

MATERIAL SAFETY DATA SHEET

SECTION 1- IDENTIFICATION

Products Name: HLC (Hybrid Layer Capacitor is designed to be connected in parallel to a primary lithium metal cell or battery with OCV of up to 3.9V.

Product designation can include additional letter, such as HLC-1550, HLC-1530, HLC-1520, HLC-1050, HLC-1030 and HLC-1020 which, can include one or more slashes and letters and digits to indicate different finishing. For example, “/T” or “/TP” or “/TP2” added for different tabs or connectors. Product name can look like: HLC-1550HC/MPT, HLC-1550B/TP2, HLC-1020C/T, HLC-1020P6/T, etc.

All the above products are cylindrical cells (diameter of 15 or 10mm) and open circuit voltage up to 3.9V.

Chemical Systems- a PulsesPlus battery that includes Lithium/Thionyl Chloride cells and Hybrid Layer Capacitor (HLC) cells. Both types are hermetically sealed.

Manufacturer Name: Tadiran, US office address- 2001 Marcus Avenue, Suite 125E, Lake Success, NY 11040.

US office address: 2001 Marcus Avenue, Suite 125E, Lake Success, NY 11040

Emergency Telephone No: CHEMTREC: 1-800-424-9300

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SECTION 2- HAZARDS IDENTIFICATION

The cells described in this MSDS is sealed unit, which are not hazardous when used according to the recommendations of the manufacturer and provide that the integrity the cells is maintained

Emergency overview: Do not short circuit, crush, immerse in water, charge, force discharge or expose to temperature above the declared operation temperature range of the product.

Potential health effects: Under normal conditions of use, the materials contained in the cells are not exposed to the outside, provided the battery integrity is maintained and seal remained intact. The risk of exposure to the internal ingredients occurs only in case of physical (mechanical) thermal or electrical abuses.

Acute exposure- electrolyte may irritate skin and eyes.

SECTION 3- COMPOSITION/INFORMATION ON INGREDIENTS

| <i>Ingredient Name</i> | <i>CAS #</i> | <i>% of wt.</i> | <i>ACGIH (TLV)</i> | <i>OSHA (PEL)</i> |
|---|------------------------|-----------------|---|--|
| Lithium Cobalt Nickel Aluminium Oxide | 207803-51-8 | 10-30 | - 0.02 mg/m ³ as Co dust and fumes. - 0.1 mg/m ³ as soluble Ni | - 0.1mg/m ³ as Co dust, and fumes. - 0.015 mg/m ³ as Ni |
| Graphite and Carbons (C6) | 7782-42-5 1333-86-4 | 10-20 | 3.5 mg/m ³ TWA for carbon | 2.0 mg/m ³ as respirable fraction (dust) |
| Lithium Hexafluoro Phosphate (LiPF ₆) | 21324-40-3 | 1-2 | None Established | None Established |
| Ethylene Carbonate | 96-49-1 | 3-12 | None Established | None Established |
| Dimethyl Carbonate | 616-38-6 | 3-12 | None Established | None Established |
| Diethyl Carbonate | 105-58-8 | 3-12 | None Established | None Established |
| PVDF | 24937-79-9 | <1 | None Established | None Established |
| Copper (Cu) | 7440-50-8 | 7-15 | 0.2 mg/m ³ , fume 1.0 mg/m ³ , dust and mist | 0.1 mg/m ³ , fume. 1.0 mg/m ³ , dust and mist. |
| Aluminium (Al) | 7429-90-5 | 3-8 | 10.0 mg/m ³ as dust | 2 mg/m ³ , as soluble salt. |
| Steel, nickel and inert components | | Balance | | |

ACGIH: American Council of Governmental Industrial Hygienists.

TLV- Threshold Limit Value is personal exposure limits determined by ACGIH.

IMPORTANT NOTE: the above levels are not anticipated under normal use conditions, when cells are not opened, exposed to water or heat.

SECTION 4 – FIRST AID MEASURES

General introduction- the chemical ingredients are contained in a hermitically sealed cans. Thus, adequate hazard warnings are included on cell and on the package. Practically, there is no potential for exposure to these ingredients unless the cell leaks, or opened when exposed to high temperature, opened mechanically or electrically abused.

