING/MELTING POINT:** 2795°F (1535°C)

**SOLUBILITY IN WATER:** Insoluble

**BOILING POINT @ 24 mm Hg:** 5432°F (3000°C)

### Section 4 - FIRE and EXPLOSION HAZARD DATA

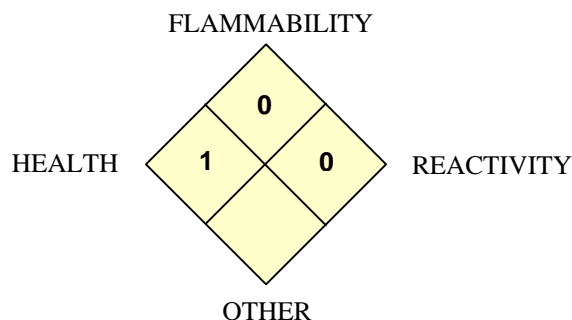
#### **NATIONAL FIRE PROTECTION ASSOCIATION:**

**Health Hazard:** 0 (material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials); 1 (materials that on exposure under fire conditions could cause irritation or minor residual injury); 2 (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); 3 (materials that can on short exposure cause serious temporary or residual injury); 4 (materials that under very short exposure causes death or major residual injury).

**Flammability Hazard:** Refer to definitions for "HMIS RATING (Hazardous Materials Information System)"

**Reactivity Hazard:** Refer to definitions for "HMIS RATING (Hazardous Materials Information System)"

#### **NFPA RATING**



**FLAMMABLE PROPERTIES:** Non-flammable as *shipped*. Brazing flame, welding arc and sparks can ignite combustibles and flammables. Refer to American National Standard Z49.1 "Safety in Welding and Cutting" and "Safe Practices" Code: SP, published by the American Welding Society for fire prevention during the use of welding, brazing and allied procedures.

**FLAMMABLE LIMITS (in air by volume, %):** Lower (LEL): Not Applicable Upper (UEL): Not Applicable

**FLASH POINT:** Not Flammable

**AUTOIGNITION TEMPERATURE:** Not Flammable

**FIRE EXTINGUISHING MATERIALS:** Water Spray: YES / Carbon Dioxide: YES / Halon: YES / Foam: YES / Dry Chemical: YES  
Other: Any "ABC" Class

**UNUSUAL FIRE AND EXPLOSION HAZARDS:** When involved in a fire, this product may generate irritating fumes containing iron compounds, metal oxides, nickel compounds and a variety of metal compounds. The molten material can present a significant thermal hazard to firefighters.

### Section 5 – STABILITY AND REACTIVITY DATA

**STABILITY:** Stable

**HAZARDOUS POLYMERIZATION:** Will not occur.

**CONDITIONS TO AVOID:** Uncontrolled exposure to extreme temperatures and incompatible materials.

**DECOMPOSITION PRODUCTS:** Thermal decomposition products can include iron fumes, a variety of iron compounds, nickel compounds, carbon monoxide, carbon dioxide and a variety of metal oxides.

**MATERIALS WITH WHICH THESE STAINLESS STEEL ELECTRODES IS INCOMPATIBLE:** Strong acids, strong oxidizers, mineral acids, some halogenated compounds, phosphorous and mercury.

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### Section 5 – STABILITY AND REACTIVITY DATA (continued)

#### *Hazardous Decomposition Products*

Welding/brazing fumes and gases can not be classified simply. The composition and quantity of both are dependent upon the metal being welded/brazed and the rods used. Coatings on the metal being welded/brazed (such as paint, plating, or galvanizing), the number of welders, the volume of the work area, the quality and the amount of ventilation, the position of the welder's head with respect to the gas plume, the presence of contaminants in the atmosphere (such as chlorinated hydrocarbon vapors from cleaning and degreasing activities), the process and procedures, as well as the welding/brazing consumables.

When these stainless steel electrodes are consumed, the fume and gas decomposition products generated are different in percent and form from the ingredients listed in Section 2. Decomposition products of normal operation include those originating from the volatilization, reaction, or oxidation of the materials shown in Section 2, plus those from the base metal, coatings, etc., as noted above.

Gaseous reaction products may include carbon monoxide and carbon dioxide. Ozone and nitrogen oxides may be formed by the radiation from an arc, in addition to the shielding gases like argon and helium, whenever they are employed.

