

Product Information Sheet

Panasonic Batteries

Panasonic Industrial Company
A Division of Panasonic Corporation of North America
5201 Tollview Drive, 1F-3
Rolling Meadows, IL 60008
Toll Free: 877-726-2228
Fax: 847-468-5750
e-mail: oembatteries@us.panasonic.com
Internet: www.panasonic.com/batteries

Product: Lithium-ion Batteries
(Li-ion)
Applicable models/sizes: All Cylindrical
and Prismatic Lithium-ion batteries

Revision: K - October 9, 2009

The batteries referenced herein are exempt articles and are not subject to the OSHA Hazard Communication Standard requirement. This sheet is provided as a service to our customers.

MSDS

Material Safety Data Sheets (MSDS) are a sub-requirement of the Occupational Safety and Health Administration (OSHA) Hazard Communication Standard, 29 CFR Subpart 1910.1200. This Hazard Communication Standard does not apply to various subcategories including anything defined by OSHA as an "article". OSHA has defined "article" as 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.

Because all of our batteries are defined as "articles", they are exempt from the requirements of the Hazard Communication Standard, hence a MSDS is not required.

The following components are found in a Panasonic Lithium Ion battery:

Nickel Manganese Cobalt Type

Component	Material	Formula
Positive Electrode	Lithium Nickel Manganese Cobalt Oxide	LiMnCoO ₂
Negative Electrode	Graphite	C
Electrolyte	Ethylene Carbonate – Solvent	C ₃ H ₄ O ₃
	Diethyl Carbonate – Solvent	C ₅ H ₁₀ O ₃
	Lithium Hexafluorophosphate – Salt	LiPF ₆

Cobalt Type

Component	Material	Formula
Positive Electrode	Lithium Cobalt Oxide	LiCoO ₂
Negative Electrode	Graphite	C
Electrolyte	Ethylene Carbonate – Solvent	C ₃ H ₄ O ₃
	Diethyl Carbonate – Solvent	C ₅ H ₁₀ O ₃
	Lithium Hexafluorophosphate – Salt	LiPF ₆

Nickel Cobalt Aluminum Type

Component	Material	Formula
Positive Electrode	Lithium Cobalt Nickel Aluminum Oxide	LiCoNiAlO ₂
Negative Electrode	Graphite	C
Electrolyte	Ethylene Carbonate – Solvent	C ₃ H ₄ O ₃
	Diethyl Carbonate – Solvent	C ₅ H ₁₀ O ₃
	Lithium Hexafluorophosphate – Salt	LiPF ₆

Notice: The information and recommendations set forth are made in good faith and are believed to be accurate at the date of preparation. Panasonic Industrial Company makes no warranty expressed or implied.



DISPOSAL

All Panasonic Lithium ion batteries are classified by the federal government as non-hazardous waste and are safe for disposal in the normal municipal waste stream. These batteries, however, do contain recyclable materials and are accepted for recycling by the Rechargeable Battery Recycling Corporation's (RBRC) Battery Recycling Program. Please call 1-800-8-BATTERY for information on recycling your used Lithium Ion battery or go to the RBRC website at www.rbrc.org for additional information.

TRANSPORTATION

Effective October 1, 2008, all Panasonic lithium ion batteries are not subject to the other requirements of the US Department of Transportation (DOT) Subchapter C, Hazardous Materials Regulations if shipped in compliance with 49 CFR 173.185 and Special Provision 188.

Effective January 1, 2009 all Panasonic lithium ion batteries can be shipped by air in accordance with International Civil Aviation Organization (ICAO), Section II or International Air Transport Association (IATA), Part 1 Packing Instructions (PI) 968 (Batteries), PI 969 (Batteries, packed with equipment) and PI 970 (Batteries, contained in equipment) as appropriate.

Currently all Panasonic lithium ion batteries are regulated by the International Maritime Organization (IMO) under Special Provisions 188 and 230. These regulations will stay in effect until January 1, 2010 when Special Provisions 188 and 230 will be updated.

If you build any of our lithium ion cells into a battery pack, you must also assure that they are tested in accordance with the UN Model Regulations, Manual of Test and Criteria. Part III, subsection 38.3. If you plan on transporting any untested prototype battery packs contact your Panasonic Sales Representative for regulatory information.

FIRST AID

If you get electrolyte in your eyes, flush with water for 15 minutes without rubbing and immediately contact a physician. If you get electrolyte on your skin wash the area immediately with soap and water. If irritation continues, contact a physician. If the battery is ingested, call the National Capital Poison Center (NCPC) at 202-625-3333 (Collect) or your local poison center immediately.

