



SAFETY DATA SHEET

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

Manufacturer/Supplier Name: **Sandvik Wire and Heating Technologies**
Address: **P.O. Box 1220, Scranton, PA 18501-1220**
Phone Number: **(570)-585-7500**
Trade Name: **SANDVIK**
Classification: **AWS A5.22/ASME SFA 5.22, ABS, CWB-AWS A5.22 Stainless Steel Electrodes for Flux Cored Arc Welding**
Product Type: **Gas Shielded Flux Cored Arc Welding Electrodes**

Product Identifiers: **308LT-0, 308LT-1, 308T-0, 308T-1, 309LT-0, 309LT-1, 309MoLT-0, 309MoLT-1, 312T-0, 312T-1, 316LT-0, 316LT-1, 317LT-0, 317LT-1, 347T-0, 347T-1, 2209T-0, 2209T-1**

SECTION 2: HAZARDS IDENTIFICATION

Chrome-Nickel flux cored electrodes consist of an 18-8 stainless steel sheath with an alloy and flux filler.

EMERGENCY OVERVIEW

Effects of Over-exposure:

Electric arc welding may create one or more of the following health hazards:

FUMES AND GASES can be dangerous to your health.

SHORT-TERM (acute) OVEREXPOSURE to welding fumes may result in discomfort, such as dizziness, nausea, or dryness or irritation of nose, throat, or eyes.

LONG-TERM (chronic) OVEREXPOSURE to welding fumes can lead to siderosis (iron deposits in lungs), silicosis or aluminosis (fibrotic lung disease), central nervous system, liver or kidney damage, skin and respiratory sensitization (allergic reaction), and is believed by some investigators to affect pulmonary function.

PRIMARY ROUTE OF ENTRY is the respiratory system.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing eye, respiratory or allergic conditions.

ARC RAYS can injure eyes and burn skin.

ELECTRIC SHOCK can kill.

CARCINOGENICITY:

Certain hexavalent chromium compounds, nickel metal and compounds and respirable crystalline silica are listed in the National Toxicology Program (NTP) Annual Report on Carcinogens, found to be a potential carcinogen in the International Agency for Research on Cancer (IARC) Monographs, or listed by OSHA/ACGIH as potential carcinogens.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

The following is composition information of the product as manufactured.

Hazardous Ingredient	CAS No.	WT %
Alumina (Al ₂ O ₃)	1334-28-1	0-3
Calcium Carbonate (CaCO ₃)	471-34-1	1-5
Calcium Fluoride (CaF ₂)	7789-75-5	1-10
Chromium (Cr)	7440-47-3	15-30
Copper (Cu)	7440-50-8	0-4
Iron (Fe)	7439-89-6	Bal.
Manganese (Mn)	7439-96-5	1-4
Manganese Tetraoxide (Mn ₃ O ₄)	1317-35-7	1-4
Magnesium Oxide	1309-48-4	0-4
Molybdenum (Mo) ¹⁾	7439-98-7	0-4
Nickel (Ni)	7440-02-0	8-15
Niobium (Nb) ²⁾	7440-03-1	0.5-1
Potassium (K)	7440-09-7	0-4
Sodium (Na)	7440-23-5	0-2
Silicon (Si)	7440-21-3	0.5-3
Silica (SiO ₂) (quartz)	14808-60-7	0-5
Titanium Dioxide (TiO ₂)	13463-67-7	1-15



Hazardous Ingredient	CAS No.	WT %
Zirconium (Zr)	7440-67-7	0.5-1
Zirconium Dioxide (ZrO ₂)	1314-23-4	0-8

The following are typical constituents of welding fumes and gases. When the electrode is consumed, the fume and gas decomposition products generated are different in percent and form than ingredients listed above. Decomposition products of normal operation include those originating from the volatilization reaction, or oxidation of the materials shown above, plus those from the base metal and coating, etc. which may include paint, plating, galvanizing, or phosphate coatings on steels which would produce phosphine gas and other contaminants in the atmosphere (such as chlorinated hydrocarbon vapors from cleaning and degreasing activities which may be decomposed by the arc into toxic gases such as phosgene).

Fume Constituent (Gases)	CAS No.	Fume Constituents (Solids)	CAS No.
Carbon Dioxide (CO ₂)	124-38-9	Aluminum Fumes	7429-90-5
Carbon Monoxide (CO)	630-08-0	Calcium Fluoride (CaF ₂)	7789-75-5
Dinitrogen Tetroxide (N ₂ O ₄)	10544-72-6	Chromates (CrO ₃)	1333-82-0
Hydrogen Fluoride (HF)	7664-39-3	Copper Oxide (CuO)	1344-70-3
Nitric Oxide (NO)	10102-43-9	Manganese Tetraoxide (Mn ₃ O ₄)	1317-35-7
Nitrogen Dioxide (NO ₂)	10102-44-0	Magnesium Oxide (MgO)	1309-48-4
Ozone (O ₃)	10028-15-6	Nickel Oxide (NiO)	1314-06-3
Phosgene (COCl ₂) *	75-44-5	Niobium Oxide (NbO) ²⁾	12034-57-0
Phosphine (PH ₃) **	7803-51-2	Silicon Dioxide (SiO ₂) (quartz)	14808-60-7
		Iron Oxide (Fe ₂ O ₃)	1309-37-1
		Molybdenum Trioxide (MoO ₃) ¹⁾	1313-27-5
		Sodium Oxide (NaO)	1313-59-3
		Potassium Oxide (KO)	12136-45-7
		Titanium Dioxide (TiO ₂)	13463-67-7
		Zirconium Dioxide (ZrO ₂)	1314-23-4

* May result from contact with chlorinated hydrocarbon vapors.

** May result from welding on phosphate coated steels.

¹⁾ Only in Molybdenum-alloyed grades.

²⁾ Only in Niobium-alloyed grades.

Refer to Section 8 for occupational exposure limits.

SECTION 4: FIRST AID MEASURES

Eye: If eye irritation occurs, flush eyes immediately with water while holding open eyelids. Get medical attention if irritation persists.

