



MATERIAL SAFETY DATA SHEET

Prepared TO U.S. OSHA, CMA, ANSI, Canadian WHMIS, European Union CLP EC 1272/2008, Australian NOHSC, Korean Standards, Chinese Standards, Japanese JIS Z7250 and the Global Harmonization Standard

1. SECTION 1 – IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

<u>TRADE NAME (AS LABELED):</u>	HYBRID CAPACITOR
<u>CHEMICAL NAMES:</u>	Capacitor Containing Electrolyte Solution Absorbed in Carbon
<u>PRODUCT USE:</u>	Energy Storage Device
<u>SYNONYMS:</u>	EDLC; Ultracapacitor
<u>U.N. NUMBER:</u>	Not Applicable
<u>U.N. DANGEROUS GOODS CLASS/SUBSIDIARY RISK:</u>	Not Applicable
<u>HAZCHEM CODE (AUSTRALIA):</u>	Not Applicable
<u>POISONS SCHEDULE NUMBER (AUSTRALIA):</u>	None Allocated
<u>U.S. SUPPLIER/MANUFACTURER'S NAME (USA/Canada):</u>	IOXUS
<u>ADDRESS:</u>	18 Stadium Circle Oneonta, NY 13820
<u>BUSINESS PHONE:</u>	1-607-441-3500 (8 a.m. to 5 p.m. EST)
<u>EUROPEAN SUPPLIER/MANUFACTURER'S NAME (USA/Canada):</u>	ADVANCED POWER COMPONENTS, LTD
<u>ADDRESS:</u>	47 Riverside, Medway City Estate, Rochester, Kent, ME2 4DP United Kingdom +44 (0) 1634 290588
<u>BUSINESS PHONE:</u>	
<u>EMAIL ADDRESS:</u>	info@ioxus.com
<u>EMERGENCY PHONE:</u>	CHEMTREC: (U.S., Canada) 1-800-424-9300 (24 hrs) (International) +01 703-527-3887 (collect-24 hrs)
<u>DATE OF PREPARATION:</u>	September 15, 2011
<u>DATE OF REVISION:</u>	New

NOTE: This product is an "Article" under the U.S. Federal OSHA Hazard Communication Standard (29 CFR 1910.1200), EU CLP 1272: 2008, New Zealand, Australian, Japanese, Chinese and Korean regulations, the Canadian Workplace Hazardous Materials Standard and the Global Harmonization Standard. Refer to Section 15 (Regulatory Information) for specific regulatory citations. As an article, this product presents negligible health and physical hazards under reasonably anticipated circumstances of use. Subsequently, a Material Safety Data Sheet is not required for this product under Standards cited above. This document is prepared to provide persons using this product with additional safety information.

2. HAZARD IDENTIFICATION

This capacitor is manufactured electronic product that contains primarily non-hazardous materials, including metal and plastic. Ultracapacitors are sealed, metal containers (steel or aluminum) which enclose layers of activated carbon which is saturated by an electrolyte solution, aluminum and plastic. The electrolyte solution contains a lithium borate compound (lithium tetrafluoroborate) dissolved in the solvent propylene carbonate. The assembled layers are inserted into the outer metal container and are saturated with the electrolyte, sealed and stored in an uncharged state. There are minor hazards that can arise from exposure to the activated carbon. If the contents of these hybrid capacitors remain sealed in the outer shell and they are kept uncharged, persons handling these products will avoid most of the risks described herein for all hazardous components of the electrolyte. As such, precautions should be taken to avoid rupture or overheating the sealed metal containers.

GLOBAL HARMONIZATION, EU CLP REGULATION (EC) 1272/2008 LABELING AND CLASSIFICATION, NEW ZEALAND HSN0 COP 8-1 09-06, NEW ZEALAND HAZARDOUS SUBSTANCE CLASSIFICATIONS STANDARD 2001, AND JAPANESE INDUSTRIAL STANDARD Z 7251:2006: This product is an article and is not required to be classified under above regulations.

EU LABELING AND CLASSIFICATION 67/548/EEC AND AUSTRALIAN NATIONAL OCCUPATION HEALTH and SAFETY COMMISSION LABELING/CLASSIFICATION: This product is an article and is not required to be classified under 67/548/EEC and the Australian National Occupational Health and Safety Commission [NOHSC(1008:2004)].

EMERGENCY OVERVIEW: Product Description: This product a solid article consisting of a green opaque plastic and metal sealed case, which is filled with activated carbon saturated with an electrolyte solution. **Health Hazards:** This product is considered a manufactured article and presents negligible health hazards under typical use conditions. Misuse of this product, such as deliberate destruction, overcharging or heating, may release the activated carbon contained within the sealed case. Skin contact with the carbon may cause moderate to severe irritation, depending on duration of exposure. **Flammability Hazards:** The activated carbon may be combustible and may be ignited if exposed to an ignition source or if subjected to direct flame. If involved in a fire, the chemicals contained in the case may decompose and produce toxic gases (e.g. carbon oxides, propylene glycol, lithium, fluoride and boron compounds). During a fire involving this product care should be taken to avoid inhalation of fumes. Misuse of this product, such as overcharging, may release these toxic fumes as well. **Reactivity Hazards:** Negligible. **Environmental Hazards:** Negligible. **Emergency Considerations:** Emergency responders must wear the proper personal protective equipment (and have appropriate fire-suppression equipment) suitable for the situation to which they are responding. Appropriate precautions should be taken in event of rupture of container under emergency conditions including fire.