GENERAL RECOMMENDATIONS

CAUTION: Risk of fire, explosion and burns. Do not short-circuit, crush, incinerate or disassemble battery.

FIRE SAFETY

In case of fire, you can use dry chemical, alcohol resistant foam or carbon dioxide fire extinguishers. Cooling the exterior of the batteries will help prevent rupturing. Burning of these batteries will generate toxic fumes. Fire fighters should use self-contained breathing apparatus. Detailed information on fighting a lithium ion fire can be found in Guide 147 (Lithium Ion Batteries) of the US DOT Emergency Response Guide.



MATERIAL SAFETY DATA SHEET

This Material Safety Data Sheet meets or exceeds the requirements of the Canadian Controlled Product Regulations (WHMIS), the United States Occupational Safety and Health Administration (OSHA) hazard communication standard, and the applicable European Union Commission Directives.

1. Product and Supplier Identification

Product: ICR 18650 Cells, 2.2Ah

Supplier: E-One Moli Energy (Canada) Ltd,
20000 Stewart Crescent,
Maple Ridge, BC, Canada, V2X 9E7
Telephone: (604) 466-6654
Facsimile: (604) 466-6600
24-hour number +1 (613) 996-6666 (Transport Emergencies Only)

2. Composition

Component	% (w/w)	Exposure Limits ¹	LD ₅₀	LC ₅₀
Lithium Cobaltite (CAS No 12190-79-3) (EC No. 235-362-0)	30-40	TLV-TWA: 0.02 mg/m ³	Not established	Not established
Ethylene Carbonate (CAS No. 96-49-1) (EC No. 202-510-0)	2.04 – 3.06	Not established	10400 mg/kg (rat/oral) > 3000 mg/kg (rabbit/dermal)	Not established
Dimethyl Carbonate (CAS No. 616-38-6) (EC Index No. 607-013-00-6)	1.53 – 3.06	Not established	13000 mg/kg (rat/oral) 5000 mg/kg (rabbit/dermal)	Not established
Diethyl Carbonate (CAS No. 105-58-8) (EINICS No. 203-311-1)	1.53 – 3.06	Not established	8500 mg/kg (rat/ subcutaneous)	Not established
Lithium Hexafluorophosphate (CAS No 21324-40-3) (EC Index 244-334-7)	1.02 – 1.53	Not established	1702 mg/kg (rat/oral)	>20 mg/kg (rat/4 hour)
Propylene Carbonate (CAS No. 108-32-7) (EC No. 607-194-00-1)	0.51 – 1.02	Not established	29100 mg/kg (rat/oral)	>5000 mg/m ³ (rat/4 hour)

1. Exposure Limits are those published by ACGIH, American Conference of Governmental Industrial Hygienists.
2. Exposure limits may vary from time to time and from one jurisdiction to another. Check with local regulatory agency for the exposure limits in your area.

3. Hazards Identification

Routes of Entry:

Skin Contact:	No
Skin Absorption:	No
Eye Contact:	No
Inhalation:	No
Ingestion:	No

Overview:

Notice to reader:

These cells have passed the quality, performance and manufacturing tests outlined in the United Nations Manual of Tests and Criteria, Part 38.3. Since these cells meet the highest standards they are unlikely to vent causing injury. The remainder of this Material Safety Data Sheet will deal with procedures for unlikely exposures to the contents of these cells.

When cells are handled as recommended by the manufacturer, there is no risk of injury. Cells must not be crushed, punctured, incinerated, immersed in water, or heated over 100°C. If, perchance, accidental exposure occurs, wash affected area with copious amounts of water for at least 15 minutes and seek medical attention. Fires involving batteries should be extinguished by use of CO₂, dry chemical powder, or foam.

Acute Health Effects: In the unlikely event of accidental exposure. Direct contact with skin and eyes are to be considered serious and must be treated immediately. Contact with eyes will cause burns. Failure to adequately administer immediate first aid may cause permanent eye injury resulting in possible blindness. Contact with the skin will cause effects ranging from severe irritation to burns that may be delayed. Although ingestion is an unlikely route of entry, ingestion will cause corrosion of the mouth and the upper gastrointestinal tract. Swelling of the tissues in the throat and mouth may result in extreme difficulty in swallowing. Significant swelling may restrict air passages. In all cases of ingestion, the risk of aspiration into the lungs exists. Entry into the lungs can cause permanent damage to the lungs resulting in pulmonary edema. This condition may lead to death. Inhalation of fumes or mists may cause the formation of hydrofluoric acid in the respiratory tract. Hydrofluoric acid is extremely toxic by inhalation.