Skin: None normally needed. Get immediate medical attention for treatment of burns.

Inhalation: Remove victim to fresh air. Give artificial respiration if needed. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

SECTION 5: FIRE FIGHTING MEASURES

(Nonflammable) – Welding arc and sparks can ignite combustibles and flammables. Refer to American National Z49.1 for fire prevention during the use of welding and allied procedures.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Pick up and return to container for use.



SECTION 7: HANDLING AND STORAGE

Avoid breathing welding fumes. Keep your head out of the fumes. Use with enough ventilation or exhaust at the arc, or both, to keep fumes and gases below the occupational exposure limits in your breathing zone and the general area. Use air sampling to determine the need for corrective action. (Refer to Section 10 for additional information)

Work in a confined space only if it is well ventilated, or while wearing an air-supplied respirator. Fumes from welding and oxygen depletion can alter the air quality causing injury or death.

Take appropriate precautions to prevent fires and explosion.

Read and understand the manufacturer's instructions and the precautionary label on the 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 2206 (29CFR 1910), U.S. Government Printing Office, Washington, DC 20402, for more information. Assure compliance with the OSHA Standard on Chromium (VI), 29CFR 1910.1026.

Storage: Store in a dry area. Refer to product data sheet (available from Sandvik Materials Technology) for specific storage information.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

See Appendix A for occupational exposure limits for Canadian Provinces

The following are the occupational exposure limits for the components of the product as manufactured.

Ingredient	OSHA PEL	ACGIH TLV	ACGIH STEL
Alumina (Al ₂ O ₃) (as Al)	5 mg/m ³ (respirable fraction) 15 mg/m ³ (total dust)	1 mg/m ³ TWA (respirable fraction)	-
Calcium Carbonate (CaCO ₃)	5 mg/m ³ TWA (respirable fraction) 15 mg/m ³ TWA (total dust)	None Established	-
Calcium Fluoride (CaF ₂) (as F)	2.5 mg/m ³ TWA	2.5 mg/m ³ TWA	-
Chromium (Cr) (as metal)	1 mg/m ³ TWA	0.5 mg/m ³ TWA	-
Copper (Cu) (as dust and mists)	1 mg/m ³ TWA	1 mg/m ³ TWA	-
Iron (Fe) (as Iron oxide)	10 mg/m ³ TWA (As fume)	5 mg/m ³ TWA (respirable)	-
Manganese (Mn)	5 mg/m ³ Ceiling Limit	0.02 mg/m ³ TWA (respirable fraction) 0.1 mg/m ³ TWA (inhalable)	-
Manganese Tetraoxide (Mn ₃ O ₄) (as Mn)	5 mg/m ³ Ceiling Limit	0.2 mg/m ³ TWA (fume)	-
Magnesium Oxide (MgO)	15 mg/m ³ TWA (fume, total particulates)	10 mg/m ³ TWA (inhalable)	-
Molybdenum (Mo) ¹⁾	15 mg/m ³ TWA (total dust)	3 mg/m ³ TWA (respirable fraction) 10 mg/m ³ TWA (inhalable)	-
Nickel (Ni) (as metal)	1 mg/m ³ TWA	1.5 mg/m ³ TWA (inhalable)	-
Niobium (Nb) ²⁾	None Established	None Established	-
Potassium (K)	None Established	None Established	-
Sodium (Na)	None Established	None Established	-
Silicon (Si)	5 mg/m ³ TWA (respirable) 15 mg/m ³ TWA (total dust)	None Established	-
Silica (SiO ₂) (quartz)	$\frac{10}{\%SiO_2+2}$ (respirable fraction) TWA 30 (total dust)	0.025 mg/m ³ TWA (respirable fraction)	-



	%SiO ₂ +2 TWA		
Titanium Dioxide (TiO ₂)	15 mg/m ³ TWA (total dust)	10 mg/m ³ TWA	-
Zirconium (Zr)	5 mg/m ³ TWA	5 mg/m ³ TWA	10 mg/m ³
Zirconium Dioxide (ZrO ₂)	5 mg/m ³ TWA	5 mg/m ³ TWA	10 mg/m ³

The following are the occupational exposure limits for the typical decomposition products.

GASES			
Fume Constituent	OSHA PEL	ACGIH TLV	ACGIH STEL
Carbon Dioxide (CO ₂)	5,000 ppm TWA	5,000ppm TWA	30,000 ppm
Carbon Monoxide (CO)	50 ppm TWA	25 ppm TWA	-
Dinitrogen Tetroxide (N ₂ O ₄)	None Established	None Established	
Hydrogen Fluoride (HF)	3 ppm TWA	0.5 ppm TWA	2 ppm Ceiling
Nitric Oxide (NO)	25 ppm TWA	25 ppm TWA	-
Nitrogen Dioxide (NO ₂)	5 ppm Ceiling Limit	0.2 ppm TWA	-
Ozone (O ₃)	0.1 ppm TWA	0.1 ppm TWA ***	-
Phosgene (COCl ₂) *	0.1 ppm TWA	0.1 ppm TWA	-
Phosphine (PH ₃) **	0.3 ppm TWA	0.3 ppm TWA	1 ppm