3. COMPOSITION and INFORMATION ON INGREDIENTS

This product a solid article consisting of a green opaque plastic and metal sealed case, which is filled with activated carbon saturated with an electrolyte solution. The following information is for the components of the electrolyte solution and the activated carbon. As manufactured, exposure to individual electrolyte components is not expected. If this product is heated, cut or otherwise manipulated in such a way that will release the activated carbon or produce fumes, exposure to these components is possible.

3. COMPOSITION and INFORMATION ON INGREDIENTS (Continued)

CHEMICAL NAME	CAS #	EUROPEAN EINECS #	JAPANESE MITI/ENC #	KOREAN ECL #	CHINESE IECSC INVENTORY	NEW ZEALAND NZIoC	% w/w	EU Classification (67/548/EEC) GHS & EU Classification (1272/2008) Risk Phrases/Hazard & Precautionary Statements
Activated Carbon	7440-44-0	231-153-3	Mineral Excepted	KE-04671	Listed	HSR001271	10-30%	HAZARD CLASSIFICATION: Not Applicable RISK PHRASES: Not Applicable
Propylene Carbonate	108-32-7	203-572-1	5-524	KE-23785	Listed	HSR003348	10-20%	<u>EU 67/548:</u> Classification: Irritant Risk Phrases: R36 Hazard Symbol: Xi <u>GHS & EU 1272/2008:</u> Classification: Eye Irritation Cat. 2 Hazard Statement Codes: H319 Hazard Symbols/Pictograms: GHS07
Lithium Tetrafluoroborate	14283-07-9	238-178-9	1-1106	KE-22597	Listed	HSR004534	1-2%	<u>SELF CLASSIFICATION</u> <u>EU 67/548:</u> Classification: Corrosive, Harmful Risk Phrases: R34, R20/21/22 Hazard Symbol: C, Xn <u>GHS & EU 1272/2008:</u> Classification: Acute Oral Toxicity Cat. 4, Acute Dermal Toxicity Cat. 4, Acute Inhalation Toxicity Cat. 4, Skin Corrosion Cat. 1B Hazard Statement Codes: H302, H312, H332, H314 Hazard Symbols/Pictograms: GHS07, GHS05
Other components which can form the balance of the capacitor (e.g. aluminum coil, metal can, PVC plastic sleeve)							Balance	HAZARD CLASSIFICATION: Not Applicable RISK PHRASES: Not Applicable

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

4. FIRST-AID MEASURES

PROTECTION OF FIRST AID RESPONDERS: RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO THIS PRODUCT WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. Rescuers should be taken for medical attention, if necessary. Only trained personnel should administer supplemental oxygen and/or cardiopulmonary resuscitation, if necessary.

DESCRIPTION OF FIRST AID MEASURES: Victim(s) must be taken for medical attention. Take copy of label and MSDS to physician or other health professional with victim(s). Remove victim(s) to fresh air, as quickly as possible. First-aid measures applicable to contamination with the electrolyte solution are as follows:

SKIN EXPOSURE: If adverse skin effects occur, discontinue use and flush contaminated area. Seek medical attention if adverse effect occurs after flushing.

EYE EXPOSURE: If vapors or fumes from the chemicals contained in this product contaminate the eyes, rinse eyes under gently running water. Use sufficient force to open eyelids and then "roll" eyes while flushing. Minimum flushing is for 20 minutes. Seek medical attention.

INHALATION: If vapors or fumes from the chemicals contained in this product are inhaled remove victim to fresh air. If necessary, use artificial respiration to support vital functions. If breathing is difficult, give oxygen. If not breathing, give artificial respiration. Seek medical attention.

INGESTION: If the unlikely event that the activated carbon contained in this product are swallowed, CALL PHYSICIAN OR POISON CONTROL CENTER FOR MOST CURRENT INFORMATION. If professional advice is not available, DO NOT INDUCE VOMITING. Never induce vomiting or give diluents (milk or water) to someone who is unconscious, having convulsions, or unable to swallow. If victim is convulsing, maintain an open airway and obtain immediate medical attention.

ELECTRIC SHOCK: Victim should not be touched if connection to the capacitor still exists. Once the device is no longer in contact with the victim, if electric shock from the device has resulted in cessation of breathing, immediately begin mouth-to-mouth resuscitation. If the heart has stopped, a qualified person should begin CPR. If no person is trained in CPR is available, obtain immediate medical advice on how to perform CPR. Immediate medical attention should be sought while attempts to revive the victim is on-going.

IMPORTANT SYMPTOMS AND EFFECTS: See Sections 3 (Hazard Identification) and 11 (Toxicological Information).

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: No medical conditions are known to be aggravated by exposure to this product.

INDICATION OF IMMEDIATE MEDICAL ATTENTION AND SPECIAL TREATMENT IF NEEDED: Eliminate exposure and treat symptoms.

5. FIRE-FIGHTING MEASURES

FLASH POINT: Not applicable for product. For Propylene Carbonate (closed cup): 130 °C (266 °F)

AUTOIGNITION TEMPERATURE: Not applicable for product. For Propylene Carbonate: 430-510 °C (806-950 °F)

FLAMMABLE LIMITS (in air by volume, %): Not applicable for product.

For Propylene Carbonate @ 200 °C: LEL: 4.7%; UEL: 21%

FIRE EXTINGUISHING MEDIA: Use fire extinguishing media appropriate for surrounding fire.

UNSUITABLE FIRE EXTINGUISHING MEDIA: None known.

