

Material Safety Data Sheet

Section 1 -IDENTIFICATION

Product Name: LITHIUM SULFURYL CHLORIDE CELLS AND BATTERIES
(all hermetically sealed Electrochem CSC/PMX cells)

Manufacturer: Electrochem Solutions (Subsidiary of Greatbatch, Inc)

670 Paramount Drive
Raynham, MA 02767 USA
Telephone: 781-830-5800 Fax: 781-575-1545

Transportation Emergency Number –**CHEMTREC** 1-800-424-9300

Revision Date -2-15-2013

Section 2 – COMPOSITION/INFORMATION ON INGREDIENTS

Hazardous Components:

- | | |
|--|---|
| 1) Lithium- CAS#7439-93-2: | TLV/PEL: None est. |
| 2) Sulfuryl Chloride –CAS#7791-25-5 | TLV/PEL: None established |
| 3) Chlorine (Cl ₂) –CAS# 7782-50-5 | ACGIH: 0.5mg/m ³ TWA/1ppm STEL |
| 4) Carbon CAS# 1333-86-4 | ACGIH: 3.5 mg/m ³ TWA |

For cell lithium content, refer to technical datasheet information.

Section 3-HAZARDS IDENTIFICATION

DANGER – Internal contents are extremely hazardous. Leaking fluid is corrosive and dangerous upon inhalation. Battery may be explosive at higher temperatures.

Do not expose to temperatures above the maximum rated temperature as specified by the manufacturer due to potential leak hazard.

If battery leaks or vents:

Primary Routes of Entry: Inhalation or skin contact

Carcinogenicity: Not listed by NTP, IARC, or regulated by OSHA

Health Hazards: Acute –Vapors are very irritating to skin, eyes, and mucous membranes. Inhalation of sulfuryl chloride or thionyl chloride vapors can result in pulmonary edema.

Chronic – Overexposure can cause symptoms of non-fibrotic lung injury.

Signs and symptoms of exposure : Eye and mucous membrane irritation.

Medical conditions generally aggravated by exposure: Asthma, or other respiratory conditions, skin allergies, and eczema.

Section 4 –FIRST AID MEASURES

Eye Contact: Flush with running water for at least 15 minutes while holding eyelids apart. Seek immediate medical attention. Eye contact may result in acidic burns to the eye.

Skin contact: Rinse with large amounts of cool water for several minutes. Avoid rubbing skin. If burns develop, seek medical attention immediately.

Inhalation: Remove to fresh air. If difficulty breathing administer oxygen. If not breathing give artificial respiration. Significant inhalation can result in pulmonary edema. Seek medical attention.

Ingestion: Drink copious amounts of water (or milk). DO NOT induce vomiting. NEVER give anything by mouth to an unconscious person. Seek medical attention immediately.

Section 5-FIRE FIGHTING MEASURES

Flash Point: N/A **Auto-Ignition Temperature:** N/A **Flammable Limits:** N/A

Extinguishing Media: Copious amounts of water. Lith-X powder, Class D fire extinguisher, Dry Lithium Chloride, Graphite powder, and Pyrene 1-may not be effective on secondary fires.

Special firefighting procedures: Cover with Lith-X powder, Class D fire extinguisher, dry lithium chloride, or graphite powder. DO NOT USE CO₂, Class ABC, or Soda Ash type extinguisher. Wear protective breathing apparatus such as SCBA (self contained breathing apparatus) or Air Purifying Respirator using NIOSH approved acid gas filter cartridges. Lithium based fires have a high potential to re-ignite resulting in a secondary fire.

Unusual Fire and explosion hazards: Do not short circuit, recharge, over charge(discharge below 0.0 volts), puncture, crush, or expose to temperatures above the manufacture rated temperature. Cells may leak, vent, or explode. Touching the positive and negative poles with a conductive metal will quickly result in heat buildup and potential vent or explosion.

Section 6-ACCIDENTAL RELEASE MEASURES

Accidental Releases: Do not breathe vapors or touch liquid with bare hands. Evacuate area until proper protective equipment is available. Only trained personnel should stop or contain a leak or spill. Neutralize spill with baking soda, soda lime, or sodium bicarbonate. Sulfuryl Chloride is highly water reactive material.

Waste Disposal Methods: Evacuate area. Seal leaking cell/battery in a plastic bag along with neutralizing material such as sodium bicarbonate, soda lime, or baking soda. Use appropriate personal protective equipment such as SCBA or Air Purifying respirator with acid gas cartridges. Follow local, state, and federal requirements for waste disposal.

Other Conditions: Follow National Emergency Response Guide, #138 for cells involved in an accident, have vented, or have exploded.

Section 7-HANDLING AND STORAGE

Storage: Cells and packs should be stored at room temperature (approx 21 deg C or 70 deg F). Do not store batteries in high humidity environments for long periods as high temperatures will degrade performance.