On contact with eyes – Is not anticipated under normal use. If cell is leaking and material contacts eyes, flush with copious amounts of clear, tepid water for at least 15 minutes (remove contact lenses if easily possible). Get medical attention at once.

On contact with skin – Is not anticipated under normal use. If cell is leaking and material contacts the skin, flush immediately with copious amounts of clear, tepid water and wash affected area with soap and water. In severe cases obtain medical attention.

If inhaled - Not anticipated under normal use. If cell is leaking, remove to fresh air. Avoid inhaling any vented gases. If irritation persists, obtain medial attention.

On ingestion – Is not anticipated. If cell is leaking, rinse mouth and surrounding area with clear, tepid water for at least 15 minutes. Give plenty of water to drink. Obtain medical attention.

Further Treatment- All cases of eye contamination, persistent skin irritation, breathing of vapors and swallowed internal ingredients, should be seen by a Doctor.

SECTION 5- FIRE - FIGHTING MEASURES

Extinguishing Media- Dry chemical type extinguishers, or CO₂ extinguishers or water extinguishers can be used effectively for burning cells or batteries. Water-based foam or copious quantities of water can be used to cool down burning cell.

Fire Fighting Procedures- If cells are involved in the fire, one should wear self-contained breathing apparatus (SCBA) to avoid breathing of irritant fumes. Full protective clothing is necessary. During water application, caution should be exercised as burning pieces of flammable particles may be ejected from the fire. Evacuate all persons from immediate area of fire. DO NOT re-enter the area until it has been thoroughly ventilated (purged) of fire vapors and from extinguishing agent.

Unusual Fire and Explosion Hazard- If cells or batteries are exposed to excessive heat or fire they may flame or leak of potentially hazardous decomposition products.

Heat, charging or over-discharge they may produce hazardous decomposition products. Burning cells emit acrid smoke, irritating fumes, and toxic fumes of hazardous oxides of carbons, hydrofluoric acid and other toxic by-products (e.g., lithium oxide, aluminum, aluminum oxide, cobalt oxide, nickel oxide, copper, copper oxide, phosphorus pentafluoride, etc.).

Damaged or opened cells/batteries or batteries can result in rapid heating and release of flammable vapors.

SECTION 6- ACCIDENTAL RELEASE MEASURES

In case of electrolyte leakage from a cell, the leaked materials should be removed using protective glass and protective gloves. Do not inhale the gas as much as possible. In addition, avoid touching the material as much as possible. Remove personnel from area until fumes dissipate. If skin has come into contact with the electrolyte, it should be washed thoroughly with water.

Damaged cells that are not hot or burning should be placed in a sealed plastic bag or container. The removal of the cells should be dealt carefully using protective glasses and protective gloves.

SECTION 7- HANDLING AND STORAGE

Cell Charging:

The HLC cells are **not** designed to be recharged from external power source besides a dedicated Tadiran Lithium Thionyl Chloride or Sulfuryl chloride cells. Connecting to any other power supply can result in fire or explosion.

Cell Disassembly

The cells should never be disassembled, or mechanically abused.

Should a cell unintentionally crushed or opened, thus release its content, rubber gloves should be used to handle all cell components. The inhalation of any vapor that may be emitted should be avoided.

In event of inhalation, eye and skin exposure to the electrolyte, refer to Section 4 “First Aid Measures”.

Short Circuiting

As with any cell, short circuit causes heating. In addition, short circuit reduces the life of the cell and can lead to ignition of surrounding materials. Physical contact with to short-circuited battery can cause skin burns.

Reverse Polarity

Avoid reverse polarity of a cell within battery pack. This can cause cell leakage or fire

Storage

Stored preferably in cool (below 30°C), dry and ventilated area, which is subject to little temperature change. Elevated temperatures may result in shortened cell life and degrade performance. Temperatures above 85°C may result in cell leakage.

Do not place cell near heating equipment, nor expose to direct sunlight for long period

Keep cells in original packaging until use and do not jumble them in order to prevent short circuit.