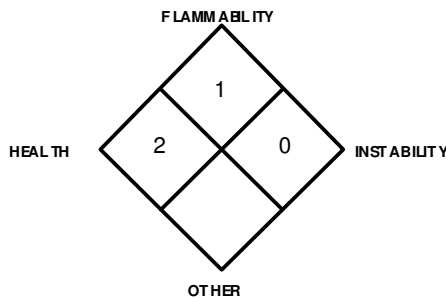
SPECIAL FIRE AND EXPLOSION HAZARDS: This product is not flammable under normal operational and non-operational conditions; however if this product is punctured or exposed to high temperatures, as may be encountered in a fire situation, the saturated activated carbon may ignite.

5. FIRE-FIGHTING MEASURES (Continued)

EXPOSURE TO ACTIVATED CARBON

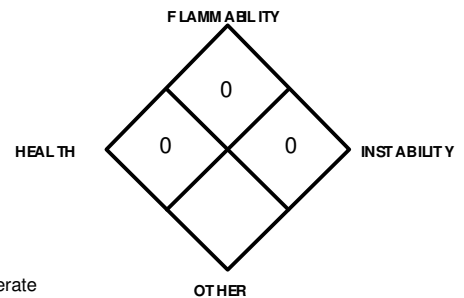
EXPOSURE TO PRODUCT AS MANUFACTURED

NFPA RATING



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

NFPA RATING



SPECIAL FIRE AND EXPLOSION HAZARDS (continued): Due to the small amount of electrolyte solution in each device and the presence of activated carbon, capacitors contain little or no free-standing liquid and so are not anticipated to pose a significant fire hazard under normal conditions of storage, use and shipment. Sealed devices involved in a fire may rupture explosively if sufficiently heated for a long period of time. If involved in a fire, the chemicals contained in the case may decompose and produce toxic gases (e.g. carbon oxides, propylene glycol, lithium, fluoride and boron compounds).

Explosion Sensitivity to Mechanical Impact: Not sensitive.

Explosion Sensitivity to Static Discharge: Not sensitive.

ADVICE TO FIRE-FIGHTERS: Incipient fire responders should wear eye protection. Structural firefighters must wear Self-Contained Breathing Apparatus (SCBA) and full protective equipment. Chemical resistant clothing may be necessary. Move containers from fire area if it can be done without risk to personnel. Water spray can be used to cool fire-exposed containers. Water fog or spray can also be used by trained firefighters to disperse this product's vapors and to protect personnel. If possible, prevent runoff water from entering storm drains, bodies of water, or other environmentally sensitive areas.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS: No special precautions are normally required. If liquid is present, wear appropriate protective equipment.

PERSONAL PROTECTIVE EQUIPMENT: Not normally needed.

Small Spill: Pick-up spilled product using gloves and safety goggles if any liquid is present.

Large Spill: If a large number of capacitors have been damaged and liquid is present, minimum Personal Protective Equipment should be rubber gloves, rubber boots, face shield, and Tyvek suit. Minimum level of personal protective equipment for releases in which the level of oxygen is less than 19.5% or is unknown must be **Level B: triple-gloves (rubber gloves and nitrile gloves over latex gloves), chemical resistant suit and boots, hard hat, and Self-Contained Breathing Apparatus.**

METHODS FOR CLEAN-UP AND CONTAINMENT: Due to the nature of this product, no special accidental release measures are normally required. If use or misuse of the product results in a spill of the electrolyte solution, releases should be responded to by trained personnel using pre-planned procedures. Eliminate all sources of ignition before cleanup begins. Call CHEMTREC (1-800-424-9300) for emergency assistance. Or if in Canada, call CANUTEC (613-996-6666).

ENVIRONMENTAL PRECAUTIONS: Avoid release to the environment. Run-off water may be contaminated by other materials and should be contained to prevent possible environmental damage.

REFERENCE TO OTHER SECTIONS: See information in Section 8 (Exposure Controls – Personal Protection) and Section 13 (Disposal Considerations) for additional information.

7. HANDLING and USE

PRECAUTIONS FOR SAFE HANDLING: Employees must be trained to properly use this product. Keep away from heat, sparks, and other sources of ignition. Do not charge in unventilated areas. Do not eat, drink, smoke, or apply cosmetics while handling this product. Wash hands thoroughly after handling this product. Avoid contact with any liquid that has escaped the capacitor. Follow SPECIFIC USE INSTRUCTIONS supplied with product. Do not use organic solvents other than recommended chemical cleaners.

CONDITIONS FOR SAFE STORAGE: When stacking capacitors, place cardboard between layers of capacitors, to avoid damage and short circuiting. Store in a cool, dry, ventilated area away from combustible materials and away from material with which it is incompatible (see Section 10, Stability and Reactivity). Post warning and "NO SMOKING" signs in storage and use areas as appropriate. Have appropriate extinguishing equipment in the storage area (i.e., sprinkler system, portable fire extinguishers). Inspect all incoming packages before storage to ensure batteries are properly labeled and not damaged.

SPECIFIC END USE(S): This material is an energy storage device.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

EXPOSURE LIMITS/CONTROL PARAMETERS:

VENTILATION AND ENGINEERING CONTROLS: Normal room ventilation should be sufficient during normal use and handling.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION (Continued)

EXPOSURE LIMITS/CONTROL PARAMETERS (continued):

OCCUPATIONAL/WORKPLACE EXPOSURE LIMITS/GUIDELINES: This product is a solid article consisting of an opaque plastic and metal case with activated carbon saturated with an electrolyte solution. The following information is for the electrolyte solution and activated carbon. As manufactured, exposure to individual components is not expected. If this product is cut or otherwise manipulated in such a way that will produce mists or fumes, exposure to these components is possible.

