



MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI, European Union and Canadian WHMIS

PART I *What is the material and what do I need to know in an emergency?*

1. PRODUCT IDENTIFICATION

<u>TRADE NAME (AS LABELED):</u>	LITHIUM-7LI HYDROXIDE
<u>CHEMICAL NAME/CLASS:</u>	Alkali Hydroxide
<u>SYNONYMS:</u>	Lithium Hydrate
<u>FORMULA:</u>	⁷ LiOH•H ₂ O
<u>PRODUCT USE:</u>	Various Uses
<u>SUPPLIER/MANUFACTURER'S NAME:</u>	BORON PRODUCTS LLC a Ceradyne Company
<u>ADDRESS:</u>	3250 South 614 Road, Quapaw, OK 74363 PO Box 798, Quapaw, OK 74363
<u>EMERGENCY PHONE:</u>	1-918-673-2201
<u>24 HR EMERGENCY PHONE:</u>	InfoTrac: 1-800-535-5053
<u>TECHNICAL CONTACT PHONE:</u>	1-918-673-2201 (8:00 AM to 4:30 PM, Mon.–Fri.)
<u>EMAIL ADDRESS/COMPETENT PERSON FOR MSDS:</u>	inquiry@ceradyneboron.com
<u>DATE OF PREPARATION:</u>	September 12, 2004
<u>DATE OF REVISION:</u>	August 29, 2010

ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-2004 format. This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR. The product is also classified per all applicable EU Directives through EC 1907: 2006

2. HAZARD IDENTIFICATION

This product is an alkali hydroxide.

EU LABELING AND CLASSIFICATION: A classification by the European Community Council Directives has not yet been published in Annex I. The following is a self-classification, based on currently known properties of this material in ingot form.

EU CLASSIFICATION: [C]: Corrosive EU RISK PHRASES: R: 35

EMERGENCY OVERVIEW : **Product Description:** Lithium Hydroxide Monohydrate is white to off-white, odorless crystals. **Health Hazards:** This product is corrosive and can severely irritate and burn skin, eyes, mucous membranes, and any other contaminated tissues. **Flammability Hazards:** This product is not flammable. If exposed to extremely high temperatures, this product can decompose to generate irritating vapors and toxic gases (e.g., lithium oxides and lithium carbonate). **Reactivity Hazards:** Contact of this product with water may generate some heat. See Section 10 (Stability and Reactivity Hazards). **Environmental Hazards:** Releases to the environment can be harmful or fatal to plants and animals. **Emergency Recommendations:** Persons who respond to releases of this product must protect themselves from inhalation of airborne dusts of Lithium Hydroxide Monohydrate, especially in areas which are downwind of the release. Extreme caution must be used when responding to releases.

3. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	EINECS #	% w/v	EU CLASSIFICATION FOR COMPONENTS
Lithium-7Li Hydroxide Monohydrate	72255-97-1	Unlisted	100%	SELF-CLASSIFICATION HAZARD CLASSIFICATION: C [Corrosive] RISK PHRASES: R: 35

See Section 15 for full EU classification information of product and components.

PART II *What should I do if a hazardous situation occurs?*

4. FIRST-AID MEASURES

Contaminated individual(s) must be taken for medical attention. Rescuers should be taken for medical attention if necessary. Remove or cover gross contamination to avoid exposure to rescuers. Take copy of label and MSDS to physician or other health professional with victim(s). Consult a physician and/or the nearest Poison Control Center for all exposures except minor instances of skin contact.

INHALATION: If exposure to dusts or particulates occurs, remove contaminated individual(s) to fresh air as quickly as possible. Only trained personnel should administer supplemental oxygen and/or cardiopulmonary resuscitation if necessary. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Seek immediate medical attention if adverse effect occurs after removal to fresh air.

4. FIRST-AID MEASURES

SKIN EXPOSURE: If this material contaminates the skin, immediately begin decontamination with running water. Minimum flushing is for 15 minutes. Do not interrupt flushing. Remove exposed or contaminated clothing, taking care not to contaminate eyes. Seek medical attention if any adverse effect occurs after flushing.

EYE EXPOSURE: If this material enters the eyes, open contaminated individual's eyes while under gently running water. Use sufficient force to open eyelids. Have contaminated individual "roll" eyes. Minimum flushing is for 15 minutes. Do not interrupt flushing. Seek medical attention if adverse effect occurs after flushing.

INGESTION: If this product is swallowed, get immediate medical attention or advice. **DO NOT INDUCE VOMITING.** Rinse mouth with water to decontaminate the oral mucosa. If no respiratory compromise is present, dilute immediately with 4 to 8 ounces of milk or water. Never give anything by mouth to a victim who is unconscious or having convulsions. If victim vomits naturally, position head lower than chest area so that aspiration into the lungs cannot occur. Contact a physician or poison control center immediately.

INHALATION: Remove victim(s) to fresh air as quickly as possible. Only trained personnel should administer supplemental oxygen and/or cardiopulmonary resuscitation if necessary. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Seek immediate medical attention.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Skin and respiratory disorders may be aggravated by prolonged overexposure to this product.

RECOMMENDATIONS TO PHYSICIANS: Provide general supportive measures. Prolonged skin irrigation may be required in severe cases, occasionally up to 12 to 24 hours. Debridement of the burn and skin grafting are more successful if performed early, and may prevent delayed necrosis. Experimental treatment for eye contamination has shown that topical applications and subconjunctival injections of 2% ascorbic acid may significantly decrease the incidence of corneal ulcerations and perforations. This treatment was given for 32 days.

5. FIRE-FIGHTING MEASURES

FLASH POINT: Not applicable.

AUTOIGNITION TEMPERATURE: Not applicable.

FLAMMABLE LIMITS (in air by volume, %):

Lower: Not applicable. Upper: Not applicable.

FIRE EXTINGUISHING MATERIALS: Use extinguishing material suitable to the surrounding fire.

FIRE EXTINGUISHING MATERIALS NOT TO BE USED: None known.

UNUSUAL FIRE AND EXPLOSION HAZARDS: This product is corrosive and presents a severe contact hazard to firefighters. If exposed to extremely high temperatures, this product can decompose to generate irritating vapors and toxic gases (e.g., lithium oxides and lithium carbonate). Contact of this product with water may generate some heat. When wet, this product may attack metals such as aluminum, tin, lead, and zinc and produce flammable and explosive hydrogen gas.

Explosion Sensitivity to Mechanical Impact: Not applicable.

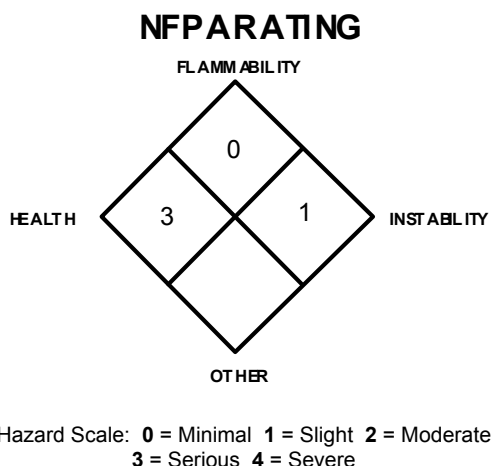
Explosion Sensitivity to Static Discharge: Not applicable.

