# SAFETY DATA SHEET (SDS)

**NICKEL ALLOY BARE WELDING WIRE & RODS** 



# SECTION 1: IDENTIFICATION OF THE SUBSTANCE / MIXTURE AND OF THE COMPANY / UNDERTAKING

Product Name: 11 Product Specification: Product Identification:

EXECUTIVE Nickel Alloy Bare Welding Wire & Rods AWS A5.7, A5.14, A5.15 & ASME SFA 5.7, 5.14, 5.15 EXECUTIVE 61 (ERNI-1) EXECUTIVE 60 (ERNiCu-7) EXECUTIVE 82 (ERNiCr-3) EXECUTIVE W (ERNiMo-3) EXECUTIVE 72 (ERNiCr-4) EXECUTIVE X (ERNiCrMo-2) EXECUTIVE 622 (ERNiCrMo-10) EXECUTIVE 59 (ERNiCrMo-13) EXECUTIVE 44 (ERNiFeMn-CI EXECUTIVE 55 (No AWS Class) EXECUTIVE 99 (ERNI-CI

EXECUTIVE 825 (ERNiFeCr-1) EXECUTIVE 62 (ERNiCrFe-5) EXECUTIVE 625 (ERNiCrMo-3) EXECUTIVE 686 (ERNiCrMo-14)

EXECUTIVE 718 (ERNiFeCr-2) EXECUTIVE 601 (ERNiCrFe-11) EXECUTIVE C-276 (ERNiCrMo-4) EXECUTIVE 617 (ERNiCrCoMo1) EXECUTIVE 67 (ERCuNi)

1.2 Relevant identified of the substance or mixture and uses advised against:

Use of the substance/mixture: Welding consumables/filler metals

1.3 Details of the supplier of the safety data sheet:

Exocor Ltd. 271 Ridley Road St. Catharines, ON L2S 0B3 Canada Tel: 888-317-2209 Fax: 855-317-2209 www.exocor.com

Emergency telephone number: 888-317-2209

#### SECTION 2: HAZARDOUS IDENTIFICATION

Classification of the substance or mixture 2.1

General Hazard Statement: The product is placed on the market in solid form.

Solid metallic products are generally as "articles" and do not constitute a hazardous material in solid form under the definition of the OSHA Hazard Communication Standard (29 CFR 1910.1200). Any articles manufactured from these solid products would be generally classified as non-hazardous. However, some hazardous elements contained in these products can be emitted under certain processing conditions such as but not limited to: burning, melting, cutting, sawing, brazing, grinding, machining, milling and welding. Products in the solid state present no fire or explosion hazard. The following classification information is for the hazardous elements which may be released during processing.

GHS US classification

Skin Sens. 1 STOT RE 1 Aquatic Chronic 3

H317 H372 H412 Carc. 1B Aquatic Acute 1 H350 H400

2.2 Label elements

**GHS-US** labelling

Hazard Pictograms (GHS-US)







Signal word (GHS-US): Danger Hazard statements (GHS-US): H317 - May cause an allergic skin reaction H350 - May cause cancer H372 - Causes damage to organs through prolonged or repeated exposure H400 - Very toxic to aquatic life H412 - Harmful to aquatic life

Precautionary statements: (GHS-US)

exposure H400 - Very toxic to aquatic life H412 - Harmful to aquatic life with long lasting effects P201 - Obtain special instructions before use P202 - Do not handle until all safety precautions have been read and understood P260 - Do not breathe dust/fume/gas/mist/vapours/spray P261 - Avoid breathing dust/fume/gas/mist/vapours/spray P264 - Wash thoroughly after handling P270 - Do no eat, drink or smoke when using this product P272 -Contaminated work clothing should not be allowed out of the workplace P273 - Avoid release to the environment P280 - Wear protective gloves/protective clothing/eye protection/face protection P302+P352 - IF ON SKIN: Wash with plenty of soap and water P308+P313 - IF exposed or concerned: Get medical advice/attention P314 - Get medical advice and attention if you feel unwell P321 - Specific treatment (see label) P333+P313 - If skin irritation or rash occurs: Get medical advice/attention P362+P364 - Take off contaminated clothing and wash it before reuse P391 - Collect spillage P405 - Store locked up P501 - Dispose of contents/container in accordance with local/regional/national/international

- 2.3 Other hazards: No additional information available
- 2.4 Unknown acute toxicity (GHS-US): No data available

#### SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

- 3.1 Substances: No data available Full text of H-phrases: see section 16
- 3.2 Mixtures: The mixture contains dangerous substances.