SOLIDS			
Fume Constituents	OSHA PEL	ACGIH TLV	ACGIH STEL
Aluminum Welding Fumes	5 mg/m ³ TWA (respirable fraction) 15 mg/m ³ TWA (total dust) (as Al metal)	None Established	-
Calcium Fluoride (CaF ₂) (as F)	2.5 mg/m ³ TWA	2.5 mg/m ³ TWA	-
Chromates (CrO ₃) (CrVI)	0.005 mg/m ³ TWA (as CrVI) 0.0025 action level	0.05 mg/m ³ TWA water soluble(as Cr) 0.01 mg/m ³ TWA certain water insoluble (as Cr)	-
Chromium (III) Compounds	0.5 mg/m ³ TWA (as Cr)	0.5 mg/m ³ TWA (as Cr)	-
Copper Oxide (CuO) (as copper fume)	0.1 mg/m ³ TWA	0.2 mg/m ³ TWA	
Iron Oxide	10 mg/m ³ TWA (as fume)	5 mg/m ³ TWA (respirable)	-
Manganese Tetraoxide (Mn ₃ O ₄) (as Mn)	5 mg/m ³ Ceiling (fume)	0.2 mg/m ³ TWA (fume)	-
Magnesium Oxide (MgO)	15 mg/m ³ TWA (total particulates)	10 mg/m ³ TWA (inhalable)	
Molybdenum Trioxide (MoO ₃) ¹⁾ (as Mo)	15 m/m ³ TWA (total dust)	3 mg/m ³ TWA (respirable fraction) 10 mg/m ³ TWA (inhalable)	-
Nickel Oxide (NiO) (as Ni)	1 mg/m ³ TWA	0.2 mg/m ³ TWA (inhalable)	-
Niobium Oxide (NbO) ²⁾	None Established	None Established	-
Silica (SiO ₂) (quartz)	$\frac{10}{\%SiO_2+2}$ (respirable fraction) TWA $\frac{30}{\%SiO_2+2}$ (total dust) TWA	0.025 mg/m ³ TWA (respirable fraction)	-
Sodium Oxide (NaO)	None Established	None Established	-
Potassium Oxide (KO)	None Established	None Established	-
Titanium Dioxide (TiO ₂)	15 mg/m ³ TWA (total dust)	10 mg/m ³ TWA	-
Zirconium Dioxide (ZrO ₂)	5 mg/m ³ TWA	5 mg/m ³ TWA	10 mg/m ³

¹⁾ Only in Molybdenum-alloyed grades.



²⁾ Only in Niobium-alloyed grades.

Definitions:

Permissible Exposure Limit (PEL) OSHA (29CFR 1910) – An exposure limit that is published and enforced by OSHA as a legal standard.

Threshold Limit Value (TLV) – American Conference of Governmental Industrial Hygienists – Time weighted average (TWA) concentration for a normal 8-hour work day and a 40-hour work week to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

Short Term Exposure Limit (STEL) OSHA (29CFR 1910) – A 15-minute time weighted average exposure which should not be exceeded at any time during a work day.

Ceiling Limit – The concentration that should not be exceeded during any part of the working exposure.

* May result from contact with chlorinated hydrocarbon vapors.

** May result from welding on phosphate coated steels.

*** For light work: 0.1ppm; for moderate work: 0.08ppm; and for heavy work: 0.05ppm of O₃.

Ventilation: Use enough ventilation, local exhaust at the arc, or both, to keep the fumes and gases below TLV/PEL in the workers' breathing zone and the general area. Train each welder to keep his/her head out of the fumes. Refer to ANSI Z49.1 and Section 10 for additional information.

Respiratory Protection: Use respirable fume respirator or air-supplied respirator when welding in confined area, or where local exhaust or ventilation does not keep exposure below TLV/PEL. Respirator selection and use should be based on contaminant type, form and concentration. Follow OSHA 1910.134, OSHA 1910.1026, ANSI Z88.2 and good Industrial Hygiene practice.

Protective Clothing: Wear head, hand, and body protection to help prevent injury from radiation, sparks, and electric shock. See ANSI Z49.1 and OSHA 1910.1026. At a minimum, this includes welder's gloves and a protective face shield, and may include arm protectors, aprons, hats, shoulder protection, and dark substantial clothing. Train each welder not to touch live electrical parts, and to insulate his/her person from work and ground.

Eye Protection: Wear helmet or use face shield with filter lens. Lens filter should be as dark as possible without obstructing view of the weld zone. Provide protective screens and flash goggles, if necessary, to shield others.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Chrome-Nickel flux cored electrodes consist of an 18-8 stainless steel sheath with an alloy and flux filler.

SECTION 10: STABILITY AND REACTIVITY

Stability: Stable under normal conditions of storage or use.

Incompatibility/Conditions to Avoid: None known. Welding arc and sparks can ignite combustibles and flammables. Refer to American National Z49.1 for fire prevention during the use of welding and allied procedures.

Hazardous Decomposition Product

Welding fumes and gases cannot be classified simply. The composition and quantity of both are dependent upon the metal being welded, and the process, procedures, and electrodes used. Other conditions which also influence the composition and quantity of the fumes and gases to which workers may be exposed include: coatings on the metal being welded (such as paint, plating, galvanizing, or phosphate coatings on steels which would produce phosphine gas), the number of welders and the volume of the work area, the quality and amount of ventilation, the 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 which may be decomposed by the arc into toxic gases such as phosgene).

When the electrode is consumed, the fume and gas decomposition products generated are different in percent and form than ingredients in the manufactured product. Typical decomposition is also listed in Section 3. Decomposition



products of normal operation include those originating from the volatilization reaction, or oxidation of the materials shown in Section 3, plus those from the base metal and coating, etc., as noted above.

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, available from the American Welding Society, P.O. Box 351040, Miami, FL 33135.

SECTION 11: TOXICOLOGICAL INFORMATION

No acute toxicity data is available; however, these products are not expected to be acutely toxic. See Section 2 for information on human health effects.

SECTION 12: ECOLOGICAL INFORMATION

No specific data is available. These products are not expected to present an environmental hazard.

SECTION 13: DISPOSAL INFORMATION

WASTE DISPOSAL METHOD: Prevent waste from contaminating the surrounding environment. Discard any product, residue, disposable container, or liner in an environmentally accepted manner, in full compliance with federal, state, and local regulations.

SECTION 14: TRANSPORT INFORMATION

These products are not regulated for transportation under DOT, IATA or IMDG.

SECTION 15: REGULATORY INFORMATION

CERCLA 103 Reportable Quantity: These products are not subject to CERCLA reporting requirement.

SARA TITLE III:

Hazard Category for Section 311/312: Acute Health, Chronic Health

Section 313 (40CFR 372) Toxic Chemicals: This product contains the following chemicals subject to SARA Title III Section 313 Reporting requirements:

Aluminum Oxide	1344-28-1	0-3%
Chromium*	7440-47-3	15-30%
Copper*	7440-50-8	0-4%
Manganese*	7440-96-5	1-4%
Nickel*	7440-02-0	8-15%

* This includes all compounds of these elements.