One recommended way to determine the composition and quantity of fumes and gases 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 "Method for Sampling Airborne Particles Generated by Welding and Allied Processes" and "Characterization of Arc Welding Fume" available from the American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

Reasonably expected decomposition products from normal use of these products include a **complex of the oxides of the materials listed in Section 2, as well as carbon monoxide, carbon dioxide, ozone (TLV 0.1 ppm ceiling and PEL 0.1 ppm), nitric oxide (TLV 25 ppm and PEL 25 ppm) and nitrogen dioxide (TLV 3, 5 ppm STEL and PEL 5 ppm ceiling). The fume limit for manganese, nickel and/or chromium may be reached before the general limit for welding fumes (TLV 5 mg/m<sup>3</sup>) is reached. A SIGNIFICANT AMOUNT OF THE CHROMIUM IN THE FUMES CAN BE HEXAVALENT CHROMIUM, ALSO KNOWN AS Cr(VI), WHICH HAS A VERY LOW EXPOSURE LIMIT OF 0.005 mg/m<sup>3</sup> (5 µg/m<sup>3</sup>).**

### Section 6 - HEALTH HAZARD DATA

- **Medical conditions aggravated by exposure to this product:** Skin, respiratory, pancreas and liver disorders may be aggravated by prolonged overexposures to the dusts or fumes generated by these products.
- **EYES:** Contact with the rod form of these products can be physically damaging to the eye (i.e., foreign object). Fumes generated during welding operations can be irritating to the eyes. Contact with the molten metal will burn the contaminated eyes. Due to the presence of **nickel**, prolonged exposure could cause conjunctivitis (inflammation of the mucous membranes of the eyes). These stainless steel electrodes also contain **calcium fluoride** and **cryolite**. Thermal decomposition of these compounds can generate fluoride compounds, which are toxic and can cause burns in extreme cases. Burns from fluoride compounds can be delayed.
- **SKIN:** Contact of the rod form of these products with the skin is not anticipated to be irritating. Fumes generated during welding operations can be irritating to the skin. Symptoms of skin *overexposure* may include irritation and redness. Prolonged or repeated skin *overexposure* may lead to allergic contact dermatitis. Contact with molten metal will burn contaminated skin. Skin absorption is not known to be a significant route of *overexposure* for any component of these products. These stainless steel electrodes also contain **calcium fluoride** and **cryolite**. Thermal decomposition of these compounds can generate fluoride compounds, which are toxic and can cause burns in extreme cases. Burns from fluoride compounds can be delayed and can penetrate to the bone.
- **INGESTION:** Repeated or prolonged ingestion exposures to >50-100 mg of iron per day can result in deposition of iron in the body tissues, which can cause disease.
- **INHALATION:** Excessive inhalation of user generated fumes from high temperature cutting or welding of these alloys may, depending on the specific features of the process used, pose a long term health hazard. The IARC has concluded that welding fumes are possibly carcinogenic to humans. Inhalation of large amounts of particulates generated by this product during metal processing operations may result in pneumoconiosis (a disease of the lungs). Repeated overexposures to the dusts or fumes generated by stainless steel electrodes during welding operations may have adverse effects on the lungs with possible pulmonary edema and emphysema. Some of the other health effects are listed below:
  - **Hexavalent chromium (Chrome 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, gastrointestinal cancer. **Hexavalent chromium** is listed as carcinogenic to humans by IARC (Group 1)\*. **Chromium** and some of its compounds are listed as carcinogenic by the NTP. **Hexavalent chromium** compounds may be generated during welding operations with alloys containing **chromium**.
  - **Columbium** also known as **niobium** could cause irritation to the respiratory tract upon acute exposure.
  - *Overexposure* to **copper fume** may exist when welding, flame cutting, etc. *Overexposure* to **copper dust/ mists** can cause irritation of the eyes, skin, and upper respiratory tract. *Chronic overexposure* may result in blood disorders (anemia), and skin and hair discoloration. *Overexposure* to **copper fume** can result in respiratory tract irritation, nausea, fever, chills, shortness of breath and malaise (metal fume fever).
  - Inhalation of dusts and fumes of **iron** can cause metal fume fever. Symptoms of metal fume fever can be delayed 24-48 hours. Inhalation of excessive **iron oxide fumes** or dusts can lead to irritation of the respiratory tract. Prolonged inhalation of **iron oxide** for periods of 6 to 10 years is known to cause siderosis which appears to be a benign pneumoconiosis.