Name	Product identifier	%	GHS-US classification
Nickel (Ni)	(CAS No) 7440-02-0	35 - 93	Skin Sens. 1, H317 Carc. 1B, H350 STOT RE 1, H372
Copper (Cu)	(CAS No) 7440-50-8	0.08 - 64.9	Not classified
Chromium (Cr)	(CAS No) 7440-47-3	<= 46	Not classified
Molybdenum (Mo)	(CAS No) 7439-98-7	<= 32	Not classified
Iron (Fe)	(CAS No) 7439-89-6	0.3 - 21	Acute Tox. 4 (Oral), H302
Tungsten (W)	(CAS No) 7440-33-7	<= 15	Not classified
Manganese (Mn)	(CAS No) 7439-96-5	0.03 - 4	Not classified
Silicon (Si)	(CAS No) 7440-21-3	<= 4	Not classified
Titanium (Ti)	(CAS No) 7440-32-6	0.2 - 3.5	Not classified
Vanadium pentoxide (V)	(CAS No) 1314-62-1	<= 0.6	Not classified
Niobium (Nb + Ta)	(CAS No) 7440-03-1	<= 0.6	Not classified

## SECTION 4: FIRST AID MEASURES

4.1 Description of first aid measures:

First-aid measures after inhalation:Remove to fresh air. If not breathing, give artificial respiration. If<br/>breathing is difficult, give oxygen. Get medical attention.First-aid measures after skin contact:Flush with water for at least 15 minutes. Seek medical attention if<br/>irritation develops or persists.First-aid measures after eye contact:Immediately flush eyes with water and continue washing for at least<br/>15 minutes. Obtain medical attention if discomfort persists.First-aid measures after ingestion:Do NOT induce vomiting. Get immediate medical attention.

#### 4.2 Most important symptoms and effects, both acute and delayed

Symptoms/injuries after inhalation:	Short-term (acute) overexposure to the gases, fumes, and dusts may include irritation of the eyes, lungs, nose, and throat. Some toxic gases associated with welding may cause pulmonary edema, asphyxiation, and death. Acute overexposure may include signs and symptoms such as watery eyes, nose and throat irritation, headache, dizziness, difficulty in breathing, frequent coughing, or chest pain. The presence of chromium/chromate in fume can cause irritation of nasal membranes and skin. The presence of nickel compounds in fume can cause metallic taste, nausea, tightness of chest, fever, and allergic reaction. Excessive inhalation or ingestion of manganese can produce manganese poisoning. Overexposure to manganese compounds may affect the central nervous system, symptoms of which are languor, sleepiness, muscular weakness, emotional disturbances, and spastic gait resembling Parkinsonism. These symptoms can become progressive and permanent if not treated. Excessive inhalation of fumes may cause "Metal Fume Fever" with Flu-like symptoms such as chills, fever, body aches, vomiting, sweating, etc.
Symptoms/injuries after skin contact: Symptoms/injuries after eye contact: Symptoms/injuries after ingestion:	Dusts may cause irritation. Causes eye irritation. Not an anticipated route of exposure during normal product handling. May be harmful if ingested.

4.3 Indication of any immediate medical attention and special treatment needed: No data available

#### SECTION 5: FIREFIGHTING MEASURES

5.1 Extinguishing mdeia

Suitable extinguishing media: Unsuitable extinguishing media: Use extinguishing media appropriate for surrounding fire. None

5.2 Special hazards arising from the substance or mixture

Fire hazard: Explosion hazard: Not flammable None known

#### 5.3 Advice for firefighters

Production during firefighting:

Firefighters should wear full protective gear

# SECTION 6: ACCIDENTIAL RELEASE MEASURES

- 6.1 Personal precautions, protective equipment and emergency procedures: For non-emergency personnel: wear appropriate personal protective equipment as specified in Section 8. Ensure adequate ventilation. For emergency responders: No data available
- 6.2 Environmental precautions: Avoid release into the environment. Avoid dispersal of spilled material and contact with soil, ground and surface water drains and sewers.
- 6.3 Methods and material for containment and cleaning up: Take up immediately. Collect the material in labeled containers and dispose of according to local and regional authority requirements.
- 6.4 Reference to other sections: See section 7 for information of safe handling. See section 8 for information on personal protection equipment. See section 13 for disposal information.