Do not store cells in high humidity environment for long periods.

Cells should be stored separately form other material and in non-combustible, well ventilated and sprinkler-protected structure with sufficient clearance between walls and cell packages.

Labeling

If the Tadiran label or package warning is not visible, it is important to provide the cell sleeve or device a label stating:

Warning: Do not short circuit, charge, puncture, incinerate, crush, immerse in water, force discharge, or expose to temperatures above the temperature range of the battery or battery. Risk of fire and explosion.

Others

The cell should not be immersed in water.

The cell should not be thrown in fire or expose to high temperature

Applying pressure and deforming the cell may lead to disassembly followed by electrolyte leakage.

Follow manufacturer recommendations regarding maximum recommended current and operating temperature range.

SECTION 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS:

Handling of undamaged cells requires no engineering controls. The cell should be kept away from heat and open flame and stored in a cool dry place. When a cell is being damaged or in the event of fire than:

OCCUPATIONAL EXPOSURE STANDARD:

The occupational exposure limits according to ACGIH and OSHA are given in Section 2, “Composition and Information on Ingredients” along with CAS number and their percentage range.

For all ingredients no available Biological Exposure Indices (BEI) exist.

RESPIRATORY PROTECTION: None necessary under normal use. In case electrolyte leakage from cells, protect hand with chemical resistant rubber gloves. If cells are burning, leave the area immediately. In all fire situations, use contained breathing apparatus.

VENTILATION: Not necessary under normal use. In case of abuse, use adequate mechanical ventilation (local exhaust) for cell that vent gas or fumes.

PROTECTIVE GLOVES: None necessary under normal use. In case of spill, use chemical resistant rubber gloves.

EYE PROTECTION: None required under normal conditions. Use safety glasses with side shields if handling a leaking or ruptured cell or battery.

SKIN AND BODY PROTECTION: Not necessary under normal use. Use chemical apron and protective gloves working in case of handling of a ruptured cell or battery.

SECTION 9 – PHYSICAL AND CHEMICAL PROPERTIES

| | |
|--|--|
| PHYSICAL STATE: | Solid |
| APPEARANCE: | Cylindrical Solid Object |
| ODOR: | No odor. If leaking, gives off organic order |
| PH: | Not Applicable, unless individual cell or internal components is exposed to water. |
| VAPOR PRESSURE | Not applicable |
| VAPOR DENSITY | Not applicable |
| BOILING POINT | Not applicable |
| FLAMMABILITY | Not applicable |
| MELTING AND BOILING POINTS | Not applicable |
| MELTING AND BOILING RANGES | Not applicable |
| IGNITION TEMPERATURE | Not applicable |
| % VOLATILES | Not applicable |
| FLASH POINT | Not applicable |
| DENSITY (gr/cc): | > 1.5 gr/cc |
| SOLUBILITY IN WATER AND OTHER SOLVENTS | Not Applicable, unless internal components exposed |
| EXPLOSION PROPERTIES | Not applicable |

SECTION 10- STABILITY AND REACTIVITY

STABILITY

The cell is stable under normal use and storage as described in Section 7.

HAZARDOUS REACTIONS OCCURRING UNDER SPECIFIC CONDITIONS:

INCOMPATIBILITY

None during normal operating conditions. Avoid exposure to heat, open flam and corrosives.

CONDITIONS TO AVOID:

Mechanical abuse such as crushing, piercing, and disassembly.

Electrical abuse such as short-circuiting, charging, over-discharge, (voltage reversal).

Heating above 85°C, exposure to open flame and incineration

MATERIALS TO AVOID:

Strong mineral acids, water, alkali solutions, strong oxidizing materials and conductive materials

HAZARDOUS
DECOMPOSITION
PRODUCTS:

None during normal operating conditions. If cell opens:

1. Thermal decomposition during fire produces hazardous oxides of carbon (mainly CO and other VOC's) and phosphorous, hydrofluoric acid and other toxic by-products

2. Metallic compounds such as oxides of nickel, cobalt and copper.

3. Electrolyte with water: Hydrofluoric acid (HF).

SECTION 11 – TOXICOLOGICAL INFORMATION

Toxicity information for cell ingredients is given in Section 2, “Composition and Information on Ingredients”. This information is generally not applicable to the intact cells normally used in application. Internal components of the cell are irritants and sensitizes. Exposure to the internal contents can occur only if the cells or battery are being ruptured.