Chronic Health Effects: Prolonged or repeated exposure to this material may cause liver, kidney or bone damage. Exposure to fluorides may result in digestive disturbances, mottled tooth enamel, abnormal hardening of the bones or other bone changes.

Mutagenic tests conducted on *S. Typhimurium* microorganisms have been positive. This product is considered a carcinogen.

4. First Aid Measures

EYE CONTACT: Immediately flush eyes with large volumes of water for at least 15 minutes, holding eyelids open while flushing. Care must be taken not to cross contaminate the eyes. In all cases of eye contact seek immediate medical attention. Continue to flush during transport to a medical facility.

SKIN CONTACT: Immediately wash skin with soap and copious amounts of water for at least 15 minutes. Remove contaminated clothing and administer a safety shower if contamination of the torso or legs above the knee has occurred. Relief from pain and swelling may be obtained by applying topical ointments after washing. Seek immediate medical advice if significant areas of the body have been affected, or if a severe skin reaction occurs. Treatment must be immediate

due to the formation of hydrofluoric acid on moist skin. Launder clothing before reuse and discard leather footwear. Soak permeable belongings in benzalkonium chloride after washing.

INHALATION: Remove victim to fresh air. If breathing is difficult a trained person may administer oxygen at a rate of 10 to 15 litres per minute. If breathing has stopped administer artificial respiration by use of a pocket mask or bag valve mask. Do NOT give mouth-to-mouth artificial respiration. Get medical attention immediately.

INGESTION: Do not give anything by mouth to a victim who is either unconscious or is losing consciousness. If swallowed, wash mouth with water and have victim spit the wash water out. Repeat. Give one to two glasses of water to wash the throat. Do NOT induce vomiting. If vomiting occurs naturally, have victim lean forward to avoid aspiration. Seek medical attention.

5. Fire Fighting Measures

Flash point:	29 °C. Closed Cup
Autoignition temperature:	Not available
Lower Explosive Limit:	4.22% (Dimethyl Carbonate)
Upper Explosion Limit:	12.87% (Dimethyl Carbonate)
Sensitivity to Impact:	Not sensitive.
Sensitivity to Static Discharge:	Vapours may be ignited by static discharges..

Incompatibility: Yes. Water, strong oxidizing agents, strong reducing agents, strong acids and strong alkalis.

Hazardous Combustion Products: Hydrogen fluoride, phosphorus oxides, sulphur oxides, lithium hydroxide and oxides of carbon.

Extinguishing Media: Dry chemical, carbon dioxide, and foam.

Fire Fighting Instructions: Water is effective for cooling but may not be an effective extinguishant. Contact with water will release gases and cause hydrogen fluoride production. Wear full bunker suits and self-contained breathing apparatus. Extremely corrosive and toxic hydrogen fluoride is produced through combustion and contact with water. Up to 120 grams of Hydrogen fluoride is produced per litre of combusted electrolyte. If possible, fight fire from upwind locations.

In the case of a fire and the release of hydrogen fluoride, it is critical to protect the skin from any contact. Hydrogen fluoride vigorously attacks skin, lung, and eye tissues. Fluoride ions penetrate skin readily causing destruction of deep tissue layers and even bone.

6. Accidental Release Measures

Overview: Evacuate area if fire is present or likely. Spills of this electrolyte from cells pose a risk to the safety of responders if water is present. Contact with water causes the production of extremely toxic and corrosive hydrofluoric acid. Remove all sources of ignition. Electrolyte will remove or soften painted surfaces causing slipperiness to be a hazard.

Personal Protection: For all spills, protect skin and eyes from contact with electrolyte. In all cases, wear self-contained breathing apparatus.

Environmental Precautions: Prevent from migration into natural waterways. Absorb spilled material with non-reactive absorbent such as vermiculite, clay or earth.

Cleanup Procedures: Evacuate spill area immediately and remove sources of ignition. Do NOT touch spilled material. Cleanup personnel must be trained in the safe handling of this product. If possible ventilate area by means of non-sparking, grounded ventilation system. Spills may be absorbed on non-reactive absorbents such as vermiculite. Place cells into individual plastic bags and then place into appropriate containers and close tightly for disposal. Ensure that cleanup procedures do not expose spilled material to any moisture. Immediately transport closed containers outside.