#### SECTION 7: HANDLING AND STORAGE

- 7.1 Precautions and safe handling: Welding may produce dust, fumes and gases hazardous to health. Avoid breathing dust, fumes and gases. Use adequate ventilations. Keep away from sources of ignition. Avoid contact with skin, eyes and clothing. Do not eat, drink and smoke in work areas.
- 7.2 Conditions for safe storage, including and incompatibilities: Store in cool, dry and well-ventilated place. Keep away from incompatible materials. Keep away from heat and open flame.
- 7.3 Specific end user(s): For welding consumables and related products.

## **SECTION 8: EXPOSURE CONTROLS / PERSONAL PROTECTOIN**

#### 8.1 Control parameters:

Nickel USA ACGIH USA OSHA	(CAS No. 7440-02-0) ACGIH TWA (mg/m³) OSHA PEL (TWA) (mg/m3)	1.5 mg/m³ 1 mg/m³
Chromium USA ACGIH USA OSHA	(CAS No. 7440-47-3) ACGIH TWA (mg/m³) OSHA PEL (TWA) (mg/m3)	0.5 mg/m³ 1 mg/m³
Copper USA ACGIH USA OSHA	(CAS No. 7440-50-8) ACGIH TWA (mg/m³) OSHA PEL (TWA) (mg/m3)	0.2 mg/m³ 1 mg/m³
Vanadium pentoxide USA ACGIH	(CAS No. 1314-62-1) ACGIH TWA (mg/m³)	0.05 mg/m³
Manganese USA ACGIH USA OSHA	(CAS No. 7439-96-5) ACGIH TWA (mg/m³) OSHA PEL (Ceiling) (mg/m3)	0.1 mg/m³ 5 mg/m³
Molybdenum USA ACGIH	(CAS No. 7439-98-7) ACGIH TWA (mg/m³)	3 mg/m³
Silicon USA OSHA	(CAS No. 7440-21-3) OSHA PEL (TWA) (mg/m3)	5 mg/m³
Tungsten USA ACGIH USA ACGIH	(CAS No. 7440-33-7) ACGIH TWA (mg/m³) ACGIH STEL (mg/m³)	5 mg/m³ 10 mg/m³

#### 8.2 Exposure controls:

Appropriate engineering controls:	Local exhaust and general ventilation must be adequate to meet exposure standards.
Hand protection:	Wear welding gloves.
Eye protection:	Wear helmet or face shield with filter lens of appropriate shade number. See ANSI/ASC Z49.1 Section 4.2. Provide protective screens and flash goggles, if necessary, to shield others.
Skin and body protection:	Wear head and body protection, which help to prevent injury from radiation, sparks, flame and electrical shock. See ANSI Z49.1. At a minimum, this includes welder's

gloves and a protective face shield, and may include arm protectors, aprons, hats, shoulder protection, as well as dark substantial clothing. Train the employee not to touch live electrical parts and to insulate him/herself from work and ground. Welders should not wear short sleeve shirts or short pants.

Respiratory protection:

If exposure limits are exceeded or irritation is experienced, NIOSH approved respiratory protection should be worn.

#### SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties:

Physical state Appearance Color Odor Odor threshold pH Relative evaporation rate (butylacetate=1) Melting point Freezing point Boiling point Flash point Self ignition temperature Decomposition temperature Flammability (solid, gas) Vapour pressure Relative vapour density at 20 °C Relative density Solubility Log Pow Log Kow Viscosity, kinematic Viscosity, dynamic Explosive properties Oxidising properties Explosive limits	Solid Rods or wire Metallic None No data available No data available
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9.2 Other information: No additional information available

# SECTION 10: STABILITY AND REACTIVITY

- 10.1 Reactivity: No additional information available.
- 10.2 Chemical stability: The product is stable at normal handling and storage conditions.
- 10.3 Possibility of hazardous reactions: Will not occur.
- 10.4 Conditions to avoid: None.
- 10.5 Incompatible materials: None.
- 10.6 Hazardous decomposition products:

Welding fumes and gases cannot be classified simply. The composition and quantity of both are dependent upon the metal being welded, the process, procedure and welding consumables used. Other conditions which also influence the composition and quantity of the fumes and gases to which workers may be exposed include: coating on the metal being welded (i.e. paint, painting, galvanizing), the number of welders, the volume of the work area, the quality and the amount of ventilation, the position of the welders head with respect to the fume plume, as well as the presence of contaminants in the atmosphere (such as chlorinated hydrocarbon vapors from the cleaning and degreasing activities).