SPECIAL FIRE-FIGHTING PROCEDURES: Use any method suitable for the surrounding fire and other materials involved. Water can be used to extinguish fire as long as the water is used in flooding amounts and care is taken to not spatter or splash the product. Incipient fire responders should wear eye protection. Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. Chemical resistant clothing may be necessary. Use water spray to keep fire-exposed containers cool. Move containers from fire area if it can be done without risk to personnel. If possible, prevent runoff water from entering storm drains, bodies of water, or other environmentally sensitive areas.

6. ACCIDENTAL RELEASE MEASURES

SPILL RESPONSE: The atmosphere must have levels of the components of this product lower than those listed in Section 8, (Exposure Limits and Personal Protection) and at least 19.5 percent oxygen before personnel can be allowed into the area without Self-Contained Breathing Apparatus (SCBA). Releases of Lithium-7Li Hydroxide Monohydrate can be detected by the use of wet pH paper, which will turn blue upon contact with the released product.

Small Spills: Clean-up spills wearing gloves, goggles and appropriate clothing. If dusts are present, sweep up spilled material or vacuum with explosion-proof vacuum, avoiding generation of dusts. Place spilled material in appropriate container for disposal, sealing tightly. Clean spill area with soap and water.



6. ACCIDENTAL RELEASE MEASURES (Continued)

SPILL RESPONSE (continued):

Large Spills: Clean-up spills wearing gloves, goggles and appropriate clothing. Trained personnel using pre-planned procedures should respond to uncontrolled releases. Proper protective equipment should be used. In case of a spill, clear the affected area, protect people, and respond with trained personnel. Minimum Personal Protective Equipment should be the following: **triple-gloves (rubber gloves and nitrile gloves over latex gloves), chemical resistant suit and boots, hard hat, and Self-Contained Breathing Apparatus.** Monitor the surrounding area for oxygen levels. The atmosphere must have at least 19.5 % oxygen before personnel can be allowed in the area without Self-Contained Breathing Apparatus. Access to the spill area should be restricted. Sweep up or vacuum spilled solid (an explosion-proof vacuum should be used), avoiding the generation of airborne dusts. The dispersal of particles into surrounding air must be avoided. Decontaminate the area thoroughly. All contaminated absorbents and other materials should be placed in an appropriate container and sealed.

Neutralize area with citric acid or other agent suitable for bases. Test area with litmus paper to insure neutralization is complete. Place all spill residue in a double plastic bag or other containment and seal. Decontaminate the area thoroughly. Do not mix with wastes from other materials. Dispose of in accordance with applicable Federal, State, and local procedures (see Section 13, Disposal Considerations). For spills on water, contain, minimize dispersion and collect. Dispose of recovered material and report spill per regulatory requirements.

PART III *How can I prevent hazardous situations from occurring?*

7. HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting this product ON YOU or IN YOU. Wash thoroughly after using this product. Do not eat, smoke, apply cosmetics, or drink while handling this material. Avoid generating airborne dusts of this product. Remove contaminated clothing immediately.

STORAGE AND HANDLING PRACTICES: All employees who handle this material should be trained to handle it safely. Avoid breathing airborne dusts generated by Lithium-7Li Hydroxide Monohydrate. Ensure containers of this product are properly labeled. Store containers in a cool, dry location, away from direct sunlight, sources of intense heat, or where freezing is possible. Open containers slowly on a stable surface. Keep container tightly closed when not in use. Store away from incompatible material. Lithium-7Li Hydroxide Monohydrate emergency equipment should be available near the point of use.

- Workers who handle Lithium-7Li Hydroxide Monohydrate should wear protective clothing, as listed in Section 8 (Exposure Controls - Personal Protection).
- Instant-acting showers should be available in the event of an emergency.
- Special eye-wash fountains or similar equipment should be available for eye irrigation.
- Proper respiratory protection equipment must be provided and workers using such equipment must be carefully trained in its operation and limitations.

Ensure containers of this product are properly labeled. Store containers in a cool, dry location, away from direct sunlight, sources of intense heat, or where freezing is possible. Open containers slowly on a stable surface. Keep container tightly closed when not in use. Store away from incompatible material. Lithium-7Li Hydroxide Monohydrate emergency equipment should be available near the point of use.

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain that application equipment is locked and tagged-out safely, as applicable. Collect all rinsates and dispose of in accordance with U.S. Federal, State and local regulations, those of Canada and its provinces, and those of EU Member States.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation to ensure exposures are below limits provided in this section. Prudent practice is to ensure eyewash/safety shower stations are available near areas where this product is used.

EXPOSURE LIMITS:

CHEMICAL NAME	CAS #	EXPOSURE LIMITS IN AIR							
		ACGIH-TLVs		OSHA-PELs		NIOSH-RELS		NIOSH	OTHER
		TWA ppm	STEL ppm	TWA ppm	STEL ppm	TWA ppm	STEL ppm	IDLH ppm	ppm
Lithium-7Li Hydroxide Monohydrate Currently there are no exposure limits for this compound. The limits given are for Sodium Hydroxide, a related compound	72255-97-1	NE	2 (ceiling)	2	NE	2 (ceiling)	NE	10	NE

INTERNATIONAL EXPOSURE LIMITS FOR COMPONENTS: Currently, there are no international exposure limits for Lithium-7Li Hydroxide Monohydrate. The following are exposure limits in place for the related compound Lithium Hydroxide:

LITHIUM HYDROXIDE:
Japan: OEL = 1 mg/m³, MAY 2006

LITHIUM HYDROXIDE (continued):
New Zealand: STEL = 1 mg/m³, JAN2002

LITHIUM HYDROXIDE (continued):
United Kingdom: STEL = 1 mg/m³, 2005

8. EXPOSURE CONTROLS - PERSONAL PROTECTION (Continued)

The following information on appropriate Personal Protective Equipment is provided to assist employers in complying with OSHA regulations found in 29 CFR Subpart I (beginning at 1910.132), equivalent standards of Canada (including CSA Standard Z94.4-02 and CSA Standard Z94.3-02), standards of EU member states (including EN 529:2005 for respiratory PPE, CEN/TR 15419:2006 for hand protection, and CR 13464:1999 for face/eye protection. Please reference applicable regulations and standards for relevant details.

RESPIRATORY PROTECTION: Maintain airborne contaminant concentrations below exposure limits listed above if applicable. If necessary, refer to U.S. OSHA 29 CFR 1910.133, the European Standard CR 13464:1999 and the Canadian CSA Standard Z94.3-M1982, *Industrial Eye and Face Protectors* for further information. Use of NIOSH-approved respirator with a protection factor of 50 or greater with P100 or more is micron size is less than 10 microns. 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). The following are NIOSH respiratory guidelines for the related compound, Sodium Hydroxide.

SODIUM HYDROXIDE

CONCENTRATION

Up to 10 mg/m³:

RESPIRATORY PROTECTION

Supplied Air Respirator (SAR) operated in a continuous flow mode; full facepiece respirator with high-efficiency particulate filter(s); powered air-purifying respirator with dust and mist filter(s); full-facepiece Self-Contained Breathing Apparatus (SCBA); or full-facepiece SAR.

Emergency or Planned Entry into Unknown Concentrations or IDLH Conditions: Positive pressure, full-facepiece SCBA or positive pressure, full-facepiece SAR with an auxiliary positive pressure SCBA.

Escape: Full-facepiece respirator with high-efficiency particulate filter(s) or escape-type SCBA.