CHEMICAL NAME	CAS #	EXPOSURE LIMITS IN AIR							
		ACGIH-TLVs		OSHA-PELs		NIOSH-RELS		OTHER	
		TWA ppm	STEL ppm	TWA ppm	STEL ppm	TWA ppm	STEL ppm	IDLH ppm	ppm
Activated Carbon	7440-44-0	NE	NE	NE	NE	NE	NE	NE	NE
Lithium Tetrafluoroborate	14283-07-9	NE	NE	NE	NE	NE	NE	NE	United Kingdom EH Workplace Exposure Limit: 2.5 mg/m ³
Propylene Carbonate	108-32-7	NE	NE	NE	NE	NE	NE	NE	NE

NE = Not Established. See Section 16 for Definitions of Other Terms Used

INTERNATIONAL OCCUPATIONAL EXPOSURE LIMITS: In addition to the exposure limit values cited in this section, other exposure limits have been established by various countries for the components of this mixture. Limits can change and these limits may not be the most current. It is recommended that competent authorities in specific countries to determine if more current limits are in force.

ACTIVATED CARBON:

Sweden: TWA = 3 mg/m³, JUN 2005

In Argentina, Bulgaria, Colombia, Jordan, Korea, New Zealand, Singapore, Vietnam, New Zealand, Singapore, Vietnam check ACGIH TLV

PROPYLENE CARBONATE:

Russia: STEL = 7 mg/m³, JUN 2003

PERSONAL PROTECTIVE EQUIPMENT: 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 Z94.3-07), standards of EU member states (including EN 529:2005 for respiratory PPE, CEN/TR 15419:2006 for hand/body protection, and CR 13464:1999 for face/eye protection), standards of Australia (including AS/NZS 1715:1994 for respiratory PPE, AS/NZS 4501.2:2006 for protective clothing, AS/NZS 2161.1:2000 for glove selection, and AS/NZS 1336:1997 for eye protection), or standards of Japan (including JIS T 8116:2005 for glove selection, JIS T 8150:2006 for respiratory PPE, JIS T 8147:2003 for eye protectors, and JIS T 8030:2005 for protective clothing). Please reference applicable regulations and standards for relevant details.

RESPIRATORY PROTECTION: Respiratory protection is not generally needed when using these products. If fumes from this product are created during use, use appropriate respiratory protection. If necessary, use only respiratory protection authorized in per appropriate country standards. 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 U.S. Federal OSHA's Respiratory Protection Standard (1910.134-1998).

EYE PROTECTION: Depending on the use of these products, safety glasses may be worn. Use goggles or safety glasses for spill response, as stated in Section 6 (Accidental Release Measures) of this MSDS. If necessary, refer to appropriate country standards.

HAND PROTECTION: Wear leather or other protective gloves while handling capacitors. Use triple gloves for spill response. The Propylene Carbonate component of the electrolyte solution can react with nitrile Buna N, Hypalon (chloro-sulfonyl-polyethylene) and Viton A. It does not attack Teflon, ethylene-propylene, neoprene, natural rubber, and polyethylene. Gloves made of these materials should not be worn if possible contact with the electrolyte solution can occur. If necessary, refer to appropriate country standards.

BODY PROTECTION: Use body protection appropriate for task (e.g., lab coat, coveralls, Tyvek suit). If necessary, refer to appropriate country standards. 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, Canadian CSA Standard Z195.1-02, *Guideline on Selection, Care, and Use of Protective Footwear*, or European Standard CEN ISO/TR 18690:2006.

9. PHYSICAL and CHEMICAL PROPERTIES

The following information is for Activated Carbon:

BOILING POINT: Sublimes at 3642°C.

EVAPORATION RATE (n-butyl acetate = 1): Not applicable.

VAPOR PRESSURE @ 3642°C: 1 mmHg

pH: Not applicable.

ODOR THRESHOLD: Not applicable.

COEFFICIENT WATER/OIL DISTRIBUTION: Not available.

FREEZING/MELTING POINT: Not available.

SOLUBILITY IN WATER: Insoluble.

SPECIFIC GRAVITY: 1.8-3.53

VAPOR DENSITY (air = 1): Not applicable.

PERCENT VOLATILES: Not applicable

FORM: Solid

The following information is for the product:

APPEARANCE, ODOR, AND COLOR: This product a solid article consisting of an opaque, green plastic and metal, sealed case, which is filled with activated carbon saturated with an electrolyte solution that is odorless.

HOW TO DETECT THIS SUBSTANCE (warning properties in event of accidental release): There are no good identification properties for the electrolyte solution.

10. STABILITY and REACTIVITY

REACTIVITY/CHEMICAL STABILITY: Stable under condition of normal temperature.

DECOMPOSITION PRODUCTS: *Combustion:* Products of thermal decomposition can include toxic gases (e.g. carbon oxides, propylene glycol, lithium, fluoride and boron compounds). *Hydrolysis:* None known.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Electrolyte Solution: Strong oxidizers, strong acids, glass, metal oxides.

10. STABILITY and REACTIVITY (Continued)



POSSIBILITY OF HAZARDOUS POLYMERIZATION: Will not occur.



CONDITIONS TO AVOID: Avoid exposure to or contact with sparks, flames, or other sources of ignition, extreme temperatures, and incompatible chemicals.