Section 302 Extremely Hazardous Substances (TPQ): None

EPA Toxic Substances Control Act (TSCA) Status: All of the components of this product are listed on the TSCA inventory.

California Proposition 65: This product contains chromium, nickel and crystalline silica, which are known to the State of California to cause cancer.

Canadian Environmental Protection Act: All of the ingredients are listed on the Canadian Domestic Substances List.



Canadian WHMIS Classification: Class D-2-A (Very Toxic Material causing other toxic effects)

This SDS has been prepared according to the criteria of the Controlled Products Regulation (CPR) and the SDS contains all of the information required by the CPR.

EU RoHS: Finished welds using Sandvik welding consumables are RoHS compliant. Sandvik Stainless Steel Welding Products contain Chromium. When welded Sandvik Stainless Steel Welding Products will produce Cr VI (hexavalent chrome), however, the weld deposit does not contain Cr VI as it will all be in the zero valent state or as Cr III as an oxide. Finished products manufactured using Sandvik Stainless Steel Welding Products will not contain Cr VI.

SECTION 16: OTHER INFORMATION

HMIS Ratings:	Health – 1*	Flammability - 0	Instability - 0
NFPA Ratings:	Health - 1	Flammability - 0	Physical Hazard - 0

* indicates the potential for chronic health effects.

SDS Updated July, 2013: Comprehensive Review. Updated exposure limits.

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DISCLAIMER: This product is intended for use only by qualified individuals experienced and trained in welding safety. Conditions of use and suitability of the product for particular uses are beyond our control, and while the information herein is given in good faith, SANDVIK MAKES NO WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Nor does Sandvik assume any liability arising out of use of the product described herein. In no event shall Sandvik be liable for any special, incidental, or consequential damages in connection with this SDS.

Appendix A

Occupational Exposure Limits for Canadian Provinces

The following are the occupational exposure limits for the components of the product as manufactured.

Ingredient	CAS	Ontario	Quebec	British Columbia
Alumina (Al ₂ O ₃)	1334-28-1	1 mg/m ³ TWA	10 mg/m ³ TWA	1 mg/m ³ TWA respirable
Calcium Carbonate (CaCO ₃)	471-34-1	None Established	10 mg/m ³ TWA total dust	10 mg/m ³ TWA total dust 20 mg/m ³ STEL
Calcium Fluoride (CaF ₂) (as fluoride compounds)	7789-75-5	2.5 mg/m ³ TWA	2.5 mg/m ³ TWA	2.5 mg/m ³ TWA
Chromium (Cr) (as chromium metal)	7440-47-3	0.5 mg/m ³ TWA	0.5 mg/m ³ TWA	0.5 mg/m ³ TWA
Copper (Cu) (as copper dust and mist)	7440-50-8	1 mg/m ³ TWA	1 mg/m ³ TWA	1 mg/m ³ TWA
Iron (Fe) (as iron oxide)	7439-89-6	5 mg/m ³ TWA (respirable dust)	5 mg/m ³ TWA	5 mg/m ³ TWA
Manganese (Mn) (as Mn and inorganic compounds)	7439-96-5	0.2 mg/m ³ TWA	5 mg/m ³ TWA	0.2 mg/m ³ TWA
Manganese Tetraoxide (Mn ₃ O ₄)	1317-35-7	0.2 mg/m ³ TWA	1mg/m ³ TWA	0.2 mg/m ³ TWA
Magnesium Oxide	1309-48-4	10 mg/m ³ TWA (inhalable)	10 mg/m ³ TWA (as fume)	3 mg/m ³ TWA TWA 10 mg/m ³ TWA STEL (as MgO dust)
Molybdenum (Mo) ¹⁾ (as Mo and insoluble compounds)	7439-98-7	3 mg/m ³ TWA respirable 10 mg/m ³ TWA inhalable	10 mg/m ³ TWA (as insoluble compounds)	3 mg/m ³ TWA respirable 10 mg/m ³ TWA inhalable
Nickel (Ni)	7440-02-0	1 mg/m ³ inhalable TWA (metal) 0.2 mg/m ³ TWA inhalable (insoluble)	1.0 mg/m ³ TWA (as metal and insoluble compounds)	0.05 mg/m ³ TWA (as metal and inorganic compounds)
Niobium (Nb) ²⁾	7440-03-1	None Established	None Established	None Established
Potassium (K)	7440-09-7	None Established	None Established	None Established
Sodium (Na)	7440-23-5	None Established	None Established	None Established
Silicon (Si)	7440-21-3	10 mg/m ³ TWA total dust	10 mg/m ³ TWA total dust	10 mg/m ³ TWA total dust (as PNOC)
Silica (SiO ₂) (quartz)	14808-60-7	0.1 mg/m ³ TWA	0.1 mg/m ³ TWA (respirable)	0.025 mg/m ³ TWA
Titanium Dioxide (TiO ₂)	13463-67-7	10 mg/m ³ TWA total dust	10 mg/m ³ TWA total dust	3 mg/m ³ TWA respirable 10 mg/m ³ TWA total dust
Zirconium (Zr)	7440-67-7	5 mg/m ³ TWA 10 mg/m ³ STEL	5 mg/m ³ TWA 10 mg/m ³ STEL	5 mg/m ³ TWA 10 mg/m ³ STEL
Zirconium Dioxide (ZrO ₂)	1314-23-4	5 mg/m ³ TWA 10 mg/m ³ STEL	5 mg/m ³ TWA 10 mg/m ³ STEL	5 mg/m ³ TWA 10 mg/m ³ STEL

The following are the occupational exposure limits for the typical decomposition products.