When an electrode is consumed, the fume and gas decomposition products generated are different in percent and form from the ingredients listed in Section 3. Fume and gas decomposition, and not the ingredients in the electrode, are important. The concentration of a given fume or gas component may decrease or increase by many times the original concentration. Also, new compounds not in the electrodes may form. Decomposition products of normal operation include those originating from the volatilization, reaction or oxidation of the materials shown in Section3, plus those from the base metal coating, etc., as noted above.

Reasonable expected fume constituents of this product would include: Complex oxides of iron, manganese, silicon, chromium, nickel, columbium, molybdenum, copper, carbon dioxide, carbon monoxide, ozone and nitrogen oxides. Some products will also contain antimony, barium, molybdenum, aluminum, columbium, magnesium, strontium, tungsten, and or zirconium. Fume limit for chromium, nickel and or manganese may be reached before limit of 5 mg/m3 of general welding fumes is reached.

Gaseous reaction products may include carbon monoxide and carbon dioxide. Ozone and nitrogen oxides may be formed by the radiation from the arc. Determine the composition and quantity of fumes and gases to which workers are exposed by taking an air sample from inside the welder's helmet if worn or in the worker's breathing zone. Improve ventilation if exposures are not below limits. See ANSI/AWS F1.1, F1.3 and F1.5, available from the American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

# SECTION 11: TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects:

Acute toxicity:	Not classified
Nickel (CAS No. 7440-02-0) LD50 oral rat	> 9000 mg/kg
Iron (CAS No. 7439-89-6) LD50 oral rat ATE (oral)	984 mg/kg 984.000 mg/kg
Vanadium pentoxide (CAS No. 1314-62-1) LD50 oral rat LD50 dermal rabbit LC50 inhalation rat (mg/l)	221.1 - 715.7 mg/kg 50 mg/kg 2.21 mg/l/4h
Manganese (CAS No. 7439-96-5) ATE (oral)	9000000.000 mg/kg
Silicon (CAS No. 7440-21-3) ATE (oral)	3160.000 mg/kg
Skin corrosion/irritation: Serious eye damage/irritation: Respiratory or skin sensitization: Germ cell mutagenicity: Carcinogenicity:	Not classified Not classified May cause an allergic skin reaction. Not classified May cause cancer
Nickel (CAS No. 7440-02-0) IARC group National Toxicity Program (NTP) Status	2B 3
Chromium (CAS No. 7440-47-3) IARC group	3
Vanadium pentoxide (CAS No. 1314-62-1) IARC group National Toxicity Program (NTP)	2B 1