11. TOXICOLOGICAL INFORMATION

EXPOSURE TO ACTIVATED CARBON

EXPOSURE TO PRODUCT AS MANUFACTURED

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM			
HEALTH HAZARD		(BLUE)	2
FLAMMABILITY HAZARD		(RED)	1
PHYSICAL HAZARD		(YELLOW)	0
PROTECTIVE EQUIPMENT			
EYES	RESPIRATORY	HANDS	BODY
	SEE SECTION 8		SEE SECTION 8
For Routine Industrial Use and Handling Applications			

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM			
HEALTH HAZARD		(BLUE)	0
FLAMMABILITY HAZARD		(RED)	0
PHYSICAL HAZARD		(YELLOW)	0
PROTECTIVE EQUIPMENT			
EYES	RESPIRATORY	HANDS	BODY
	SEE SECTION 8		SEE SECTION 8
For Routine Industrial Use and Handling Applications			

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

SYMPTOMS OF OVEREXPOSURE BY ROUTE OF EXPOSURE: There is no health hazard anticipated to occur during routine use of this product. In the unlikely event that the metal can ruptures and the electrolyte solution is released there are potential health hazards associated with this solution that may impact persons in the immediate area of the release. The most significant routes of exposure in case of such a release are by inhalation and skin and eye contact and are described as follows:

INHALATION: Under normal conditions of use and handling, no inhalation hazard is present. Misuse of this product, such as deliberate destruction or heating, may release toxic vapors and create an inhalation hazard in the immediate vicinity. Breathing fumes from the electrolyte solution may cause moderate irritation of the respiratory system. Symptoms may include difficulty breathing, coughing and sneezing. Though not likely to occur, severe inhalation exposure may cause burns to the respiratory system or other adverse effects described under 'Other Health Effects', due to the presence of Lithium Tetrafluoroborate.

CONTACT WITH SKIN or EYES: Under normal conditions of use and handling, this product does not pose a hazard to the skin or eyes. Eye contact with vapors or fumes of the electrolyte solution moderate to severe irritation may occur. Direct contact with the liquid may cause burns to eye tissue. Skin contact with the electrolyte solution may be moderately to severely irritating, depending on duration of exposure. Repeated skin contact to low concentration may lead to dermatitis.

SKIN ABSORPTION: No component of the electrolyte solution is known to be absorbed by intact skin.

INGESTION: Ingestion is not a likely route of exposure for this product.

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

OTHER HEALTH EFFECTS: If this product has been charged, it poses a risk of shock. Normally, hybrid capacitors are stored in an uncharged state (large capacitors are short-circuited during storage). When in operation, they carry a charge. Individual cells are rated at 2.5V maximum when operational. The voltage of any device is a function of the number of discrete cells connected in a series; cells connected in series may have higher voltage, which will be labeled on the device. Precautions should be taken to avoid electric shock and unintended discharge where capacitors are in a charged state. In extreme cases of electric shock, burns can occur and there is a risk that the heart or breathing can stop.

Large doses of the lithium ion (the Lithium Tetrafluoroborate component) can cause dizziness and prostration, and kidney damage if sodium intake is limited. Dehydration, weight loss, dermatological effects, and thyroid disturbances have been reported. Central nervous system effects that include slurred speech, blurred vision, sensory loss, ataxia, and convulsions may occur. Diarrhea, vomiting, salivation, fever and neuromuscular effects such as tremor, clonus, and hyperactive reflexes may occur as a result of repeated exposure to lithium ion. These effects are not expected to occur from exposure to this product due to the small amount of liquid present in this product; however, all contact with the electrolyte solution should be avoided.

11. TOXICOLOGICAL INFORMATION (Continued)

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in Lay Terms. Exposure to chemicals contained in this battery (due to deliberate destruction, heating or other misuse) may cause the following health effects:

Acute: Fumes from chemicals in the electrolyte solution may cause irritation by all routes of exposure. Direct contact with the liquid may cause moderate to severe irritation or burns, depending on duration of exposure. If charged, contact with this product may result in electric shock and possible cessation of respiration and the heart.

Chronic: Repeated skin contact with the saturated activated carbon may cause dermatitis.

TARGET ORGANS: ACUTE: Respiratory system, skin, eyes (from fumes from the electrolyte solution). **CHRONIC:** Skin (from contact with the saturated activated carbon).

TOXICITY DATA: As an article, this product does not present a health hazard by inhalation, ingestion, or skin contact.

PROPYLENE CARBONATE:

Standard Draize Test (Skin-Human) 100 mg/3 days-intermittent: Moderate

Standard Draize Test (Skin-Rabbit) 500 mg: Moderate

Standard Draize Test (Eye-Rabbit) 60 mg: Moderate

LC₅₀ (Inhalation-Rat) > 5 gm/m³

LD₅₀ (Oral-Rat) 29,100 µL/kg

LD₅₀ (Oral-Rat) > 5000 mg/kg

LD₅₀ (Oral-Mouse) 20,700 mg/kg

LD₅₀ (Skin-Rabbit) > 20 mL/kg

LD₅₀ (Skin-Rabbit) > 2000 mg/kg

LD₅₀ (Subcutaneous-Rat) 11,100 mg/kg: Behavioral: altered sleep time (including change in righting reflex), somnolence (general depressed activity)

PROPYLENE CARBONATE (continued):

LD₅₀ (Subcutaneous-Mouse) 15,800 mg/kg: Behavioral: altered sleep time (including change in righting reflex), somnolence (general depressed activity)