Appendix A



GASES			
Fume Constituent	Ontario	Quebec	British Columbia
Carbon Dioxide (CO ₂)	5,000 ppm TWA 30,000 ppm STEL	5,000 ppm TWA 30,000 ppm STEL	5,000 ppm TWA 15,000 ppm STEL
Carbon Monoxide (CO)	25 ppm TWA 100 ppm STEL	35 ppm TWA 200 ppm STEL	25 ppm TWA 100 ppm STEL
Dinitrogen Tetroxide (N ₂ O ₄)	None Established	None Established	None Established
Hydrogen Fluoride (HF)	0.5 ppm TWA 2 ppm Ceiling	3 ppm Ceiling	2 ppm Ceiling
Nitric Oxide (NO)	25 ppm TWA	25 ppm TWA	25 ppm TWA
Nitrogen Dioxide (NO ₂)	3 ppm TWA 5 ppm STEL	3 ppm TWA	1 ppm Ceiling
Ozone (O ₃)	0.1 ppm TWA 0.3 ppm STEL	0.1 ppm Ceiling	0.1 ppm TWA***
Phosgene (COCl ₂) *	0.1 ppm TWA	0.1 ppm TWA	0.1 ppm TWA
Phosphine (PH ₃) **	0.3 ppm TWA 1 ppm STEL	0.3 ppm TWA 1 ppm STEL	0.3 ppm TWA 1 ppm STEL

SOLIDS			
Fume Constituent t	Ontario	Quebec	British Columbia
Aluminum Welding Fumes	10 mg/m ³ TWA (as aluminum oxide)	5 mg/m ³ TWA (as welding fumes)	None Established
Calcium Fluoride (CaF ₂) (as fluorides)	2.5 mg/m ³ TWA	2.5 mg/m ³ TWA	2.5 mg/m ³ TWA
Chromates (CrO ₃) (CrVI)	0.01 mg/m ³ TWA (as insoluble compounds) 0.05 mg/m ³ TWA (as hexavalent chromium comp)	0.01 mg/m ³ TWA (as water insoluble comp) 0.05 TWA (as water soluble comp)	0.01 mg/m ³ TWA (insoluble) 0.025 mg/m ³ TWA (water soluble) 0.1 mg/m ³ Ceiling
Chromium (III) Compounds	0.5 mg/m ³ TWA	0.5 mg/m ³ TWA	0.5 mg/m ³ TWA
Copper Oxide (CuO) (as copper fume)	0.2 mg/m ³ TWA	0.2 mg/m ³ TWA	0.2 mg/m ³ TWA
Iron Oxide (as fume)	5 mg/m ³ TWA respirable	5 mg/m ³ TWA	5 mg/m ³ TWA 10 mg/m ³ STEL
Manganese Tetraoxide (Mn ₃ O ₄) (as Mn inorganic compounds)	0.2 mg/m ³ TWA	1 mg/m ³ TWA	0.2 mg/m ³ TWA
Magnesium Oxide	10 mg/m ³ TWA (inhalable)	10 mg/m ³ TWA (as fume)	3 mg/m ³ TWA TWA 10 mg/m ³ TWA STEL (as MgO dust)
Molybdenum Trioxide (MoO ₃) ¹⁾ (as insoluble compounds)	3 mg/m ³ TWA (respirable) 10 mg/m ³ TWA (inhalable)	3 mg/m ³ TWA (respirable)	3 mg/m ³ TWA (as respirable) 10 mg/m ³ TWA (inhalable)
Nickel Oxide (NiO) (as nickel soluble compounds)	0.1 mg/m ³ TWA (inhalable)	0.1 mg/m ³ TWA	0.05 mg/m ³ TWA
Niobium Oxide (NbO) ²⁾	None Established	None Established	None Established
Silica (SiO ₂) (quartz)	0.1 mg/m ³ TWA	0.1 mg/m ³ TWA	0.025 mg/m ³ TWA
Sodium Oxide (NaO)	None Established	None Established	None Established
Potassium Oxide (KO)	None Established	None Established	None Established
Titanium Dioxide (TiO ₂)	10 mg/m ³ TWA total dust	10 mg/m ³ TWA total dust	3 mg/m ³ TWA respirable 10 mg/m ³ TWA total dust
Zirconium Dioxide (ZrO ₂)	5 mg/m ³ TWA 10 mg/m ³ STEL	5 mg/m ³ TWA 10 mg/m ³ STEL	5 mg/m ³ TWA 10 mg/m ³ STEL

The following are the occupational exposure limits for the components of the product as manufactured.