Precautions: Do not short circuit or expose to temperatures higher than the maximum temperature provided by Electrochem. Do not recharge, over charge, puncture, or crush any cell or pack.

Other Precautions: Do not store cells in close proximity of other combustible/flammable materials.

Section 8 – EXPOSURE CONTROLS/PERSONAL PROTECTION

When handling internal cell components:

Respiratory Protection: Wear SCBA (self contained breathing apparatus) or Air Purifying respirator with gas cartridges rated for these materials.

Protective Gloves: Nitrile or PVC gloves at least 15 ml thick.

Eye Protection: Safety goggles, Faceshield with glasses, or SCBA/APR with full face protection.

Ventilation: Use a well ventilated negative pressure fume hood designed to handle these vapors.

Other protective equipment: Protective acid resistant apron with sleeves.

Hygienic work practices: Avoid unnecessary contact. Never store or use food/drink near contents.

Section 9- PHYSICAL/CHEMICAL PROPERTIES

Boiling point: Sulfuryl Chloride –(69 deg C)

Vapor pressure: Sulfuryl Chloride – (148hPa@ 20deg C)

Density: Sulfuryl Chloride –(1.66/cm³)

Solubility in water: Sulfuryl Chloride –Decomposes violently on contact with water

Specific Gravity: Sulfuryl Chloride –(13.8 lbs/gal)

Melting Point: Sulfuryl Chloride (-54 deg C)

Decomposition Temperature: begins at 140 deg C

Evaporation Rate: No data

Water Reactive: Sulfuryl Chloride hydrolyzes to form sulfuric, chlorosulfonic, and hydrochloric acids resulting in strongy acidic wastewater.

Appearance and Odor: Sulfuryl Chloride – Slightly Yellow appearance with sharp pungent odor

Section 10 –STABILITY AND REACTIVITY

Stability: Stable in final battery configuration

Incompatibility: Water if cell contents are exposed. N/A with closed or sealed cell.

Hazardous Polymerization: Will not occur

Conditions to avoid: Temperatures above rated maximum temperature and exposure to high humidity for long periods.

Hazardous Decomposition Products: Sulfur Dioxide, Hydrogen Chloride, Hydrogen, Chlorine, Sulfur Monochloride, Hydrochloric acid

Section 11- TOXICOLOGICAL INFORMATION

Acute Toxicity:

	<u>Sulfuryl Chloride</u>
- LC50 Inhalation:	0.878 mg/l (rat 4 hr)
- LD50: Oral	2140 mg/kg (rat)
- Eye effects:	Corrosive
- Skin effects:	Corrosive

Section 12 –ECOLOGICAL INFORMATION

Aquatic Toxicity: Only the internal components may affect marine environments if cell is damaged. Avoid any release to waterways, groundwater, or any environmental media. Harmful effects due to ph shift are expected.

Section 13-DISPOSAL CONSIDERATION

Proper shipping name: Waste lithium batteries

UN Number: UN3090 or UN3091 for lithium batteries contained within or with equipment.

Hazard Class: Class 9

Packing Group: II

Labels: Miscellaneous, Hazardous waste

Waste Disposal Code: US EPA RCRA only –D003

Other: All Sulfuryl chloride batteries should be disposed/recycled by a licensed disposal/recycling facility that meets requirements in your specific region/country.

Section 14-TRANSPORT INFORMATION

IATA/ICAO/DOT

Proper Shipping Name: Lithium Metal Batteries

UN Number: UN3090 (If packed in or with equipment then UN3091)

Lithium content: Depends on specific cell. Refer to technical information-datasheet.

Hazard Classification: Class 9 Misc

Packing Group: Depends on lithium content and total package weight

Labels Required: Lithium Metal Batteries, Class 9, Cargo Aircraft only – Depends on lithium content and weight –See IATA DGR and Section 16 information.

Additional: Cells can be shipped by cargo or passenger aircraft, however consult IATA DGR for specific requirements.

ADR/RID/IMDG Surface (Truck/Sea/Rail) Transportation

ADR/IMDG Special provision 188

To ship lithium batteries by surface (rail, truck, sea vessel, etc) outside the United States, the shipments must meet the criteria shown below. Maximum road and sea amount is 30kg gross weight.

- Cell and batteries must meet the requirements of UN Manual of Test and Criteria, Part III, sub-section 38.3.
- Cells and batteries shall be packed in strong outer packagings and inner packagings that completely enclose the cell or battery and protect the batteries from short circuit.
- Each package shall be marked with an indication:
- The package contains 'lithium metal' cells or batteries;
- The package shall be handled with care and that a flammability hazard exists if the package is damaged;
- Information that special procedures shall be followed if the package is damaged and that inspection and possible repackaging is necessary; and
- A telephone number of more information.
- While not technically required, the IATA label shown below meets the marking requirements listed above for the shippable package. The minimum dimensions of the label are 120 mm x 110mm. The red border is mandatory but the batteries, glass and fire can be in black and white.