Lined steel drums are suitable for storage of damaged cells until they can be proper disposal can be arranged.

7. Handling and Storage

Handling Procedures: This product is flammable and corrosive. Reaction products with water are also toxic.

Eliminate all ignition sources, (e.g. sparks, open flames, hot surfaces). Keep away from heat. Post "NO-SMOKING" signs. It is very important to keep areas where this material is used clear of other materials which can burn (e.g., cardboard, sawdust).

Use non-sparking ventilation systems, approved explosion-proof equipment and intrinsically safe electrical systems in areas of use. To prevent sparking, generously wet hard surfaces before they are chipped, ground, etc, in potentially hazardous areas. Keep aisles and exits free of obstruction. Do not use with incompatible materials such as water, strong oxidizing agents, strong reducing agents, strong acids and strong alkalis. Avoid generating vapours or mists. Prevent the release of vapours and mists into the workplace air. To avoid splashing, carefully dispense into sturdy containers made of compatible materials. Never transfer liquids by pressurizing the original shipping containers with air or inert gas. Do not dispense in storage area unless dispensing area is segregated by fire-resistant construction. Ground all drums, transfer vessels, hoses and piping. Ground clips must contact bare metal. When dispensing in other than a closed system, ensure dispensing container is bonded to receiving transfer equipment and container. Never return contaminated material to its original container. Label containers. Keep containers closed when not in use. Avoid damaging containers. Empty containers may contain hazardous residues.

Storage: Store in a cool, dry, well-ventilated area, out of direct sunlight and away from heat and ignition sources. Keep storage area clear of burnable materials (e.g. old rags, cardboard). Lighted cigarettes, matches, or any other ignition sources should not be allowed around indoor or outdoor storage areas. Inspect all incoming containers to make sure they are properly labeled and not damaged. Keep quantity stored as small as possible. Store away from water, strong oxidizing agents, strong reducing agents, strong acids and strong alkalis. Store in suitable, labeled containers (usually the shipping container). Keep containers tightly closed. Avoid stacking of containers. Protect from damage. Keep empty containers in separate storage area. Empty containers may contain hazardous residues. Keep closed. Store small quantities in approved fireproof flammables cabinet or storage room. Store flammable materials according to occupational health and safety regulations and fire and building codes, which will describe the kind of storage area and the type of storage containers for a specified amount of the material. Store in an isolated fireproof building, if possible. Ground floor storage facilities are usually recommended. Storage facilities should be made of fire resistant materials. Use a grounded, non-sparking ventilation system, approved explosion-proof equipment and intrinsically safe electrical systems. Store within temperature range recommended by electrolyte manufacturer/supplier. Storage area should be clearly identified, clear of obstruction and accessible only to trained and authorized personnel. Keep storage area separate from work areas. Store away from work process and production areas, elevators, building and room exits or main aisles leading to exits. Post warning signs. Inspect periodically for damage or leaks. Have appropriate fire extinguishers and spill clean-up equipment in or near storage area.

8. Exposure Controls, Personal Protection

Engineering Controls: Use only in area provided with adequate general and local exhaust ventilation to limit exposures below the exposure limits. These controls may be augmented by the use of process or personnel enclosures, control of process conditions, or by process modification.

Respiratory Protection: NIOSH/MSA approved half mask or full-face respirator with organic vapour/acid gas cartridges. In case of water contamination, fire, or major spill, use self-contained breathing apparatus (SCBA). When cartridge type respirators are used, ensure that the cartridges are changed frequently according to the manufacturer's recommendations. Respirator selection must be done by a qualified person and be based upon a risk assessment of the work activities and exposure levels. Respirators must be fit tested and users must be clean-shaven where the respirator seals to face. Exposure must be kept at or below the applicable exposure limits and the maximum use concentration of the respirator must not be exceeded.

Skin Protection: Heavy butyl rubber gloves for chance of major contact. Use of polyethylene or other chemical resistant material is recommended. Do NOT use latex gloves. Rubber apron useful in splash situations, impervious suit in fires or major spills.

Eye and Face Protection: Safety goggles if half mask respirator is used.

Other: Have a safety shower and eye wash station readily available.