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### **Section 6 - HEALTH HAZARD DATA (continued)**

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- **INHALATION: (continued)**
  - *Chronic exposure* to high levels of **manganese dust or fumes** can cause nervous system disorders, pneumonitis (inflammation of lung tissue), and may cause fibrosis and reproductive disorders in males. It can also lead to neurological problems such as apathy, drowsiness, weakness, spastic gait, paralysis and other neurological problems resembling Parkinsonism. Excessive inhalation of fumes may cause "Metal Fume Fever" with its flu like symptoms, such as chills, fever, body aches, vomiting, sweating, etc. *Chronic overexposure* to **manganese compounds** may affect the central nervous system. Symptoms include languor, sleepiness, muscular weakness, emotional disturbances and spastic gait.
  - Inhalation of **molybdenum fumes** has caused kidney damage, respiratory irritation and liver damage in animals.
  - The U.S. National Toxicology Program has listed **nickel** and seven **nickel compounds** as reasonably anticipated to be a carcinogen based on the production of injection-site tumors in experimental animals. **Nickel compounds** are listed as carcinogenic to humans by IARC (Group 1)\*. Epidemiological studies of workers exposed to **nickel powder** and to dust and fume generated in the production of **nickel alloys** and of stainless steel have not indicated the presence of a significant respiratory cancer hazard. **Nickel** can cause pulmonary asthma in hypersensitive individuals. *Chronic overexposure* to **nickel fumes** may also cause pulmonary fibrosis and edema.
  - Welding processes generate fumes and an intense ultraviolet radiation that results in the formation of ozone and oxides of nitrogen. Exposure to *low* levels of **ozone** can cause irritation of the eyes, nose and throat. Inhalation can cause chest tightness, headache, shortness of breath, cough, wheeze and narrowing of airways. Symptoms disappear when removed from exposure.
  - Exposure to *high* levels of **ozone** may cause acute respiratory distress with shortness of breath, pulmonary changes, hemorrhage and pulmonary edema. Symptoms of pulmonary edema may be delayed for one or more hours. Exposure of test animals and human tissue to high concentrations has shown chromosomal changes, reproductive effects, blood changes, and death from lung congestion.
  - High concentrations of **silicon dust** will cause some irritation to the nose and throat. Inhalation of crystalline silica over a long period can cause silicosis. Crystalline silica is listed as carcinogenic to humans by IARC (Group 1)\*.
  - Inhalation of **titanium** could cause mild irritation to the respiratory tract. Inhalation of **titanium dioxide** dust or fume could produce lung fibrosis and chronic bronchitis.
- **\*IARC CLASSIFICATIONS:** Group 1: The agent is carcinogenic to humans. There is sufficient evidence that a causal relationship existed between exposure to the agent and human cancer.

### **Section 7 - PRECAUTIONS FOR SAFE HANDLING & USE/APPLICABLE CONTROL MEASURES**

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**VENTILATION AND ENGINEERING CONTROLS:** Maintain exposures below the acceptable exposure levels (see Section 2). Use industrial hygiene air monitoring to ensure that your use of these products does not create exposures that exceed the recommended exposure limits. Always use exhaust ventilation in user operations such as high temperature cutting, grinding, welding and brazing. Train the welder to keep his head out of the fume plume. Confined spaces require adequate ventilation and/or air supplied respirators. Read and understand the manufacturer's instructions and the precautionary label on the product. See American National Standard Z49.1, *Safety in Welding, Cutting, and Allied Processes*, published by the American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126 and OSHA Publication 2206 (29CFR1910), US Government Printing Office, Washington, D.C. 20402 for more details on many of the following.

**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's (see Section 2). Use only NIOSH approved respirators in accordance with 29 CFR 1910.134 – Respiratory Protection. Oxygen levels below 19.5% are considered IDLH by OSHA. In such atmospheres, use of a full-facepiece pressure/demand SCBA or a full facepiece, supplied air respirator with auxiliary self-contained air supply is required under OSHA's Respiratory Protection Standard (1910.134-1998).

**FOR MAXIMUM SAFETY, BE CERTIFIED FOR AND WEAR A RESPIRATOR AT ALL TIMES WHEN WELDING OR BRAZING!**

**EYE PROTECTION:** Ensure eyewash/safety shower stations are available near areas where these products are used. Wear safety glasses, goggles or face-shield with filter lens of appropriate shade number (per ANSI Z49.1-1988, "Safety in Welding and Cutting").

**PROTECTIVE CLOTHING:** Wear head, hand, and body protection which help to prevent injury from radiation, sparks, and electrical shock. See ANSI Z49.1. As a minimum this includes welder's gloves, protective face shield, dark substantial clothing, and may include arm protectors, aprons, hats, and shoulder protection.

**WORK PRACTICES AND HYGIENE PRACTICES:** As with all chemicals, avoid getting these products ON YOU or IN YOU. Wash hands after handling these products. Do not eat or drink while handling these products.

**WASTE DISPOSAL METHOD:** Prevent waste from contaminating surrounding environment. Discard any product, residue, disposable container or liner in an environmentally acceptable manner, in full compliance with federal, state and local regulations. However, alloy wastes are normally collected to recover metal values.