Section 15- REGULATORY INFORMATION

OSHA –This product is considered an article as a finished cell/pack. Materials inside the pack (lithium, sulfuryl chloride, thionyl chloride, chlorine) are considered hazardous under US OSHA and are subject to the requirements of 29 CFR 1200 Hazard Communication

Section 16-OTHER INFORMATION

Lithium Battery Safety

With proper use and handling, lithium batteries have demonstrated an excellent safety record. The success and wide use of lithium batteries is partially due to the fact that they contain more energy per unit weight than conventional batteries. However, the same properties that result in a high energy density also contribute to potential hazards if the energy is released at a fast-uncontrolled rate. In recognition of the high-energy content of lithium systems, safety has been incorporated into the design and manufacture of all Electrochem batteries. However, abuse or mishandling of lithium batteries can still result in hazardous conditions. The information provided here is intended to give users some guidelines to safe handling and use of Electrochem lithium batteries.

Lithium Content Per Cell type

<u>Electrochem Part Number</u>	<u>Lithium grams per cell</u>
3B0024	0.6 g
3B0029	1.2 g
3B0665	0.9 g
3B0030	2.2 g
3B0035	4.6 g
3B0036	10.3 g
3B6200	14.7 g
3B5700	0.27 g
3B1065	0.5 g
3B3700	1.9 g
3B3000	4.2 g
3B2800	8.3 g
3B5100	1.9 g
3B5200	4.2 g

Cell Abuse

In general, the conditions that cause damage to cells and jeopardize safety are summarized on the label of each cell. These conditions include:

- Short Circuit
- Charging

- Forced Over discharge
- Excessive heating or incineration
- Crush, puncture or disassembly
- Very rough handling or high shock and vibration could also result in cell damage.

Cell Handling and Inspection Guidelines

The most frequent forms of cell abuse can easily be identified and controlled in the workplace. It is our experience that inadvertent short circuits are the largest single cause of field failures.

Problems associated with shorting as well as other hazardous conditions can be greatly reduced by observing the following guidelines:

- Cover all metal work surfaces with an insulating material.
- The work area should be clean and free of sharp objects that could puncture the insulating sleeve on each cell.
- Never remove the shrink-wrap from a cell or battery pack.
- All persons handling cells should remove jewelry items such as rings, wristwatches, pendants, etc., that could come in contact with the battery terminals.
- If cells are removed from their original packages for inspection, they should be neatly arranged to preclude shorting.
- Cells should be transported in plastic trays set on pushcarts. This will reduce the chances of cells being dropped on the floor, causing physical damage.
- All inspection tools (calipers, rulers, etc.) should be made from non-conductive materials, or covered with a non-conductive tape.
- Cells should be inspected for physical damage. Cells with dented cases or terminal caps should be inspected for electrolyte leakage. If any is noted, the cell should be disposed of in the proper manner.

Cell Storage

Cells should be stored in their original containers. Store cells in a well ventilated, cool, dry area. Store cells in an isolated area, away from combustible materials. Never stack heavy objects on top of boxes containing lithium batteries to preclude crushing or puncturing the cell case.

Handling During Product Assembly

All personnel handling batteries should wear appropriate protective equipment such as safety glasses.

- Do not solder wires or tabs directly to the battery. Only solder to the leads welded to the cell by the manufacturer.
- Never touch a cell case directly with a hot soldering iron. Heat sinks should be used when soldering to the tabs, and contact with the solder tabs should be limited to a few seconds.
- Cells should not be forced into (or out of) battery holders or housings. This could deform the cell causing an internal short circuit, or fracturing the glass to metal hermetic seal.
- All ovens or environmental chambers used for testing cells or batteries should be equipped with an over-temperature controller to protect against excessive heat.

- Only precision convection ovens should be used for cell testing. Lesser ovens may exhibit uneven heating and hot spots that can exceed the rated temperature of the battery.
- Do not connect cells or batteries of different chemistries together.
- Do not connect cells or batteries of different sizes together.
- Do not connect old and new batteries together.
- Consult Electrochem before encapsulating batteries during discharge. Cells may exceed their maximum rated temperature if insulated.

- Although we have provided a general overview of lithium battery safety and handling, we urge you to call us with any questions. Our technical services staff will be pleased to assist you with your questions.

- For cells or battery packs involved in an accident, cells that have vented, or exploded, follow the North American Emergency Response Guide (NAERG) #138.

- **24-HOUR TRANSPORTATION EMERGENCY RESPONSE PHONE NUMBER:**
800-424-9300 CHEMTREC

Rev. Date 2/15/2013