Not classified Not classified

# SECTION 12: ECOLOGICAL INFORMATION

12.1 Toxicity:

Ecology – general:	Very toxic to aquatic life
Nickel (CAS No. 7440-02-0) LC50 fishes 1 EC50 Daphnia 1 EC50 other aquatic organisms 1 LC50 fish 2 EC50 Daphnia 2 EC50 other aquatic organisms 2	<ul> <li>&gt; 100 mg/l (Exposure time: 96 h - Species: Brachydanio rerio)</li> <li>&gt; 100 mg/l (Exposure time: 48 h - Species: Daphnia magna)</li> <li>0.18 mg/l (Exposure time: 72 h - Species: Pseudokirchneriella subcapitata)</li> <li>1.3 mg/l (Exposure time: 96 h - Species: Cyprinus carpio [semi-static])</li> <li>1 mg/l (Exposure time: 48 h - Species: Daphnia magna [Static])</li> <li>0.174 - 0.311 mg/l (Exposure time: 96 h-Species: Pseudokirchneriella subcapitata</li> </ul>
Iron (CAS No. 7439-89-6) LC50 fishes 1 LC50 fish 2	13.6 mg/l (Exposure time: 96 h - Species: Morone saxatilis [static]) 0.56 mg/l (Exposure time: 96 h - Species: Cyprinus carpio [semi-static])
Copper (CAS No. 7440-50-8) LC50 fishes 1 EC50 Daphnia 1 EC50 other aquatic organisms 1 LC50 fish 2 EC50 other aquatic organisms 2	0.0068 - 0.0156 mg/l (Exposure time: 96 h - Species: Pimephales promelas) 0.03 mg/l (Exposure time: 48 h - Species: Daphnia magna [Static]) 0.0426 - 0.0535 mg/l (Exposure time: 72 h - Species: Pseudokirchneriella subcapitata [static]) < 0.3 mg/l (Exposure time: 96 h - Species: Pimephales promelas [static]) 0.031 - 0.054 mg/l (Exposure time: 96 h - Species: Pseudokirchneriella subcapitata [static])
12.2 Persistence and degradability:	No additional information available
12.3. Bioaccumulative potential:	No additional information available
12.4. Mobility in soil:	No additional information available
12.5. Other adverse effects:	No additional

#### SECTION 13: DISPOSAL CONSIDERATION

13.1 Waste treatment methods: Dispose of in accordance with local and regional regulations.

Waste disposal recommendations: Dispose of contents/container in accordance with local/regional/national/international regulations.

# SECTION 14: TRANSPORT INFORMATION

In accordance with DOT / ADR / RID / ADNR / IMDG / ICAO / IATA

- 14.1 UN Number: Not a dangerous good in sense of transport regulations
- 14.2 UN proper shipping name: Not applicable

# SECTION 15: REGULATORY INFORMATION

15.1 US Federal Regulations:

	Nickel (CAS No. 7440-02-0) Listed on the United States TSCA (Toxic Substances Contro (Specific toxic chemical listings) SARA Section 313 - Emission Reporting	ol Act) inventory Listed on SARA Section 313
	Iron (CAS No. 7439-89-6) Listed on the United States TSCA (Toxic Substances Contro	ol Act) inventory
	Chromium (CAS No. 7440-47-3) Listed on the United States TSCA (Toxic Substances Contro (Specific toxic chemical listings) SARA Section 313 - Emission Reporting	ol Act) inventory Listed on SARA Section 313
	Copper (CAS No. 7440-50-8) Listed on the United States TSCA (Toxic Substances Contro (Specific toxic chemical listings) SARA Section 313 - Emission Reporting	ol Act) inventory Listed on SARA Section 313
	Vanadium pentoxide (CAS No. 1314-62-1) Listed on the United States TSCA (Toxic Substances Contro (Specific toxic chemical listings) SARA Section 302 Threshold Planning Quantity (TPQ)	ol Act) inventory Listed on SARA Section 302 ≤ 1000
	Manganese (CAS No. 7439-96-5) Listed on the United States TSCA (Toxic Substances Contro (Specific toxic chemical listings) SARA Section 313 - Emission Reporting	ol Act) inventory Listed on SARA Section 313
	Molybdenum (CAS No. 7439-98-7) Listed on the United States TSCA (Toxic Substances Contro	ol Act) inventory
	Niobium (CAS No. 7440-03-1) Listed on the United States TSCA (Toxic Substances Contro	ol Act) inventory
	Silicon (CAS No. 7440-21-3) Listed on the United States TSCA (Toxic Substances Contro	ol Act) inventory
	Titanium (CAS No. 7440-32-6) Listed on the United States TSCA (Toxic Substances Contro	ol Act) inventory
	Tungsten (CAS No. 7440-33-7) Listed on the United States TSCA (Toxic Substances Contro	ol Act) inventory
15.2	2 US State Regulations:	

Nickel (CAS No. 7440-02-0)

U.S California - Proposition 65 - Carcinogens List	U.S California - Proposition 65 - Developmental Toxicity	U.S California - Proposition 65 - Reproductive Toxicity - Female	U.S California - Proposition 65 - Reproductive Toxicity - Male	No significance risk level (NSRL)
Yes				

Vanadium pentoxide (CAS No. 1314-62-1)