<u>Ingredient</u>	<u>CAS</u>	<u>Prince Edward Island</u> <u>Newfoundland and Labrador</u>	<u>Saskatchewan</u>	<u>Alberta</u>
Alumina (Al ₂ O ₃)	1334-28-1	1 mg/m ³ TWA (respirable) (as Al insoluble compounds)	10 mg/m ³ TWA 20 mg/m ³ STEL	10 mg/m ³ TWA
Calcium Carbonate (CaCO ₃)	471-34-1	None Established	10 mg/m ³ TWA 20 mg/m ³ STEL	10 mg/m ³ TWA
Calcium Fluoride (CaF ₂) (as fluoride compounds)	7789-75-5	2.5 mg/m ³ TWA	2.5 mg/m ³ TWA 5 mg/m ³ STEL	2.5 mg/m ³ TWA
Chromium (Cr)	7440-47-3	0.5 mg/m ³ TWA	0.5 mg/m ³ TWA (as Cr metal) 1.5 mg/m ³ STEL	0.5 mg/m ³ TWA
Copper (Cu) (as copper dust and mist)	7440-50-8	1 mg/m ³ TWA	1 mg/m ³ TWA	1 mg/m ³ TWA
Iron (Fe) (as iron oxide)	7439-89-6	5 mg/m ³ TWA (respirable)	5 mg/m ³ TWA 10 mg/m ³ STEL (dust and fume)	5 mg/m ³ TWA (respirable)
Manganese (Mn) (as Mn and inorganic compounds)	7439-96-5	0.2 mg/m ³ TWA	0.2 mg/m ³ TWA 0.6 mg/m ³ STEL	0.2 mg/m ³ TWA
Manganese Tetraoxide (Mn ₃ O ₄)	1317-35-7	0.2 mg/m ³ TWA	0.2 mg/m ³ TWA 0.6 mg/m ³ STEL (as inorganic compound)	0.2 mg/m ³ TWA (inorganic compound)
Magnesium Oxide	1309-48-4	10 mg/m ³ TWA (inhalable)	10 mg/m ³ TWA 20 mg/m ³ STEL (inhalable)	10 mg/m ³ TWA (as fume)
Molybdenum (Mo) ¹⁾ (as Mo and insoluble compounds)	7439-98-7	3 mg/m ³ TWA (respirable fraction)	3 mg/m ³ TWA (respirable) 6 mg/m ³ STEL 10 mg/m ³ TWA (inhalable) 20 mg/m ³ STEL	3 mg/m ³ TWA (respirable) 10 mg/m ³ TWA (total dust)
Nickel (Ni) (as nickel metal)	7440-02-0	1.5 mg/m ³ TWA	1.5 mg/m ³ TWA (inhalable fraction) 3 mg/m ³ STEL	1.5 mg/m ³ TWA
Niobium (Nb) ²⁾	7440-03-1	None Established	None Established	None Established
Potassium (K)	7440-09-7	None Established	None Established	None Established
Sodium (Na)	7440-23-5	None Established	None Established	None Established
Silicon (Si)	7440-21-3	None Established	10 mg/m ³ TWA 20 mg/m ³ STEL	3 mg/m ³ TWA (respirable) 10 mg/m ³ TWA (total dust) (as PNOC)
Silica (SiO ₂) (quartz)	14808-60-7	0.025 mg/m ³ TWA	0.05 mg/m ³ TWA	0.025 mg/m ³ TWA (respirable)
Titanium Dioxide (TiO ₂)	13463-67-7	10 mg/m ³ TWA	10 mg/m ³ TWA 20 mg/m ³ STEL	10 mg/m ³ TWA
Zirconium (Zr)	7440-67-7	5 mg/m ³ TWA 10 mg/m ³ STEL	5 mg/m ³ TWA 10 mg/m ³ STEL	5 mg/m ³ TWA 10 mg/m ³ STEL
Zirconium Dioxide (ZrO ₂)	1314-23-4	5 mg/m ³ TWA 10 mg/m ³ STEL	5 mg/m ³ TWA 10 mg/m ³ STEL	5 mg/m ³ TWA 10 mg/m ³ STEL

The following are the occupational exposure limits for the typical decomposition products.

GASES			
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<u>Fume Constituent</u>	<u>Prince Edward Island</u> <u>Newfoundland and Labrador</u>	<u>Saskatchewan</u>	<u>Alberta</u>
Carbon Dioxide (CO ₂)	5,000 ppm TWA 30,000 ppm STEL	5,000 ppm TWA 30,000 ppm STEL	5,000 ppm TWA 30,000 ppm STEL
Carbon Monoxide (CO)	25 ppm TWA	25 ppm TWA 190 ppm STEL	25 ppm TWA
Dinitrogen Tetroxide (N ₂ O ₄)	None Established	None Established	None Established
Hydrogen Fluoride (HF)	0.5 ppm TWA 2 ppm Ceiling Limit	0.5 ppm TWA 2 ppm Ceiling	0.5 ppm TWA 2 ppm Ceiling
Nitric Oxide (NO)	25 ppm TWA	25 ppm TWA 38 ppm STEL	25 ppm TWA
Nitrogen Dioxide (NO ₂)	3 ppm TWA 5 ppm STEL	3 ppm TWA 5 ppm STEL	3 ppm TWA 5 ppm STEL
Ozone (O ₃)	0.1 ppm TWA ***	0.05 ppm TWA 0.15 ppm STEL	0.1 ppm TWA 0.3 ppm STEL
Phosgene (COCl ₂) *	0.1 ppm TWA	0.1 ppm TWA 0.3 ppm STEL	0.1 ppm TWA
Phosphine (PH ₃) **	0.3 ppm TWA 1 ppm STEL	0.3 ppm TWA 1 ppm STEL	0.3 ppm TWA 1 ppm STEL

SOLIDS			
<u>Fume Constituent</u>	<u>Prince Edward Island</u> <u>Newfoundland and Labrador</u>	<u>Saskatchewan</u>	<u>Alberta</u>
Aluminum Welding Fumes	1 mg/m ³ TWA (respirable fraction) (as aluminum insoluble compounds)	10 mg/m ³ TWA 20 mg/m ³ STEL (as aluminum oxide)	10 mg/m ³ TWA (as aluminum oxide)
Calcium Fluoride (CaF ₂) (as fluoride compounds)	2.5 mg/m ³ TWA	2.5 mg/m ³ 5 mg/m ³ STEL	2.5 mg/m ³ TWA
Chromates (CrO ₃) (CrVI)	0.05 mg/m ³ TWA (water soluble comp) 0.01 mg/m ³ TWA (certain water insoluble comp)	0.05 mg/m ³ TWA, 0.15 mg/m ³ STEL (soluble) 0.01 mg/m ³ TWA 0.03 mg/m ³ STEL (insoluble)	0.05 mg/m ³ TWA (soluble comp) 0.01 mg/m ³ TWA (as insoluble compounds)
Chromium (III) Compounds	0.5 mg/m ³ TWA	0.5 mg/m ³ TWA 1.5 mg/m ³ STEL	0.5 mg/m ³ TWA
Copper Oxide (CuO) (as copper fume)	0.2 mg/m ³ TWA	0.2 mg/m ³ TWA 0.6 mg/m ³ STEL	0.2 mg/m ³ TWA
Iron Oxide	5 mg/m ³ TWA (respirable)	5 mg/m ³ TWA 10 mg/m ³ STEL (as fume)	5 mg/m ³ TWA (respirable)
Manganese Tetraoxide (Mn ₃ O ₄)	0.2 mg/m ³ TWA (as fume)	0.2 mg/m ³ TWA 0.6 mg/m ³ STEL (as inorganic compound)	0.2 mg/m ³ TWA (inorganic compound)
Magnesium Oxide	10 mg/m ³ TWA (inhalable)	10 mg/m ³ TWA 20 mg/m ³ STEL (inhalable)	10 mg/m ³ TWA (as fume)
Molybdenum Trioxide (MoO ₃) (as molybdenum insoluble compounds)	3 mg/m ³ TWA (respirable fraction)	3 mg/m ³ TWA respirable 10 mg/m ³ (total dust)	3 mg/m ³ TWA respirable 10 mg/m ³ TWA (total dust)
Nickel Oxide (NiO) (as nickel soluble compounds)	0.1 mg/m ³ TWA	0.1 mg/m ³ TWA 0.3 mg/m ³ STEL	0.1 mg/m ³ TWA (soluble)
Niobium Oxide (NbO) ²⁾	None Established	None Established	None Established
Silica (SiO ₂) (quartz)	0.025 mg/m ³ TWA	0.005 mg/m ³ TWA	0.025 mg/m ³ TWA (respirable)
Sodium Oxide (NaO)	None Established	None Established	None Established