1. Irritancy- in the event of exposure to internal content, corrosive fumes are can result in irritation to skin, eyes and mucous membranes. Overexposure can cause symptoms of non-fibrotic lung injury and membrane irritation.

2. Sensitation-. no information is available at this time for the cell.

3. Carcinogenicity-

3.1 According to OSHA CFR29 Part 1910 1200 Nickel and certain Nickel Compounds are deemed to be possible cancer hazards.

3.2 Cobalt and certain Cobalt compounds are categorized to IARC Group 2B and possibly carcinogenic to humans.

4. Teragenocytivity- no information is available at this time for the cell

5. Reproductive toxicity- no information is available at this time for the cell

6. Acute toxicity- not applicable to intact cell: Cobalt and Nickel compounds are listed as a possible carcinogen, see para. 3 above.

SECTION 12. - ECOLOGICAL INFORMATION

When properly used and disposed, cells and batteries do not present an environmental hazard. Some materials within the cells are bioaccumulative, so do not bury or throw out into the environment.

SECTION 13- DISPOSAL CONSIDERATIONS

Waste must be disposed in accordance with applicable Federal, State and Local regulations. Disposal should be performed by certified disposal company, knowledgeable in Federal, State or Local requirements of hazardous waste treatment transportation. The HLC cells contain recyclable materials. The recycling options available should be considered when disposing of this product, through licensed waste carrier. Cell should have its terminal insulated in order to prevent short circuit during the transportation to the disposal site. Incineration should never be performed by battery users.

RCRA Waste Code- Not regulated.

SECTION 14- TRANSPORT INFORMATION

Shipping Name:

UN 3090: Lithium Metal Batteries
UN 3091: Lithium Metal Batteries contained in equipment, or
Lithium Metal Batteries packed with equipment

Hazard Classification: Class 9

Packing Group: min. II

Special provisions and packing instructions:

The cells and batteries are manufactured under a quality management program in an ISO9001 certified factory and meet all the requirements of a UN manual of tests and criteria, Part III, sub-section 38.3. The cells and batteries must be packed in accordance with Packing Instructions / Special Provisions (SP) of the applicable code:

IATA (62nd revised edition)/ICAO (Packing Instructions: PI968, PI969 and PI970)

IMDG Code (SP188)

ADR (SP188).

Transportation within, to and from the US: are governed by the US DOT CFR 49, Parts 171, 172, 173 and 175. They detail the required packaging and labels and transportation mode of cells transported separately or in equipment.

Air transport: Lithium Ion Batteries are forbidden for transport on passenger aircraft worldwide.

SECTION 15 –REGULATORY INFORMATION

1. All the cells and batteries are defined as “articles” and thus are exempt from the requirements of the Hazard Communication Standard”.
2. The internal component (Thionyl chloride) is hazardous under the criteria of the Federal OSHA Hazard Communication Standard 29 CFR 1920.1200.
3. NFPA rating- Lithium batteries are not included in the NFPA material list. Below is the NFPA rating for lithium metal. Lithium metal is an internal component, enclosed by hermetically sealed metallic can. Under normal application is not exposed.

SECTION 16 – OTHER INFORMATION

The information and the recommendations set forth are made in good faith and believed to be accurate at the date of preparation. The present file refers to normal use of the product in question. Tadiran Batteries makes no warranty expressed or implied.

Assembly of battery packs:

The design and assembly of battery packs require special skills, expertise and experience. Therefore, it is not recommended that the end user will attempt to self-assemble battery packs. It is preferable that any battery using lithium cells will be assembled by TADIRAN to ensure proper battery design and construction. A full assembly service is available from TADIRAN who can be contact for further information. If for any reason, this is not possible, TADIRAN can review the pack design in confidential to ensure that the design is safe and capable of meeting the stated performance requirements.