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U.S California - Proposition 65 - Carcinogens List	U.S California - Proposition 65 - Developmental Toxicity	U.S California - Proposition 65 - Reproductive Toxicity - Female	U.S California - Proposition 65 - Reproductive Toxicity - Male	No significance risk level (NSRL)
Yes				

Nickel (CAS No. 7440-02-0)

- U.S. Massachusetts Right To Know List
- U.S. Minnesota Hazardous Substance List
- U.S. New Jersey Right to Know Hazardous Substance List
- U.S. Pennsylvania RTK (Right to Know) List

Chromium (CAS No. 7440-47-3)

- U.S. Massachusetts Right To Know List
- U.S. Minnesota Hazardous Substance List
- U.S. New Jersey Right to Know Hazardous Substance List U.S. Pennsylvania RTK (Right to Know) List

Copper (CAS No. 7440-50-8)

- U.S. Massachusetts Right To Know List
- U.S. Minnesota Hazardous Substance List
- U.S. New Jersey Right to Know Hazardous Substance List U.S. Pennsylvania RTK (Right to Know) List

Vanadium pentoxide (CAS No. 1314-62-1)

U.S. - Massachusetts - Right To Know List

Vanadium pentoxide (CAS No. 1314-62-1)

- U.S. Minnesota Hazardous Substance List
- U.S. New Jersey Right to Know Hazardous Substance List
- U.S. Pennsylvania RTK (Right to Know) List

Manganese (CAS No. 7439-96-5)

- U.S. Massachusetts Right To Know List U.S. Minnesota Hazardous Substance List
- U.S. New Jersey Right to Know Hazardous Substance List
- U.S. Pennsylvania RTK (Right to Know) List

Molybdenum (CAS No. 7439-98-7)

- U.S. Minnesota Hazardous Substance List
- U.S. New Jersey Right to Know Hazardous Substance List U.S. Pennsylvania RTK (Right to Know) List

Silicon (CAS No. 7440-21-3)

- U.S. Massachusetts Right To Know List
- U.S. Minnesota Hazardous Substance List U.S. New Jersey Right to Know Hazardous Substance List
- U.S. Pennsylvania RTK (Right to Know) List

Titanium (CAS No. 7440-32-6)

U.S. - New Jersey - Right to Know Hazardous Substance List

Tungsten (CAS No. 7440-33-7)

U.S. - Massachusetts - Right To Know List

U.S. - Minnesota - Hazardous Substance List

U.S. - New Jersey - Right to Know Hazardous Substance List

U.S. - Pennsylvania - RTK (Right to Know) List

#### SECTION 16: OTHER INFORMATION

We believe that the information contained herein is current as of the date of this SDS. As the condition or methods of use are beyond Exocor's control, we do not assume any responsibility and expressly disclaim any liability for any use of this material. Information contained herein is believed to be true and accurate, but all statements or suggestions are made without any warranty, expressed or implied, regarding the accuracy of the information, the hazard connected with the use of this material or the results to be obtained for use thereof. It is the user's obligation to determine the conditions of safe use of these products.

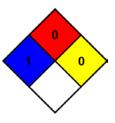
# Full text of H-phrases:

Acute Tox. 4 (Oral)	Acute toxicity (oral) Category 4
Aquatic Acute 1	Hazardous to the aquatic environment - Acute Hazard Category 1
Aquatic Chronic 3	Hazardous to the aquatic environment - Chronic Hazard Category 3
Carc. 1B	Carcinogenicity Category 1B
Skin Sens. 1	Skin sensitisation Category 1
STOT RE 1	Specific target organ toxicity (repeated exposure) Category 1
H302	Harmful if swallowed
H317	May cause an allergic skin reaction
H350	May cause cancer
H372	Causes damage to organs through prolonged or repeated exposure
H400	Very toxic to aquatic life
H412	Harmful to aquatic life with long lasting effects

NAPA health hazard: 1 – Exposure could cause imitation but only minor residual injury even if no treatment is given.
 NAPA fire hazard: 0 – Material that will not burn.

NFPA reactivity:

0 – Normally stable, even under fire exposure conditions and are not reactive with water.



HMIS III Rating

Heath: Flammability: Physical: 2 Moderate Hazard – Temporary or minor injury may occur 0 Minimal Hazard 0 Minimal Hazard