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SOLIDS			
<u>Fume Constituent</u>	<u>Prince Edward Island</u> <u>Newfoundland and Labrador</u>	<u>Saskatchewan</u>	<u>Alberta</u>
Potassium Oxide (KO)	None Established	None Established	None Established
Titanium Dioxide (TiO ₂)	10 mg/m ³ TWA	10 mg/m ³ TWA 20 mg/m ³ STEL	10 mg/m ³ TWA
Zirconium Dioxide	5 mg/m ³ TWA 10 mg/m ³ STEL	5 mg/m ³ TWA 10 mg/m ³ STEL	5 mg/m ³ TWA 10 mg/m ³ STEL

The following are the occupational exposure limits for the components of the product as manufactured.

<u>Ingredient</u>	<u>CAS</u>	<u>Nunavut</u> <u>Northwest Territories</u>	<u>Yukon</u>	<u>Nova Scotia</u> <u>New Brunswick</u> <u>Manitoba</u>
Alumina (Al ₂ O ₃)	1334-28-1	10 mg/m ³ TWA 20 mg/m ³ STEL (as Al metal)	None Established	1 mg/m ³ TWA (respirable fraction) (as aluminum insoluble compounds)
Calcium Carbonate (CaCO ₃)	471-34-1	5 mg/m ³ TWA (respirable) 10 mg/m ³ TWA (total dust)	10 mg/m ³ TWA 20 mg/m ³ STEL	None Established
Calcium Fluoride (CaF ₂) (as fluoride compounds)	7789-75-5	2.5 mg/m ³ TWA 5 mg/m ³ STEL	2.5 mg/m ³ TWA 2.5 mg/m ³ STEL	2.5 mg/m ³ TWA
Chromium (Cr) (as chromium metal)	7440-47-3	0.5 mg/m ³ TWA (as Cr metal) 1.5 mg/m ³ STEL	0.1 mg/m ³ TWA (as Cr metal) 3 mg/m ³ STEL	0.5 mg/m ³ TWA
Copper (Cu) (as copper dust and mist)	7440-50-8	1 mg/m ³ TWA 2 mg/m ³ STEL	1 mg/m ³ TWA 2 mg/m ³ STEL	1 mg/m ³ TWA
Iron (Fe) (as iron oxide)	7439-89-6	5 mg/m ³ TWA (as fume) 10 mg/m ³ STEL	5 mg/m ³ TWA (as fume) 10 mg/m ³ STEL	5 mg/m ³ TWA (respirable dust)
Manganese (Mn) (as Mn and inorganic compounds)	7439-96-5	5 mg/m ³ Ceiling	5mg/m ³ TWA	0.2 mg/m ³ TWA
Manganese Tetraoxide (Mn ₃ O ₄)	1317-35-7	1 mg/m ³ TWA 3 mg/m ³ STEL (as fume)	5 mg/m ³ TWA (as Mn compounds)	0.2 mg/m ³ TWA
Magnesium Oxide	1309-48-4	10 mg/m ³ TWA 20 mg/m ³ STEL (as fume)	10 mg/m ³ TWA 10 mg/m ³ STEL (as magnesium oxide fume)	10 mg/m ³ TWA (inhalable)
Molybdenum (Mo) ¹⁾ (as Mo and insoluble compounds)	7439-98-7	10 mg/m ³ TWA 20 mg/m ³ STEL)	10 mg/m ³ TWA 20 mg/m ³ STEL	3 mg/m ³ TWA respirable 10 mg/m ³ TWA inhalable
Nickel (Ni)	7440-02-0	1 mg/m ³ TWA 2 mg/m ³ STEL	1 mg/m ³ TWA 3 mg/m ³ STEL	1.5 mg/m ³ inhalable
Niobium (Nb) ²⁾	7440-03-1	None Established	None Established	None Established
Potassium (K)	7440-09-7	None Established	None Established	None Established
Sodium (Na)	7440-23-5	None Established	None Established	None Established

Appendix A



<u>Ingredient</u>	<u>CAS</u>	<u>Nunavut</u>	<u>Yukon</u>	<u>Nova Scotia</u>
		<u>Northwest Territories</u>		<u>New Brunswick</u> <u>Manitoba</u>
Silicon (Si)	7440-21-3	5 mg/m3 TWA (respirable) 10 mg/m3 TWA (total dust)	10 mg/m3 TWA 20 mg/m3 STEL	None Established
Silica (SiO ₂) (quartz)	14808-60-7	0.1 mg/m3 TWA (respirable) 0.3 mg/m3 TWA (total dust)	300 particles/mL	0.025 mg/m3 TWA
Titanium Dioxide (TiO ₂)	13463-67-7	5 mg/m3 TWA (respirable) 10 mg/m3 TWA (total dust)	10 mg/m3 TWA 20 mg/m3 STEL	10 mg/m3 TWA
Zirconium (Zr)	7440-67-7	5 mg/m3 TWA 10 mg/m3 STEL	5 mg/m3 TWA 10 mg/m3 STEL	5 mg/m3 TWA 10 mg/m3 STEL
Zirconium Dioxide (ZrO ₂)	1314-23-4	5 mg/m3 TWA 10 mg/m3 STEL	5 mg/m3 TWA 10 mg/m3 STEL	5 mg/m3 TWA 10 mg/m3 STEL

The following are the occupational exposure limits for the typical decomposition products.