EYE PROTECTION: Splash goggles or safety glasses. If necessary, refer to U.S. OSHA 29 CFR 1910.133, the European Standard CR 13464:1999 and the Canadian CSA Standard Z94.3-M1982, *Industrial Eye and Face Protectors* for further information.

HAND PROTECTION: Wear puncture resistant gloves when using this material. Lightweight nitrile or natural rubber gloves are not recommended. Check gloves for leaks prior to use. If necessary, refer to U.S. OSHA 29 CFR 1910.138, the European Standard DIN EN 374, the European Standard CEN/TR 15419:2006 and Standards of Canada for further information.

BODY PROTECTION: Use body protection appropriate for task. If necessary, refer to appropriate Standards of Canada or the European DIN EN 465 for other requirements. If necessary, refer to the OSHA Technical Manual (Section VII: Personal Protective Equipment) or appropriate Standards of Canada. If a hazard of injury to the feet exists due to falling objects, rolling objects, where objects may pierce the soles of the feet or where employee's feet may be exposed to electrical hazards, use foot protection, as described in U.S. OSHA 29 CFR 1910.136 and the Canadian CSA Standard Z195-M1984, *Protective Footwear*.

9. PHYSICAL and CHEMICAL PROPERTIES

EVAPORATION RATE (nBuAc = 1): Not applicable. **VAPOR DENSITY:** Not applicable.

SPECIFIC GRAVITY (water = 1): 1.51

MELTING/FREEZING POINT: 471°C (880°F) [anhydrous form]

SOLUBILITY IN WATER: Soluble.

BOILING POINT: 924°C (1695°F) [anhydrous form]

VAPOR PRESSURE: Not applicable.

pH: Approximately 14 (1N solution)

ODOR THRESHOLD: Odorless.

MOLECULAR WEIGHT: 42.0375

COEFFICIENT OF OIL/WATER DISTRIBUTION (PARTITION COEFFICIENT): Not available.

APPEARANCE, ODOR AND COLOR: Lithium Hydroxide Monohydrate is white to off-white, odorless crystals.

HOW TO DETECT THIS SUBSTANCE (warning properties): Wet litmus paper will turn blue upon contact with this material.

10. STABILITY and REACTIVITY

STABILITY: Can react slowly with carbon dioxide in air and form lithium carbonate.

DECOMPOSITION PRODUCTS: If exposed to extremely high temperatures, this product can decompose to generate irritating vapors and toxic gases (e.g., lithium oxides and lithium carbonate).

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: This product is not compatible with carbon dioxide, strong acids, aluminum, zinc, and strong oxidizers.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Contact with incompatible chemicals.

PART IV *Is there any other useful information about this material?*

11. TOXICOLOGICAL INFORMATION

SYMPTOMS OF OVEREXPOSURE BY ROUTE OF EXPOSURE: The most significant routes of overexposure for this product are skin and eye contact. The symptoms of overexposure to this product, via route of exposure are as follows:

INHALATION: Inhalation of airborne dusts of this product can severely irritate and burn the nose, mouth, throat, and other tissues of the respiratory system. Inhalation overexposure may cause a life threatening accumulation of fluid in the lungs (pulmonary edema) and ulceration of nasal passages. Effects of inhalation may be delayed. Chronic overexposure may cause obstructive airway disease.

11. TOXICOLOGICAL INFORMATION (Continued)

CONTACT WITH SKIN or EYES: Skin contact with Lithium Hydroxide Monohydrate can cause severe burns, ulceration, and permanent scarring. Skin damage may not be apparent until many hours following exposure, as alkali compounds penetrate the skin slowly. Chronic exposure to low levels can cause dermatitis.

CONTACT WITH SKIN or EYES (continued): Eye contact with the solid or a concentrated solution can disintegrate the corneal and conjunctival epithelia and cause corneal opacification. Symptoms can include scarring, blistering, ulceration, clouding of the eye tissue, and blindness. Delayed effects may include glaucoma and cataracts.

SKIN ABSORPTION: Skin absorption is not known to be a route of exposure for this product

INGESTION: Ingestion of Lithium-7Li Hydroxide Monohydrate can irritate, burn, and damage the tissues of the mouth, throat, esophagus, and other tissues of the digestive system. Symptoms may include burning pain, vomiting, diarrhea, hyper-salivation, shortness of breath, potential glottic edema with respiratory compromise, and collapse. Concentrated solutions of Lithium-7Li Hydroxide Monohydrate can cause perforation of the stomach or gastrointestinal tract and corrosion and necrosis of the lips, mouth, tongue, pharynx, esophagus, and gastric mucosa. Ingestion of Lithium-7Li Hydroxide Monohydrate can be fatal.

INJECTION: Injection is not a significant route of exposure for this product.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in **Lay Terms.**

ACUTE: This product is corrosive, and can burn and damage eyes, skin, mucous membranes, and any other exposed tissue. Inhalation and ingestion overexposure can be fatal. Skin contact can cause ulceration and permanent scarring. Eye contact can cause blindness.

CHRONIC: Chronic inhalation overexposure may cause obstructive airway disease. Chronic skin exposure to low levels can cause dermatitis.

TARGET ORGANS: ACUTE: Skin, eyes, respiratory system. CHRONIC: Skin, respiratory system.

TOXICITY DATA: Currently, there are no specific toxicology data currently available for Lithium-7Li Hydroxide Monohydrate. The following are toxicological data for the related compound, Lithium Hydroxide:

LITHIUM HYDROXIDE:

LC₅₀ (inhalation, rat) = 960 mg/m³/4 hours; Lungs, Thorax, or Respiration: other changes
LD₅₀ (oral, rat) = 210 mg/kg; Behavioral: somnolence (general depressed activity), convulsions or effect on seizure threshold; Nutritional and Gross Metabolic: weight loss or decreased weight gain

LITHIUM HYDROXIDE (continued):

LD₅₀ (intratracheal, rat) = 8200 µg/kg; Lungs, Thorax, or Respiration: other changes; Blood: hemorrhage
LD₅₀ (oral, mouse) = 363 mg/kg; Behavioral: somnolence (general depressed activity), convulsions or effect on seizure threshold; Nutritional and Gross Metabolic: weight loss or decreased weight gain
LDLo (subcutaneous, mouse) = 300 mg/kg

LITHIUM HYDROXIDE (continued):

TDLo (oral, mammal) = 9100 µg/kg/26 weeks/intermittent; Liver: liver function tests impaired; Blood: pigmented or nucleated red blood cells; Nutritional and Gross Metabolic: weight loss or decreased weight gain
TCLo (inhalation, mammal) = 8 mg/m³/4 hours/30 days/intermittent; Lungs, Thorax, or Respiration: other changes

CARCINOGENIC POTENTIAL: This material is not found on the following lists: FEDERAL OSHA Z LIST, NTP, IARC, and CAL/OSHA, and therefore is neither considered to be nor suspected to be cancer-causing agents by these agencies.

IRRITANCY OF PRODUCT: This product is severely irritating and corrosive to all contaminated tissue.

SENSITIZATION TO THE PRODUCT: Lithium-7Li Hydroxide Monohydrate is not known to be a human skin or respiratory sensitizer.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of this gas on the human reproductive system.

Mutagenicity: Lithium-7Li Hydroxide Monohydrate is not reported to cause reproductive effects in humans.

Embryotoxicity: Lithium-7Li Hydroxide Monohydrate is not reported to produce embryotoxic effects in humans.

Teratogenicity: Lithium-7Li Hydroxide Monohydrate is not reported to cause teratogenic effects in humans.