9. Physical and Chemical Properties

Appearance:	Thin colourless liquid	Melting Point:	-25 - -35°C
Odour:	Medium sweet and fruity odour	Boiling Point:	170 - 190°C
pH:	<2.0 (with 50% H ₂ O).	Critical Temperature:	Not available
Vapour Pressure:	1.1-1.3 kPa @ 20°C	Relative Density:	1.2 kg/litre
Solubility:	Miscible in water	Partition Coefficient:	No data
Vapour Density:	3.5 (air = 1)	Evaporation Rate:	> 1 (n-butyl acetate =1)
		Percent Volatiles:	45%

10. Stability and Reactivity

Chemical Stability: Stable when dry (containing no moisture). Spontaneous decomposition will not occur at normal ambient temperatures if electrolyte is kept dry. Mixing with as little as 1% water will cause toxic gases, hydrogen fluoride and sulphuric acid to be evolved.

Incompatibility: Avoid contact with moist air, water strong oxidizing agents, strong reducing agents, strong acids and strong alkalis.

Hazardous Decomposition Products: May decompose to produce hydrogen fluoride, phosphorus oxides, sulphur oxides, sulphuric acid, lithium hydroxide, carbon monoxide and carbon dioxide.

Hazardous Polymerization: Hazardous polymerization will not occur.

11. Toxicological Information

Acute Exposure:	See Section 3
Chronic Exposure:	See Section 3.
Exposure Limits:	See Section 2.
Irritancy:	See Section 3.
Sensitization:	See Section 3.
Carcinogenicity:	Yes, electrolyte contains a suspected cancer hazard.
Teratogenicity:	No data.
Reproductive toxicity:	See Section 3.
Mutagenicity:	See Section 3.
Synergistic Products:	None reported.

12. Ecological Information

Environmental toxicity: No data available.

Biodegradability: No data available.

13. Disposal Considerations

Canadian Environmental Protection Act: Spent cells are not considered hazardous waste. Cells involved in a fire may be considered to be hazardous waste. Comply with all provincial and local regulations.

Resource Conservation and Recovery Act (RCRA): Spent cells are not considered hazardous waste. Cells involved in a fire may be considered to be hazardous waste. Comply with all state and local regulations.

14. Transport Information

Canadian Transportation of Dangerous Goods Regulations: These cells have passed the tests listed in the United Nations Manual of Tests and Criteria, Part 38.3. Not regulated for transport under Special Provision 34 of the Canadian Transport of Dangerous Goods Regulations

United States Hazardous Materials Regulations (49 CFR): These cells have passed the tests listed in the United Nations Manual of Tests and Criteria, Part 38.3. Not regulated for transport by Special Provision 188 of the United States Code of Federal Regulations Title 49.

International Air Transport Association (IATA): These cells have passed the tests listed in the United Nations Manual of Tests and Criteria, Part 38.3. These cells must be packaged in accordance with Packing instruction 965, Part 1.

International Maritime Organization (IMO): These cells have passed the tests listed in the United Nations Manual of Tests and Criteria, Part 38.3. Not regulated for transport under Special Provision 188 of the International Maritime Dangerous Goods Code (IMDG).

15. Regulatory Information

Canadian Federal Regulations:

Canadian Environmental Protection Act: All ingredients in the electrolyte are on the Domestic Substances List.

WHMIS Classification: Not controlled, manufactured article

United States Federal Regulations:

Toxic Substances Control Act: All ingredients are listed in the inventory.

OSHA: Does not meet criteria as per Part 1910.1200, manufactured article.

CERCLA: Does not meet criteria

SARA 313: Does not meet criteria

SARA 311/312 EPA Hazard Categories: Does not meet criteria

EU Regulations

EINECS: Not applicable

EU Classification: Not classifiable

Labels: None

16. Other Information

Preparation Date: January 16, 2009

Prepared by: E-One Moli Energy (Canada) Limited. 20,000 Stewart Crescent, Maple Ridge, British Columbia, Canada V2X 9E7

Disclaimer: This Material Safety Data Sheet was prepared in accordance with criteria and requirements of the Hazardous Products Act and the Controlled Products Regulations, European Union Commission Directives and the Occupational Safety and Health Administration using information provided by the manufacturer and other sources including CCINFO (Chemical Information published by the Canadian Centre for Occupational Health and Safety). The information in the Material Safety Data Sheet is offered for your consideration and guidance when exposed to this product. E-One Moli Energy (Canada) Ltd. expressly disclaims all expressed or implied warranties and assumes no responsibilities for the accuracy or completeness of the data contained herein. The data in this MSDS does not apply to use with any other product or in any other process.

This Material Safety Data Sheet may not be changed, or altered in any way without the expressed knowledge and permission of E-One Moli Energy (Canada) Ltd.

Revisions: None