LD (Intraperitoneal-Mouse) > 500 mg/kg

TCLo (Inhalation-Rat) 500 mg/m³/93 days-continuous: Sense Organs and Special Senses (Eye): conjunctive irritation

TDLo (Oral-Rat) 30,000 mg/kg: female 6-15 day(s) after conception: Reproductive: Maternal Effects: other effects

ACTIVATED CARBON:

LD (Oral-Rat) > 5 gm/kg

LD (Oral-Mouse) > 5 gm/kg

ACTIVATED CARBON (continued):

LD (Oral-Dog) > 5 gm/kg

LD (Intraperitoneal-Rat) > 5 gm/kg

LD (Intraperitoneal-Mouse) > 5 gm/kg

LD (Intraperitoneal-Dog) > 5 gm/kg

LD (Subcutaneous-Rat) > 5 gm/kg

LD (Subcutaneous-Mouse) > 5 gm/kg

LD (Subcutaneous-Dog) > 5 gm/kg

LD₅₀ (Intravenous-Mouse) 440 mg/kg

TDLo (Subcutaneous-Rat) 167 mg/kg: female 8 day(s) after conception: Reproductive: Fertility: post-implantation mortality (e.g. dead and/or resorbed implants per total number of implants)

IRRITANCY OF PRODUCT: Misuse of this product, such as deliberate destruction, heating or overcharging, may toxic fumes which may irritate contaminated tissues. Direct contact with the liquid may cause moderate to severe irritation or burns depending on duration of exposure.

SENSITIZATION OF PRODUCT: Contact with this product does not pose a hazard of sensitization.

SUSPECTED CANCER AGENTS: No component of the electrolyte solution are listed by agencies tracking the carcinogenic potential of chemical compounds.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects the electrolyte solution and its components on human and animal reproductive systems.

Mutagenicity: Components of the electrolyte solution are not reported to cause human mutagenic effects.

Embryotoxicity: Components of the electrolyte solution are not reported to cause human embryotoxic effects.

Teratogenicity: Components of the electrolyte solution are not reported to cause human teratogenic effects.

Reproductive Toxicity: Components of the electrolyte solution are not reported to cause human reproductive effects.

A **mutagen** is a chemical that causes permanent changes to genetic material (DNA) such that the changes will propagate through generation lines. An **embryo toxin** 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.

ACGIH BIOLOGICAL EXPOSURE INDICES (BEIs): Currently, there are no ACGIH Biological Exposure Indices (BEIs) determined for the components of the electrolyte solution.

12. ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.

ENVIRONMENTAL STABILITY: This product is not expected to decompose in the environment. The following environmental data are available for components of the electrolyte solution.

MOBILITY: This product has not been tested for mobility in soil. The following information is available for the Acetonitrile component.

PROPYLENE CARBONATE:

The Koc of Propylene Carbonate is estimated as 14, using a log Kow of -0.41 and a regression-derived equation. According to a classification scheme, this estimated Koc value suggests that Propylene Carbonate is expected to have very high mobility in soil.

PERSISTENCE AND BIODEGRADABILITY: The metal and plastic case of this product will persist in the environment for extended periods of time. The following information is available for the Acetonitrile component of the electrolyte solution.

PROPYLENE CARBONATE:

If released to air, a vapor pressure of 0.045 mm Hg at 25°C indicates Propylene Carbonate will exist solely as a vapor in the ambient atmosphere. Vapor-phase Propylene Carbonate will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 4 days. Propylene Carbonate may also undergo direct photolysis since this compound contains a functional group that can absorb light greater than 290 nm, but the kinetics of this reaction are unknown. If released to soil, Propylene Carbonate is expected to have very high mobility based upon an estimated Koc of 14. Volatilization from moist soil surfaces is not expected to be an important fate process based upon an estimated Henry's Law constant of 3.4X10⁻⁸ atm-cu m/mole. Volatilization from dry soil surfaces is not expected to be an important fate process based upon the vapor pressure. Propylene Carbonate was biodegraded 80 percent in a single aerobic screening study during a 10 day incubation period. If released into water, Propylene Carbonate is not expected to adsorb to suspended solids and sediment in water based upon the estimated Koc. Volatilization from water surfaces is not expected to be an important fate process based upon this compound's estimated Henry's Law constant. Propylene Carbonate may undergo hydrolysis in the environment since this compound has functional groups susceptible to hydrolysis.

BIO-ACCUMULATION POTENTIAL: The metal and plastic case of this product will not bioaccumulate.

PROPYLENE CARBONATE:

An estimated BCF of 3 was calculated for Propylene Carbonate, using a log Kow of -0.41 and a regression-derived equation. According to a classification scheme, this BCF suggests the potential for bioconcentration in aquatic organisms is low.

AQUATIC TOXICITY: If release of the electrolyte solution occurs to an aquatic environment, damage to aquatic plants and animals may occur. The following aquatic toxicity data are available for the Propylene Carbonate component.

PROPYLENE CARBONATE:

EC₅₀ (*Daphnia magna* Water flea) 48 hours = > 500 mg/L

EC₅₀ (*Desmodesmus subspicatus* green algae) 72 hours = > 500 mg/L

PROPYLENE CARBONATE (continued):

LC₅₀ (Bacteria) 72 hours = > 10,000 mg/L

LC₅₀ (*Leuciscus idus* Golden orfe) 96 hours = 5,300 mg/L

OTHER ADVERSE EFFECTS: This product does not contain any component with known ozone depletion potential.