Reproductive Toxicity: Lithium-7Li Hydroxide Monohydrate is not reported to cause reproductive effects in humans.

A **mutagen** is a chemical that causes permanent changes to genetic material (DNA) such that the changes will propagate through generational lines. An **embryotoxin** is a chemical that causes damage to a developing embryo (i.e. within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A **teratogen** is a chemical that causes damage to a developing fetus, but the damage does not propagate across generational lines. A **reproductive toxin** is any substance that interferes in any way with the reproductive process.

BIOLOGICAL EXPOSURES INDICES (BEIs): Currently, there are no Biological Exposure Indices (BEIs) applicable to this product.

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM

HEALTH HAZARD	(BLUE)	3
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FLAMMABILITY HAZARD	(RED)	0
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PHYSICAL HAZARD	(YELLOW)	1
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PROTECTIVE EQUIPMENT

EYES	RESPIRATORY	HANDS	BODY
SEE SECTION 8			

For Routine Industrial Use and Handling Applications

Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate
3 = Serious 4 = Severe * = Chronic hazard

12. ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.

MOBILITY: This product has not been tested for mobility in soil. It is not expected to be mobile.

PERSISTENCE AND BIODEGRADABILITY: No specific data are available this material; however, zinc compounds do not readily biodegrade and may remain in sediments indefinitely.

BIO-ACCUMULATION POTENTIAL: This product has not been tested for bio-accumulation potential.

ECOTOXICITY: This product has not been tested for aquatic or animal toxicity. All release to terrestrial, atmospheric and aquatic environments should be avoided.

OTHER ADVERSE EFFECTS: This compound is not listed as having ozone depletion potential.

EFFECT OF CHEMICAL ON AQUATIC LIFE: This material would be harmful or fatal to aquatic life.

ENVIRONMENTAL EXPOSURE CONTROLS: Controls should be engineered to prevent release to the environment, including procedures to prevent spills, atmospheric release and release to waterways.

13. DISPOSAL CONSIDERATIONS

DISPOSAL METHODS: It is the responsibility of the generator to determine at the time of disposal whether the product meets the criteria of a hazardous waste per regulations of the area in which the waste is generated and/or disposed of. Waste disposal must be in accordance with appropriate Federal, State, and local regulations. This product, if unaltered by use, may be disposed of by treatment at a permitted facility or as advised by your local hazardous waste regulatory authority. Shipment of wastes must be done with appropriately permitted and registered transporters.

DISPOSAL CONTAINERS: Waste materials must be placed in and shipped in appropriate 5-gallon or 55 gallon poly or metal waste pails or drums. Permeable cardboard containers are not appropriate and should not be used. Ensure that any required marking or labeling of the containers be done to all applicable regulations.

PRECAUTIONS TO BE FOLLOWED DURING WASTE HANDLING: Wear proper protective equipment when handling waste materials. Dispose of in accordance with applicable Federal, State, and local procedures and standards.

EPA WASTE NUMBER: D002 (Characteristic/Corrosivity) applicable to wastes only of this product.

EUROPEAN WC WASTE CODE: 16 01 99 (Wastes Not Otherwise Specified)

14. TRANSPORTATION INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION REGULATIONS: This product is classified as dangerous goods, per U.S. DOT regulations, under 49 CFR 172.101.

<u>PROPER SHIPPING NAME</u> :	Lithium Hydroxide
<u>HAZARD CLASS NUMBER and DESCRIPTION</u> :	Class 8 (Corrosive)
<u>UN IDENTIFICATION NUMBER</u> :	UN 2680
<u>DOT LABEL(S) REQUIRED</u> :	Class 8 (Corrosive)
<u>PACKAGING GROUP</u> :	II
<u>EMERGENCY RESPONSE GUIDEBOOK NUMBER (2004)</u> :	154
<u>MARINE POLLUTANT</u> :	Not applicable (49 CFR 172.101, Appendix B).

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: This product is classified as Dangerous Goods, per regulations of Transport Canada. The use of the above U.S. DOT information from the U.S. 49 CFR regulations is allowed for shipments that originate in the U.S. For shipments via ground vehicle or rail that originate in Canada, the following information is applicable.

<u>PROPER SHIPPING NAME</u> :	Lithium Hydroxide
<u>HAZARD CLASS NUMBER and DESCRIPTION</u> :	Class 8 (Corrosive)
<u>UN IDENTIFICATION NUMBER</u> :	UN 2680
<u>PACKING GROUP</u> :	II
<u>HAZARD LABEL(S) REQUIRED</u> :	Class 8 (Corrosive)
<u>SPECIAL PROVISIONS</u> :	None
<u>EXPLOSIVE LIMIT & LIMITED QUANTITY INDEX</u> :	1
<u>ERAP INDEX</u> :	None
<u>PASSENGER CARRYING SHIP INDEX</u> :	None
<u>PASSENGER CARRYING ROAD OR RAIL VEHICLE INDEX</u> :	15
<u>MARINE POLLUTANT</u> :	This product is not a Marine Pollutant under Transport Canada regulations.

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA): This product is classified, by rules of IATA, as follows:

<u>PROPER SHIPPING NAME</u> :	Lithium Hydroxide
<u>HAZARD CLASS NUMBER and DESCRIPTION</u> :	Class 8 (Corrosive)
<u>UN IDENTIFICATION NUMBER</u> :	UN 2680
<u>PACKING GROUP</u> :	II
<u>HAZARD LABEL(S) REQUIRED</u> :	Class 8 (Corrosive)
<u>PASSENGER & CARGO AIRCRAFT PACKING INSTRUCTION</u> :	814
<u>PASSENGER & CARGO AIRCRAFT MAXIMUM NET QUANTITY/PKG</u> :	15 kg
<u>CARGO AIRCRAFT ONLY PACKING INSTRUCTION</u> :	816
<u>CARGO AIRCRAFT ONLY MAXIMUM NET QUANTITY/PKG</u> :	50 kg
<u>SPECIAL PROVISIONS</u> :	None
<u>ERG CODE</u> :	8L

14. TRANSPORTATION INFORMATION (Continued)

INTERNATIONAL MARITIME ORGANIZATION (IMO): This product is classified as follows, per rules of the IMO.

<u>UN IDENTIFICATION NUMBER:</u>	UN 2680
<u>PROPER SHIPPING NAME:</u>	Lithium Hydroxide
<u>CLASS:</u>	8
<u>SUBSIDIARY RISK:</u>	None
<u>PACKING GROUP:</u>	II
<u>SPECIAL PROVISIONS:</u>	None
<u>HAZARD LABEL(S) REQUIRED:</u>	Class 8 (Corrosive)
<u>LIMITED QUANTITIES:</u>	1 kg
<u>PACKING INSTRUCTION:</u>	P002
<u>EmS:</u>	F-A, S-B
<u>STOWAGE AND SEGREGATION:</u>	Category A.

EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD (ADR): This is classified as follows, per regulations of the U.N. Economic Commission for Europe.