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### Section 8 - FIRST AID MEASURES

- **EYE EXPOSURE:** Flush eyes with plenty of water or saline for at least 15 minutes. Consult a physician.
  - **SKIN EXPOSURE:** Wash thoroughly with soap and water. If molten material contaminates the skin, immediately begin decontamination with cold, running water. Minimum flushing is for 15 minutes. Consult a physician if irritation persists.
  - **INHALATION EXPOSURE:** Remove to fresh air. Check for clear airway, breathing and presence of pulse. Provide CPR for persons without pulse or respirations. Consult a physician immediately.
  - **INGESTION EXPOSURE:** Ingestion is not a likely route of exposure for these rods. If swallowed CALL PHYSICIAN OR POISON CONTROL CENTER FOR MOST CURRENT INFORMATION. DO NOT INDUCE VOMITING, unless directed by medical personnel. Have victim rinse mouth with water, if conscious. Never induce vomiting or give diluents (milk or water) to someone who is unconscious, having convulsions, or unable to swallow.
- RECOMMENDATIONS TO PHYSICIANS:** Treat symptoms and eliminate overexposure.

### Section 9 - TOXICOLOGICAL INFORMATION

Below are human toxicological data available for the components of these products present in concentration greater than 1%.

<b>Cr (VI) OXIDE:</b> (CAS No. 1333-82-0) LD <sub>50</sub> (oral, rat) = 80 mg/kg <b>COPPER OXIDE:</b> (CAS No. 1317-39-1) LD <sub>50</sub> (oral, rat) = 470 mg/kg <b>IRON:</b> TDLo (oral, child) = 77 mg/kg;BAH gastrointestinal tract, blood effects	<b>IRON OXIDE:</b> (CAS No. 1309-37-1) LD <sub>50</sub> (intraperitoneal, rat) = 5500 mg/kg <b>MANGANESE:</b> TCLo (inhalation, man) =2300µg/m <sup>3</sup> BRN, central nervous system effects <b>NICKEL OXIDE:</b> (CAS No. 1313-99-1) LD <sub>50</sub> (subcutaneous, mouse) = 50 mg/kg	<b>OZONE:</b> (CAS No. 10028-15-6) LC <sub>50</sub> (inhalation, cat) = 34.5 ppm/3H <b>POTASSIUM HYDROXIDE:</b> Skin Irritancy (human) = 50 mg; severe <b>TITANIUM DIOXIDE:</b> Skin (human) = 300 µg/3 days intermittent; mild irritation effects
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### Section 10 – REGULATORY INFORMATION

**U.S. SARA REPORTING REQUIREMENTS:** The components of these products are subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act, as follows:

CHEMICAL NAME	SARA 302 (40 CFR 355, Appendix A)	SARA 304 (40 CFR Table 302.4)	SARA 313 (40 CFR 372.65)
Calcium Fluoride and Cryolite (as fluoride compounds)	No	No	Yes; category code N040
Chromium (III) Oxide (Chromium Compound Category)	No	Yes	Yes
Chromium	No	Yes	No
Manganese	No	No	Yes
Nickel	No	Yes	Yes
Potassium Hydroxide	No	Yes	No

**U.S. SARA THRESHOLD PLANNING QUANTITY:** There are no specific Threshold Planning Quantities for the components of these products. The default Federal MSDS submission and inventory requirement filing threshold of 10,000 lbs (4,540 kg) therefore applies, per 40 CFR 370.20.

**CALIFORNIA PROPOSITION 65: WARNING:** This product contains or produces a chemical known to the State of California to cause cancer and birth defects (or other reproductive harm). (California Health & Safety Code 25249.5 et seq.)

### Section 11 – DEFINITIONS OF TERMS

CAS No. - Chemical Abstracts Service Number PEL - Permissible Exposure Level TLV - Threshold Limit Value  
 TWA - Time Weighted Average STEL - Short Term Exposure Limit IARC – International Agency for Research on Cancer  
 NIOSH – National Institute of Occupational Safety and Health OSHA – U.S. Occupational Safety and Health Administration  
 TDLo – the lowest dose to cause a symptom TCLo – the lowest concentration to cause a symptom  
 TDo, LDLo, and LDo, or TC, TCo, LCLo, and LCo – the lowest dose (or concentration) to cause lethal or toxic effects.  
 SARA – Superfund Amendments and Reauthorization Act ACGIH – American Conference of Governmental Industrial Hygienists  
 LD<sub>50</sub> & LC<sub>50</sub> – These values are the amount of a substance given to the stated species that causes 50% of that species to die.  
 mppcf – Millions of Particles Per Cubic Foot

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