12. ECOLOGICAL INFORMATION (Continued)

RESULTS OF PBT and vPvB ASSESSMENT: No data available. PBT and vPvB assessments are part of the chemical safety report required for some substances in European Union Regulation (EC) 1907/2006, Article 14.

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

PREPARING WASTES FOR DISPOSAL: Ultracapacitors contain an organic electrolyte, which is regulated as a Characteristic/ Ignitable Liquid under USEPA RCRA standards. It is recommended that ultracapacitor users contact the local hazardous waste regulatory authority for guidance on proper recycling or disposal procedures. Under no cases should the ultracapacitor be disposed of in fire. Prior to recycling or disposal, the ultracapacitor should be electrically discharged and securely shorted. A copy of the MSDS should be provided to the recycler or disposer during the planning process. All applicable local regulations should be followed.

DISPOSAL METHODS: Ultracapacitors are neither specifically listed nor exempted from government hazardous waste regulations. The only material of possible concern is the organic solvent, which when discarded or disposed of, is a hazardous waste according to Federal regulations (40 CFR 261). It is listed as Hazardous Waste Number U003, so listed due to its toxicity and ignitability. Disposal can occur only in properly permitted facilities. Check state and local regulations for any additional requirements, as these may be more restrictive than federal laws and regulations. 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. Waste disposal must be in accordance with appropriate Federal, State, and local regulations. Check with the competent authority in your area for specific guidance and advice on local battery collectors and recyclers. 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.

U.S. EPA WASTE NUMBER: Wastes of this product should be tested to see if they meet D001 (Waste Characteristic/Ignitability).

EUROPEAN WASTE CODES: 16 02 Wastes from Electrical and Electronic Equipment: 16 02 13: Discarded Equipment Containing Hazardous Components Other Than Those Mentioned in 16 02 09 to 16 02 12.

14. TRANSPORTATION INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION: This product is not classified as dangerous goods, per U.S. DOT regulations, under 49 CFR 172.101. Ultracapacitors as articles are not specifically listed nor exempted from hazardous materials regulations (HMR). The materials comprising the ultracapacitors are "...in a quantity and form that does not pose a hazard in transportation". Therefore, the ultracapacitors are not subject to the HMR.

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: This product is NOT classified as Dangerous Goods, per regulations of Transport Canada.

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA): This product is NOT classified as dangerous goods under rules of IATA.

INTERNATIONAL MARITIME ORGANIZATION (IMO) DESIGNATION: This product is NOT classified as Dangerous Goods by the International Maritime Organization.

EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD (ADR): This product is NOT classified by the United Nations Economic Commission for Europe to be dangerous goods.

AUSTRALIAN FEDERAL OFFICE OF ROAD SAFETY CODE FOR THE TRANSPORTATION OF DANGEROUS GOODS BY ROAD OR RAIL: This product is NOT classified as dangerous goods, per regulations of the Australian Federal Office of Road Safety.

15. REGULATORY INFORMATION

ADDITIONAL UNITED STATES REGULATIONS:

U.S. SARA REPORTING REQUIREMENTS: The components of these products are not subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act, as follows.

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

U.S. SARA HAZARD CATEGORIES (SECTION 311/312, 40 CFR 370-21):

For Product As Manufactured: ACUTE: No; CHRONIC: No; FIRE: No; REACTIVE: No; SUDDEN RELEASE: No;

For Electrolyte Solution: ACUTE: Yes; CHRONIC: No; FIRE: No; REACTIVE: No; SUDDEN RELEASE: No

U.S. CERCLA REPORTABLE QUANTITY (RQ): Not applicable.

U.S. TSCA INVENTORY STATUS: This is an article and is not subject to the requirements of TSCA.

15. REGULATORY INFORMATION (Continued)

ADDITIONAL UNITED STATES REGULATIONS (continued):

OTHER U.S. FEDERAL REGULATIONS: This product meets the definition of an "Article" under the U.S. Federal OSHA Hazard Communication Standard (29 CFR 1910.1200). For further information, the definition of "Article" is provided below.

Article means a manufactured item other than a fluid or particle: (i) which is formed to a specific shape or design during manufacture; (ii) which has end use function(s) dependent in whole or in part upon its shape or design during end use; and (iii) which under normal conditions of use does not release more than very small quantities, e.g., minute or trace amounts of a hazardous chemical, and does not pose a physical hazard or health risk to employees.

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): No component of this product is on the CA Proposition 65 Lists.

ANSI LABELING (Z129.1): This is a manufactured article; no label information is required under OSHA 29 CFR 1910.1200 or ANSI Z400.1 to address the chemical hazards.

ADDITIONAL CANADIAN REGULATIONS:

CANADIAN DSL INVENTORY: This is a manufactured item and is not subject to the DSL requirements under CEPA.

OTHER CANADIAN REGULATIONS: This product meets the definition of an article under WHMIS Regulations (Hazardous Products Act, 6 & 7, Part II (Sections 11 and 12).

CANADIAN ENVIRONMENTAL PROTECTION AGENCY (CEPA) PRIORITIES SUBSTANCES LISTS: No component of this product is listed on the Priorities Substances Lists.

CANADIAN WHMIS CLASSIFICATION and SYMBOLS: Not applicable for articles.

ADDITIONAL EUROPEAN REGULATIONS:

SAFETY, HEALTH, AND ENVIRONMENTAL REGULATIONS/LEGISLATION SPECIFIC FOR THE PRODUCT: Currently, there is no specific legislation pertaining to this product.

CHEMICAL SAFETY ASSESSMENT: No data available. The chemical safety assessment is required for some substances according to European Union Regulation (EC) 1907/2006, Article 14.