<u>UN NUMBER:</u>	UN 2680
<u>NAME AND DESCRIPTION:</u>	Lithium Hydroxide
<u>CLASS:</u>	8
<u>CLASSIFICATION CODE:</u>	C6
<u>PACKING GROUP:</u>	II
<u>LABELS:</u>	8
<u>SPECIAL PROVISIONS:</u>	None
<u>LIMITED QUANTITIES:</u>	LQ23
<u>PACKING INSTRUCTION:</u>	P002, IBC08
<u>MIXED PACKING INSTRUCTION:</u>	MP10
<u>HAZARD IDENTIFICATION NUMBER:</u>	80

15. REGULATORY INFORMATION**ADDITIONAL U.S. REGULATIONS:**

U.S. SARA REPORTING REQUIREMENTS: Lithium-7Li Hydroxide Monohydrate is not subject to the reporting requirements of Sections 302, 304, and 313 of Title III of the Superfund Amendments and Reauthorization Act.

U.S. SARA 302 EXTREMELY HAZARDOUS THRESHOLD PLANNING QUANTITY: Not applicable.

U.S. SARA 304 EXTREMELY HAZARDOUS REPORTABLE QUANTITY (RQ): Not applicable.

U.S. CERCLA REPORTABLE QUANTITY (RQ): D002 Unlisted Hazardous Wastes Characteristic of Corrosivity = 100 lb (45.4 kg).

U.S. TSCA INVENTORY STATUS: Lithium-7Li Hydroxide Monohydrate is produced under a LVE in compliance with TSCA regulations.

OTHER U.S. FEDERAL REGULATIONS: Not applicable.

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): Lithium-7Li Hydroxide Monohydrate is not on the California Proposition 65 Lists.

ANSI LABELING (Z129.1; Provided to Summarize Occupational Hazard Information): **DANGER! CORROSIVE. CAUSES EYE, SKIN, GASTROINTESTINAL TRACT, AND RESPIRATORY TRACT BURNS.** Do not taste or swallow. Do not get on skin, in eyes, or on clothes. Do not breathe airborne dusts. Keep container closed. Use only with adequate ventilation. Wash thoroughly after handling. Wear gloves and goggles. Use in accordance with the Material Safety Data Sheet.

FIRST-AID:

IF INHALED, remove to fresh air. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, give oxygen. Call a physician.

IN CASE OF CONTACT, immediately flush eyes or skin with water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician. Wash clothing before reuse. (Discard contaminated shoes).

DO NOT REMOVE THIS PRODUCT LABEL.

ADDITIONAL CANADIAN REGULATIONS:

CANADIAN DSL/NDSL INVENTORY: Lithium-7Li Hydroxide Monohydrate is not listed on the DSL or NDSL Inventories. The related material Lithium Hydroxide is listed on the DSL Inventory.

OTHER CANADIAN REGULATIONS: Not applicable.

CANADIAN ENVIRONMENTAL PROTECTION AGENCY (CEPA) PRIORITY SUBSTANCES LISTS: This material is not on the CEPA Priorities Substances Lists.

15. REGULATORY INFORMATION (Continued)

ADDITIONAL CANADIAN REGULATIONS (continued):

CANADIAN WHMIS CLASSIFICATION and SYMBOLS: Class E: Corrosive



ADDITIONAL EUROPEAN UNION INFORMATION:

EU LABELING AND CLASSIFICATION: This product is considered to be dangerous according to current European Community Guidelines. This product meets the definition of EU Hazard Class C (Corrosive).

EU CLASSIFICATION: C [Corrosive]

EU RISK PHRASES: [R: 35]: Cause severe burns.

EU SAFETY PHRASES: [S: 1/2]: Keep locked up and out of reach of children. (*This safety phrase can be omitted from the label when the substance or preparation is sold for industrial use only.*) [S: 26]: In case of contact with the eyes, rinse immediately with plenty of water. [S: 37/39]: Wear suitable gloves and eye/face protection. [S: 45]: In case of accident or if you feel unwell, seek medical advice immediately (show label where possible).

EU CLASSIFICATION SYMBOLS:



16. OTHER INFORMATION

ORIGINAL MSDS PREPARED BY:

CHEMICAL SAFETY ASSOCIATES, INC.

PO Box 3519, La Mesa, CA 91944-3519 (800) 441-3365 • (619) 670-0609

UPDATE PREPARED BY:

BORON PRODUCTS, LLC

The information contained herein is furnished without warranty of any kind. Persons using this product should consider these data only as a supplement to other information gathered by them and must make independent determinations of suitability and completeness of information from all sources to assure proper use and disposal of this material, the safety of health of employees and customers and the protection of the environment.

DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these, which are commonly used, include the following:

CAS #: This is the Chemical Abstract Service Number that uniquely identifies each constituent.

EXPOSURE LIMITS IN AIR:

CEILING LEVEL: The concentration that shall not be exceeded during any part of the working exposure.

DFG MAK Germ Cell Mutagen Categories: **1:** Germ cell mutagens which have been shown to increase the mutant frequency in the progeny of exposed humans. **2:** Germ cell mutagens which have been shown to increase the mutant frequency in the progeny of exposed mammals.

3A: Substances which have been shown to induce genetic damage in germ cells of human or animals, or which produce mutagenic effects in somatic cells of mammals *in vivo* and have been shown to reach the germ cells in an active form. **3B:** Substances which are suspected of being germ cell mutagens because of their genotoxic effects in mammalian somatic cell *in vivo*; in exceptional cases, substances for which there are no *in vivo* data, but which are clearly mutagenic *in vitro* and structurally related to known *in vivo* mutagens. **4:** Not applicable (Category 4 carcinogenic substances are those with non-genotoxic mechanisms of action. By definition, germ cell mutagens are genotoxic. Therefore, a Category 4 for germ cell mutagens cannot apply. At some time in the future, it is conceivable that a Category 4 could be established for genotoxic substances with primary targets other than DNA [e.g. purely aneugenic substances] if research results make this seem sensible.) **5:** Germ cell mutagens, the potency of which is considered to be so low that, provided the MAK value is observed, their contribution to genetic risk for humans is expected not to be significant.

DFG MAK Pregnancy Risk Group Classification: **Group A:** A risk of damage to the developing embryo or fetus has been unequivocally demonstrated. Exposure of pregnant women can lead to damage of the developing organism, even when MAK and BAT (Biological Tolerance Value for Working Materials) values are observed. **Group B:** Currently available information indicates a risk of damage to the developing embryo or fetus must be considered to be probable. Damage to the developing organism cannot be excluded when pregnant women are exposed, even when MAK and BAT values are observed. **Group C:** There is no reason to fear a risk of damage to the developing embryo or fetus when MAK and BAT values are observed. **Group D:** Classification in one of the groups A-C is not yet possible because, although the data available may indicate a trend, they are not sufficient for final evaluation.

IDLH-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.

LOQ: Limit of Quantitation.

MAK: Federal Republic of Germany Maximum Concentration Values in the workplace.

NE: Not Established. When no exposure guidelines are established, an entry of NE is made for reference.

NIC: Notice of Intended Change.

NIOSH CEILING: The exposure that shall not be exceeded during any part of the workday. If instantaneous monitoring is not feasible, the ceiling shall be assumed as a 15-minute TWA exposure (unless otherwise specified) that shall not be exceeded at any time during a workday.

NIOSH RELS: NIOSH's Recommended Exposure Limits.

EXPOSURE LIMITS IN AIR (continued):

PEL-Permissible Exposure Limit: OSHA's Permissible Exposure Limits. This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA. The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (Federal Register: 58: 35338-35351 and 58: 40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL," is placed next to the PEL that was vacated by Court Order.

SKIN: Used when there is a danger of cutaneous absorption.