GASES			
<u>Fume Constituent</u>	<u>Nunavut</u> <u>Northwest Territories</u>	<u>Yukon</u>	<u>Nova Scotia</u> <u>New Brunswick</u> <u>Manitoba</u>
Carbon Dioxide (CO ₂)	5,000 ppm TWA 15,000 ppm STEL	5,000 ppm TWA, 15,000 ppm STEL	5,000 ppm TWA 30,000 ppm STEL
Carbon Monoxide (CO)	50 ppm TWA 400 ppm STEL	50 ppm TWA 400 ppm STEL	25 ppm TWA
Dinitrogen Tetroxide (N ₂ O ₄)	None Established	None Established	None Established
Hydrogen Fluoride (HF)	3 ppm TWA 6 ppm STEL	3 ppm TWA 3 ppm STEL	0.5 ppm 2 ppm Ceiling Limit
Nitric Oxide (NO)	25 ppm TWA 35 ppm STEL	25 ppm TWA 35 ppm STEL	25 ppm TWA
Nitrogen Dioxide (NO ₂)	3 ppm TWA 5 ppm STEL	5 ppm TWA	3 ppm TWA 5 ppm STEL
Ozone (O ₃)	0.1 ppm TWA 0.3 ppm STEL	0.1 ppm TWA 0.3 ppm STEL	0.1 ppm TWA ***
Phosgene (COCl ₂) *	0.1 ppm TWA 0.3 ppm STEL	0.1 ppm TWA 0.3 ppm STEL	0.1 ppm TWA
Phosphine (PH ₃) **	0.3 ppm TWA 1 ppm STEL	0.3 ppm TWA 1 ppm STEL	0.3 ppm TWA 1 ppm STEL

SOLIDS			
<u>Fume Constituent</u>	<u>Nunavut</u> <u>Northwest Territories</u>	<u>Yukon</u>	<u>Nova Scotia</u> <u>New Brunswick</u> <u>Manitoba</u>

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SOLIDS	Nunavut	Yukon	Nova Scotia
Fume Constituent	Northwest Territories		New Brunswick
			Manitoba
Aluminum Welding fumes	5 mg/m ³ TWA 10 mg/m ³ STEL	5 mg/m ³ TWA 5 mg/m ³ STEL (as welding fumes)	1 mg/m ³ TWA (respirable fraction) (as aluminum insoluble compounds)
Calcium Fluoride (CaF ₂) (as fluoride compounds)	2.5 mg/m ³ TWA 5 mg/m ³ STEL	2.5 mg/m ³ TWA 2.5 mg/m ³ STEL	2.5 mg/m ³ TWA
Chromates (CrO ₃) (CrVI)	0.05 mg/m ³ TWA 0.15 mg/m ³ STEL (soluble or insoluble compounds)	0.1 mg/m ³ TWA 0.1 mg/m ³ STEL (as chromates)	0.05 mg/m ³ TWA (as water soluble comp) 0.01 mg/m ³ TWA (as certain water insoluble comp)
Chromium (III) Compounds	0.5 mg/m ³ TWA 1.5 mg/m ³ STEL	0.15 mg/m ³ TWA 0.15 mg/m ³ STEL	0.5 mg/m ³ TWA
Copper Oxide (CuO) (as copper fume)	0.2 mg/m ³ TWA 0.6 mg/m ³ STEL	0.2 mg/m ³ TWA 0.2 mg/m ³ STEL	0.2 mg/m ³ TWA
Iron Oxide	5 mg/m ³ TWA 10 mg/m ³ STEL (as fume)	5 mg/m ³ TWA 10 mg/m ³ STEL (as fume)	5 mg/m ³ TWA
Manganese Tetraoxide (Mn ₃ O ₄)	5 mg/m ³ TWA	5 mg/m ³ TWA (as Mn compounds)	0.2 mg/m ³ TWA
Magnesium Oxide	10 mg/m ³ TWA 20 mg/m ³ STEL (as fume)	10 mg/m ³ TWA 10 mg/m ³ STEL (as magnesium oxide fume)	10 mg/m ³ TWA (inhalable)
Molybdenum Trioxide (MoO ₃) (as molybdenum insoluble compounds)	10 mg/m ³ TWA 20 mg/m ³ STEL	10 mg/m ³ TWA 20 mg/m ³ STEL	3 mg/m ³ TWA (as respirable) 10 mg/m ³ TWA (inhalable)
Nickel Oxide (NiO) (as nickel soluble compounds)	0.1 mg/m ³ TWA 0.3 mg/m ³ STEL	0.1 mg/m ³ TWA 0.3 mg/m ³ STEL	0.1 mg/m ³ TWA
Niobium Oxide (NbO) ²⁾	None Established	None Established	None Established
Silica (SiO ₂) (quartz)	0.1 mg/m ³ TWA (respirable) 0.3 mg/m ³ TWA (total dust)	300 particles/mL	0.025 mg/m ³ TWA
Sodium Oxide (NaO)	None Established	None Established	None Established
Potassium Oxide (KO)	None Established	None Established	None Established
Titanium Dioxide (TiO ₂)	5 mg/m ³ TWA (respirable) 10 mg/m ³ TWA (total dust)	10 mg/m ³ TWA 20 mg/m ³ STEL	10 mg/m ³ TWA
Zirconium Dioxide	5 mg/m ³ TWA 10 mg/m ³ STEL	5 mg/m ³ TWA 10 mg/m ³ STEL	5 mg/m ³ TWA 10 mg/m ³ STEL

¹⁾ Only in Molybdenum-alloyed grades.

²⁾ Only in Niobium-alloyed grades.