ADDITIONAL AUSTRALIAN REGULATIONS:

AUSTRALIAN INVENTORY OF CHEMICAL SUBSTANCES (AICS) STATUS: The components of this product are listed on the AICS.

HAZARDOUS SUBSTANCES INFORMATION SYSTEM (HSIS): The Propylene Carbonate component of this product is listed in the HSIS.

STANDARD FOR THE UNIFORM SCHEDULING OF DRUGS AND POISONS: Not applicable.

LABELING AND CLASSIFICATION: This product does not meet the definition of any hazard class, based a review of the regulation [NOHSC: 10005 (1994)].

ADDITIONAL JAPANESE REGULATIONS:

JAPANESE EXISTING AND NEW CHEMICAL SUBSTANCE LIST (ENCS) STATUS: As an article, this product is not subject to the requirements of the Japanese ENCS Inventory.

JAPANESE MINISTER OF INTERNATIONAL TRADE AND INDUSTRY (MITI) STATUS: Not applicable.

JAPANESE POISONOUS AND DELETERIOUS SUBSTANCES CONTROL LAW: Not applicable.

ADDITIONAL KOREAN REGULATIONS:

KOREAN EXISTING CHEMICALS LIST (ECL) STATUS: As an article, this product is not subject to the requirements of the Korean ECL Inventory.

16. OTHER INFORMATION

GLOBAL HARMONIZATION AND EU CLP REGULATION (EC) 1272/2008 LABELING AND CLASSIFICATION and JAPANESE JIS Z7250:2005: This product is an article and is not required to be classified under CLP Regulation (EC) 1272/2008 or the Japanese Z7250:2005.

Classification: Not Applicable

Signal Word: Not Applicable

Hazard Statements: Not Applicable

Precautionary Statements: Not Applicable

Hazard Symbols: Not Applicable

EU LABELING AND CLASSIFICATION 67/548/EEC AND AUSTRALIAN NATIONAL OCCUPATION HEALTH and SAFETY COMMISSION LABELING/CLASSIFICATION: Not applicable as articles.

Classification: Not Applicable

Risk Phrases: Not Applicable

Safety Phrases: Not Applicable

Hazard Symbol: Not Applicable

COMPONENT FULL TEXT:

FOR GLOBAL HARMONIZATION AND EU CLP REGULATION (EC) 1272/2008:

Propylene Carbonate:

Classification: Eye Irritation Category 2

Signal Word: Warning

Hazard Statements: H319: Causes serious eye irritation.

Lithium Tetrafluoroborate: Self Classification

Classification: Acute Oral Toxicity Category 4, Acute Dermal Toxicity Category 4, Acute Inhalation Toxicity Category 4, Skin Corrosion Category 1B

Signal Word: Danger

Hazard Statements: H302: Harmful if swallowed. H312: Harmful in contact with skin. H332: Harmful if inhaled. H314: Causes severe skin burns and eye damage.

Other Components:

Classification: An official classification for these substances has not been published in Commission Directive CLP 1272: 2008 or the Global Harmonization Standard.

16. OTHER INFORMATION (Continued)

COMPONENT FULL TEXT (continued):

FOR EU 67/548/EEC AND AUSTRALIAN NOHSC REGULATIONS:

Propylene Carbonate:

Classification: Irritant

Risk Phrases: R36: Irritating to the eyes.

Lithium Tetrafluoroborate: Self-Classification

Classification: Corrosive, Harmful

Risk Phrases: R34: Causes burns. R20/21/22: Harmful by inhalation, in contact with skin and if swallowed

Other Components:

Classification: An official classification for these substances has not been published in Commission Directives 93/72/EEC or 94/69/EC.

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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 of 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.

LOG: 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.

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 a 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);

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS (continued):

HEALTH HAZARD (continued): 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).

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 (Serious 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.; *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.

DEFINITIONS OF TERMS (Continued)

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS (continued):

FLAMMABILITY HAZARD (continued): 1 (continued): *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:* Packing 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 \geq 514.7 psi absolute at 21.1°C (70°F) [500 psig]. *Pyrophorics:* No Rating. *Oxidizers:* Packing 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. *Oxidizers:* **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". *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.

NATIONAL FIRE PROTECTION ASSOCIATION HAZARD RATINGS (continued):

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 according 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 up 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. **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. **2:** Materials that readily undergo violent chemical change 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 10 W/mL and below 100W/mL. **3:** Materials that in themselves are capable of detonation or explosive decomposition or explosive reaction, but that require a strong initiating source or that must be heated under confinement before initiation: Materials that have an estimated instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) at or above 100 W/mL and below 1000 W/mL. Materials that are sensitive to thermal or mechanical shock at elevated temperatures and pressures. **4** Materials that in themselves are readily capable of detonation or explosive decomposition or explosive reaction at normal temperatures and pressures: Materials that have an estimated instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) of 1000 W/mL or greater. Materials that are sensitive to localized thermal or mechanical shock at normal temperatures and pressures.

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.

DEFINITIONS OF TERMS (Continued)

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 **TDL_o**, the lowest dose to cause a symptom and **TCL_o** 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:

This section explains the impact of various laws and regulations on the material. **ACGIH:** American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits. **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/NDSL**); 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: **EU** is the European Union (formerly known as the **EEC**, European Economic Community). **EINECS:** This 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. **AUSTRALIAN:** **AICS** is the Australian Inventory of Chemical Substances. **NOHSC:** National Occupational Health & Safety Code.