STEL-Short Term Exposure Limit: Short Term Exposure Limit, usually a 15-minute time-weighted average (TWA) exposure that should not be exceeded at any time during a workday, even if the 8-hr TWA is within the TLV-TWA, PEL-TWA or REL-TWA.

TLV-Threshold Limit Value: An airborne concentration of a substance that represents conditions under which it is generally believed that nearly all workers may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour.

TWA-Time Weighted Average: Time Weighted Average exposure concentration for a conventional 8-hr (TLV, PEL) or up to a 10-hr (REL) workday and a 40-hr workweek.

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS:

This rating system was developed by the National Paint and Coating Association and has been adopted by industry to identify the degree of chemical hazards.

HEALTH HAZARD:

0 (Minimal Hazard): No significant health risk, irritation of skin or eyes not anticipated. *Skin Irritation:* Essentially non-irritating. PII or Draize = "0". *Eye Irritation:* Essentially non-irritating, or minimal effects which clear in < 24 hours [e.g. mechanical irritation]. Draize = "0". *Oral Toxicity LD₅₀ Rat:* < 5000 mg/kg. *Dermal Toxicity LD₅₀ Rat or Rabbit:* < 2000 mg/kg. *Inhalation Toxicity 4-hrs LC₅₀ Rat:* < 20 mg/L; **1 (Slight Hazard):** Minor reversible injury may occur; slightly or mildly irritating. *Skin Irritation:* Slightly or mildly irritating. *Eye Irritation:* Slightly or mildly irritating. *Oral Toxicity LD₅₀ Rat:* > 500-5000 mg/kg. *Dermal Toxicity LD₅₀ Rat or Rabbit:* > 1000-2000 mg/kg. *Inhalation Toxicity LC₅₀ 4-hrs Rat:* > 2-20 mg/L; **2 (Moderate Hazard):** Temporary or transitory injury may occur. *Skin Irritation:* Moderately irritating; primary irritant; sensitizer. PII or Draize > 0, < 5. *Eye Irritation:* Moderately to severely irritating and/or corrosive; reversible corneal opacity; corneal involvement or irritation clearing in 8-21 days. Draize > 0, ≤ 25. *Oral Toxicity LD₅₀ Rat:* > 50-500 mg/kg. *Dermal Toxicity LD₅₀ Rat or Rabbit:* > 200-1000 mg/kg. *Inhalation Toxicity LC₅₀ 4-hrs Rat:* > 0.5-2 mg/L; **3 (Serious Hazard):** Major injury likely unless prompt action is taken and medical treatment is given; high level of toxicity; corrosive. *Skin Irritation:* Severely irritating and/or corrosive; may destroy dermal tissue, cause skin burns, dermal necrosis. PII or Draize > 5-8 with destruction of tissue. *Eye Irritation:* Corrosive, irreversible destruction of ocular tissue; corneal involvement or irritation persisting for more than 21 days. Draize > 80 with effects irreversible in 21 days. *Oral Toxicity LD₅₀ Rat:* > 1-50 mg/kg. *Dermal Toxicity LD₅₀ Rat or Rabbit:* > 20-200 mg/kg. *Inhalation Toxicity LC₅₀ 4-hrs Rat:* > 0.05-0.5 mg/L; **4 (Severe Hazard):** Life-threatening; major or permanent damage may result from single or repeated exposure. *Skin Irritation:* Not appropriate. Do not rate as a "4", based on skin irritation alone. *Eye Irritation:* Not appropriate. Do not rate as a "4", based on eye irritation alone. *Oral Toxicity LD₅₀ Rat:* ≤ 1 mg/kg. *Dermal Toxicity LD₅₀ Rat or Rabbit:* ≤ 20 mg/kg. *Inhalation Toxicity LC₅₀ 4-hrs Rat:* ≤ 0.05 mg/L.

DEFINITIONS OF TERMS (Continued)

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS (continued):

FLAMMABILITY HAZARD:

0 (Minimal Hazard-Materials that will not burn in air when exposure to a temperature of 815.5°C [1500°F] for a period of 5 minutes.); **1** (Slight Hazard-Materials that must be pre-heated before ignition can occur. Material require considerable pre-heating, under all ambient temperature conditions before ignition and combustion can occur. Including: Materials that will burn in air when exposed to a temperature of 815.5°C (1500°F) for a period of 5 minutes or less; Liquids, solids and semisolids having a flash point at or above 93.3°C [200°F] (e.g. OSHA Class IIIB, or; Most ordinary combustible materials [e.g. wood, paper, etc.]); **2** (Moderate Hazard-Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur. Materials in this degree would not, under normal conditions, form hazardous atmospheres in air, but under high ambient temperatures or moderate heating may release vapor in sufficient quantities to produce hazardous atmospheres in air. Including: Liquids having a flash-point at or above 37.8°C [100°F]; Solid materials in the form of course dusts that may burn rapidly but that generally do not form explosive atmospheres; Solid materials in a fibrous or shredded form that may burn rapidly and create flash fire hazards (e.g. cotton, sisal, hemp; Solids and semisolids that readily give off flammable vapors.); **3** (Severe Hazard-Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures, or, unaffected by ambient temperature, are readily ignited under almost all conditions, including: Liquids having a flash point below 22.8°C [73°F] and having a boiling point at or above 38°C [100°F] and below 37.8°C [100°F] [e.g. OSHA Class IB and IC]; Materials that on account of their physical form or environmental conditions can form explosive mixtures with air and are readily dispersed in air [e.g., dusts of combustible solids, mists or droplets of flammable liquids]; Materials that burn extremely rapidly, usually by reason of self-contained oxygen [e.g. dry nitrocellulose and many organic peroxides]); **4** (Severe Hazard-Materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air, and which will burn readily, including: Flammable gases; Flammable cryogenic materials; Any liquid or gaseous material that is liquid while under pressure and has a flash point below 22.8°C [73°F] and a boiling point below 37.8°C [100°F] [e.g. OSHA Class IA; Material that ignite spontaneously when exposed to air at a temperature of 54.4°C [130°F] or below [e.g. pyrophoric].

PHYSICAL HAZARD:

0 (Water Reactivity: Materials that do not react with water. *Organic Peroxides*: Materials that are normally stable, even under fire conditions and will not react with water. *Explosives*: Substances that are Non-Explosive. *Unstable Compressed Gases*: No Rating. *Pyrophorics*: No Rating. *Oxidizers*: No "0" rating allowed. *Unstable Reactives*: Substances that will not polymerize, decompose, condense or self-react.); **1** (Water Reactivity: Materials that change or decompose upon exposure to moisture. *Organic Peroxides*: Materials that are normally stable, but can become unstable at high temperatures and pressures. These materials may react with water, but will not release energy. *Explosives*: Division 1.5 & 1.6 substances that are very insensitive explosives or that do not have a mass explosion hazard. *Compressed Gases*: Pressure below OSHA definition. *Pyrophorics*: No Rating. *Oxidizers*: Packaging Group III; *Solids*: any material that in either concentration tested, exhibits a mean burning time less than or equal to the mean burning time of a 3:7 potassium bromate/cellulose mixture and the criteria for Packing Group I and II are not met. *Liquids*: any material that exhibits a mean pressure rise time less than or equal to the pressure rise time of a 1:1 nitric acid (65%) cellulose mixture and the criteria for Packing Group I and II are not met. *Unstable Reactives*: Substances that may decompose, condense or self-react, but only under conditions of high temperature and/or pressure and have little or no potential to cause significant heat generation or explosive hazard. Substances that readily undergo hazardous polymerization in the absence of inhibitors.); **2** (Water Reactivity: Materials that may react violently with water. *Organic Peroxides*: Materials that, in themselves, are normally unstable and will readily undergo violent chemical change, but will not detonate. These materials may also react violently with water. *Explosives*: Division 1.4 – Explosive substances where the explosive effect are largely confined to the package and no projection of fragments of appreciable size or range are expected. An external fire must not cause virtually instantaneous explosion of almost the entire contents of the package. *Compressed Gases*: Pressurized and meet OSHA definition but < 514.7 psi absolute at 21.1°C (70°F) [500 psig]. *Pyrophorics*: No Rating. *Oxidizers*: Packaging Group II *Solids*: any material that, either in concentration tested, exhibits a mean burning time of less than or equal to the mean burning time of a 2:3 potassium bromate/cellulose mixture and the criteria for Packing Group I are not met. *Liquids*: any material that exhibits a mean pressure rise time less than or equal to the pressure rise of a 1:1 aqueous sodium chlorate solution (40%) cellulose mixture and the criteria for Packing Group I are not met. *Unstable Reactives*: Substances that may polymerize, decompose, condense, or self-react at ambient temperature and/or pressure, but have a low potential for significant heat generation or explosion. Substances that readily form peroxides upon exposure to air or oxygen at room temperature); **3** (Water Reactivity: Materials that may form explosive reactions with water. *Organic Peroxides*: Materials that are capable of detonation or explosive reaction, but require a strong initiating source, or must be heated under confinement before initiation; or materials that react explosively with water. *Explosives*: Division 1.2 – Explosive substances that have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but do not have a mass explosion hazard. *Compressed Gases*: Pressure ≥ 514.7 psi absolute at 21.1°C (70°F) [500 psig]. *Pyrophorics*: No Rating. *Oxidizers*: Packaging Group I *Solids*: any material that, in either concentration tested, exhibits a mean burning time less than the mean burning time of a 3:2 potassium bromate/cellulose mixture. *Liquids*: Any material that spontaneously ignites when mixed with cellulose in a 1:1 ratio, or which exhibits a mean pressure rise time less than the pressure rise time of a 1:1 perchloric acid (50%) cellulose mixture. *Unstable Reactives*: Substances that may polymerize, decompose, condense or self-react at ambient temperature and/or pressure and have a moderate potential to cause significant heat generation or explosion.); **4** (Water Reactivity: Materials that react explosively with water without requiring heat or confinement. *Organic Peroxides*: Materials that are readily capable of detonation or explosive decomposition at normal temperature and pressures. *Explosives*: Division 1.1 & 1.2-explosive substances that have a mass explosion hazard or have a projection hazard. A mass explosion is one that affects almost the entire load instantaneously. *Compressed Gases*: No Rating. *Pyrophorics*: Add to the definition of Flammability "4".

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS (continued):

PHYSICAL HAZARD (continued):

4 (continued): *Oxidizers*: No "4" rating. *Unstable Reactives*: Substances that may polymerize, decompose, condense or self-react at ambient temperature and/or pressure and have a high potential to cause significant heat generation or explosion

NATIONAL FIRE PROTECTION ASSOCIATION HAZARD RATINGS:

HEALTH HAZARD: 0 (materials that, under emergency conditions, would offer no hazard beyond that of ordinary combustible materials): Gases and vapors whose LC₅₀ for acute inhalation toxicity is greater than 10,000 ppm. Dusts and mists whose LC₅₀ for acute inhalation toxicity is greater than 200 mg/L. Materials whose LD₅₀ for acute dermal toxicity is greater than 2000 mg/kg. Materials whose LD₅₀ for acute oral toxicity is greater than 2000 mg/kg. Materials that are essentially non-irritating to the respiratory tract, eyes and skin. **1** (materials that, under emergency conditions, can cause significant irritation): Gases and vapors whose LC₅₀ for acute inhalation toxicity is greater than 5,000 ppm but less than or equal to 10,000 ppm. Dusts and mists whose LC₅₀ for acute inhalation toxicity is greater than 10 mg/L but less than or equal to 200 mg/L. Materials whose LD₅₀ for acute dermal toxicity is greater than 1000 mg/kg but less than or equal to 2000 mg/kg. Materials whose LD₅₀ for acute oral toxicity is greater than 500 mg/kg but less than or equal to 2000 mg/kg. Materials that cause slight to moderate irritation to the respiratory tract, eyes and skin. **2** (materials that, under emergency conditions, can cause temporary incapacitation or residual injury): Gases and vapors whose LC₅₀ for acute inhalation toxicity is greater than 3,000 ppm but less than or equal to 5,000 ppm. Dusts and mists whose LC₅₀ for acute inhalation toxicity is greater than 2 mg/L but less than or equal to 10 mg/L. Materials whose LD₅₀ for acute dermal toxicity is greater than 200 mg/kg but less than or equal to 1000 mg/kg. Materials whose LD₅₀ for acute oral toxicity is greater than 50 mg/kg but less than or equal to 500 mg/kg. Any liquid whose saturated vapor concentration at 20°C (68°F) is equal to or greater than one-fifth its LC₅₀ for acute inhalation toxicity, if its LC₅₀ is less than or equal to 5000 ppm and that does not meet the criteria for either degree of hazard 3 or degree of hazard 4. Compressed liquefied gases with boiling points between -30°C (-22°F) and -55°C (-66.5°F) that cause severe tissue damage, depending on duration of exposure. Materials that are respiratory irritants. Materials that cause severe, but reversible irritation to the eyes or are lachrymators. Materials that are primary skin irritants or sensitizers. **3** (materials that, under emergency conditions, can cause serious or permanent injury): Gases and vapors whose LC₅₀ for acute inhalation toxicity is greater than 1,000 ppm but less than or equal to 3,000 ppm. Dusts and mists whose LC₅₀ for acute inhalation toxicity is greater than 0.5 mg/L but less than or equal to 2 mg/L. Materials whose LD₅₀ for acute dermal toxicity is greater than 40 mg/kg but less than or equal to 200 mg/kg. Materials whose LD₅₀ for acute oral toxicity is greater than 5 mg/kg but less than or equal to 50 mg/kg. Any liquid whose saturated vapor concentration at 20°C (68°F) is equal to or greater than one-fifth its LC₅₀ for acute inhalation toxicity, if its LC₅₀ is less than or equal to 3000 ppm and that does not meet the criteria for degree of hazard 4. Compressed liquefied gases with boiling points between -30°C (-22°F) and -55°C (-66.5°F) that cause frostbite and irreversible tissue damage. Materials that are respiratory irritants. Cryogenic gases that cause frostbite and irreversible tissue damage. Materials that are corrosive to the respiratory tract. Materials that are corrosive to the eyes or cause irreversible corneal opacity. Materials that are corrosive to the skin. **4** (materials that, under emergency conditions, can be lethal): Gases and vapors whose LC₅₀ for acute inhalation toxicity less than or equal to 1,000 ppm. Dusts and mists whose LC₅₀ for acute inhalation toxicity is less than or equal to 0.5 mg/L. Materials whose LD₅₀ for acute dermal toxicity is less than or equal to 40 mg/kg. Materials whose LD₅₀ for acute oral toxicity is less than or equal to 5 mg/kg. Any liquid whose saturated vapor concentration at 20°C (68°F) is equal to or greater than one-fifth its LC₅₀ for acute inhalation toxicity, if its LC₅₀ is less than or equal to 1000 ppm.

FLAMMABILITY HAZARD: 0 Materials that will not burn under typical fire conditions, including intrinsically noncombustible materials such as concrete, stone, and sand: Materials that will not burn in air when exposed to a temperature of 816°C (1500°F) for a period of 5 minutes in accordance with Annex D. **1** Materials that must be preheated before ignition can occur. Materials in this degree require considerable preheating, under all ambient temperature conditions, before ignition and combustion can occur: Materials that will burn in air when exposed to a temperature of 816°C (1500°F) for a period of 5 minutes in accordance with Annex D. Liquids, solids and semisolids having a flash point at or above 93.4°C (200°F) (i.e. Class IIIB liquids). Liquids with a flash point greater than 35°C (95°F) that do not sustain combustion when tested using the *Method of Testing for Sustained Combustibility*, per 49 CFR 173, Appendix H or the *UN Recommendation on the Transport of Dangerous Goods, Model Regulations* (current edition) and the related *Manual of Tests and Criteria* (current edition). Liquids with a flash point greater than 35°C (95°F) in a water-miscible solution or dispersion with a water non-combustible liquid/solid content of more than 85 percent by weight. Liquids that have no fire point when tested by ASTM D 92 Standard Test Method for Flash and Fire Points by Cleveland Open Cup, up to a boiling point of the liquid or up to a temperature at which the sample being tested shows an obvious physical change. Combustible pellets with a representative diameter of greater than 2 mm (10 mesh). Solids containing greater than 0.5 percent by weight of a flammable or combustible solvent are rated by the closed cup flash point of the solvent. Most ordinary combustible materials. **2** Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur. Materials in this degree would not under normal conditions form hazardous atmospheres with air, but under high ambient temperatures or under moderate heating could release vapor in sufficient quantities to produce hazardous atmospheres with air: Liquids having a flash point at or above 37.8°C (100°F) and below 93.4°C (200°F) (i.e. Class II and Class IIIA liquids.) Solid materials in the form of powders or coarse dusts of representative diameter between 420 microns (40 mesh) and 2 mm (10 mesh) that burn rapidly but that generally do not form explosive mixtures in air. Solid materials in fibrous or shredded form that burn rapidly and create flash fire hazards, such as cotton, sisal and hemp. Solids and semisolids that readily give off flammable vapors. Solids containing greater than 0.5 percent by weight of a flammable or combustible solvent are rated by the closed cup flash point of the solvent.

DEFINITIONS OF TERMS (Continued)

NATIONAL FIRE PROTECTION ASSOCIATION HAZARD RATINGS (continued):

FLAMMABILITY HAZARD (continued): 3 Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures or, though unaffected by ambient temperatures, are readily ignited under almost all conditions. Liquids having a flash point below 22.8°C (73°F) and having a boiling point at or above 37.8°C (100°F) and those liquids having a flash point at or above 22.8°C (73°F) and below 37.8°C (73°F) and below 37.8°C (100°F) (i.e. Class IB and IC liquids). Materials that, on account of their physical form or environmental conditions, can form explosive mixtures with air and are readily dispersed in air. Flammable or combustible dusts with a representative diameter less than 420 microns (40 mesh). Materials that burn with extreme rapidity, usually by reason of self-contained oxygen (e.g. dry nitrocellulose and many organic peroxides). Solids containing greater than 0.5 percent by weight of a flammable or combustible solvent are rated by the closed cup flash point of the solvent. **4** Materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air and will burn readily: Flammable gases. Flammable cryogenic materials. Any liquid or gaseous materials that is liquid while under pressure and has a flash point below 22.8°C (73°F) and a boiling point below 37.8°C (100°F) (i.e. Class IA liquids). Materials that ignite when exposed to air. Solids containing greater than 0.5 percent by weight of a flammable or combustible solvent are rated by the closed cup flash point of the solvent.

INSTABILITY HAZARD: 0 Materials that in themselves are normally stable, even under fire conditions: Materials that have an estimated instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) below 0.01 W/mL. Materials that do not exhibit an exotherm at temperatures less than or equal to 500°C (932°F) when tested by differential scanning calorimetry. **1** Materials that in themselves are normally stable, but that can become unstable at elevated temperatures and pressures: Materials that have an estimated instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) at or above 0.01 W/mL and below 10 W/mL.

FLAMMABILITY LIMITS IN AIR:

Much of the information related to fire and explosion is derived from the National Fire Protection Association (NFPA). **Flash Point** - Minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. **Autoignition Temperature:** The minimum temperature required to initiate combustion in air with no other source of ignition. **LEL** - the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. **UEL** - the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

TOXICOLOGICAL INFORMATION:

Human and Animal Toxicology : Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are: **LD₅₀** - Lethal Dose (solids & liquids) which kills 50% of the exposed animals; **LC₅₀** - Lethal Concentration (gases) which kills 50% of the exposed animals; **ppm** concentration expressed in parts of material per million parts of air or water; **mg/m³** concentration expressed in weight of substance per volume of air; **mg/kg** quantity of material, by weight, administered to a test subject, based on their body weight in kg. Other measures of toxicity include **TDLo**, the lowest dose to cause a symptom and **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. **Cancer Information:** The sources are: **IARC** - the International Agency for Research on Cancer; **NTP** - the National Toxicology Program, **RTECS** - the Registry of Toxic Effects of Chemical Substances, **OSHA** and **CAL/OSHA**. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. **Other Information:** **BEI** - ACGIH Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV.

ECOLOGICAL INFORMATION:

EC is the effect concentration in water. **BCF** = Bioconcentration Factor, which is used to determine if a substance will concentrate in lifeforms which consume contaminated plant or animal matter. **TL_m** = median threshold limit; Coefficient of Oil/Water Distribution is represented by **log K_{ow}** or **log K_{oc}** and is used to assess a substance's behavior in the environment.

REGULATORY INFORMATION:**U.S. and CANADA:**

ACGIH: American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits.

This section explains the impact of various laws and regulations on the material. **EPA** is the U.S. Environmental Protection Agency. **NIOSH** is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. Occupational Safety and Health Administration (**OSHA**). **WHMIS** is the Canadian Workplace Hazardous Materials Information System. **DOT** and **TC** are the U.S. Department of Transportation and the Transport Canada, respectively. Superfund Amendments and Reauthorization Act (**SARA**); the Canadian Domestic/Non-Domestic Substances List (**DSL/NDL**); the U.S. Toxic Substance Control Act (**TSCA**); Marine Pollutant status according to the **DOT**; the Comprehensive Environmental Response, Compensation, and Liability Act (**CERCLA** or **Superfund**); and various state regulations. This section also includes information on the precautionary warnings which appear on the material's package label. **OSHA** - U.S. Occupational Safety and Health Administration.

EUROPEAN and INTERNATIONAL:

The DFG: This is the Federal Republic of Germany's Occupation Health Agency, similar to the U.S. OSHA. **EU** is the European Union (formerly known as the **EEC**, European Economic Community). **EINECS:** This is the European Inventory of Now-Existing Chemical Substances. The **ARD** is the European Agreement Concerning the International Carriage of Dangerous Goods by Road and the **RID** are the International Regulations Concerning the Carriage of Dangerous Goods by Rail. **AICS** is the Australian Inventory of Chemical Substances. **MITI** is the Japanese Minister of International Trade and Industry