

HAZARD COMMUNICATION SAFETY DATA SHEET (SDS)

Issued: 4/11/2016

Section 1 – PRODUCT AND COMPANY IDENTIFICATION

**Product Name: DD-HR Al 150C Lithium Metal Battery
DD-HR Ga 150C Lithium Metal Battery**

**DD-SIZE Lithium Thionyl Chloride Cell
High-Rate Electrodes**

**Part Number: 32126H150A (Aluminum)
32126H150G (Gallium)**

Recommended Use

Power source for MWD (Measure While Drilling), LWD (Logging While Drilling), and other related operations in the oil exploration and drilling industries. Cells may be utilized individually, in a series/parallel assembly, or installed in a battery pack constructed by professional pack manufacturer(s).

Restrictions on Use

Use only as directed for the applications as prescribed. Cells should be stored at room temperature, approx. 21°C (70°F). Store cells in the original shipping containers where and when possible. To prevent potential for personal injury, property damage or ecological damage, do not attempt to short circuit, open or disassemble individual cells, or expose contents to water, expose to fire, or tamper with cell housing, end caps, or shrink. Contains highly flammable solid (Lithium Metal) and corrosive electrolyte. Contents can cause injury or death if not handled with suitable care and protective gear by qualified professionals. Observe all safety protocols within this MSDS and consult qualified professionals for any questions relating to proper use and handling of product.

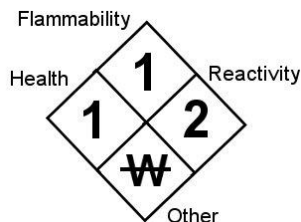
Supplier

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Manufactured by Vitzrocell Co. LTD, VITZRO B/D 3rd Floor 25 Gil-10 Neungdong-ro Gwangjin-Gu, Seoul 143-837
South Korea. TEL:82-2024-3244 FAX:82-2-499-2759.

Emergency Contact

24 Hour Emergency Telephone – (PERS) US/Canada: +1-800-633-8253 (Int'l Call Collect: +1-801-629-0667)

Section 2 – HAZARDS IDENTIFICATION



This product is a Hazard Class 9 Substance, Lithium Metal Battery, UN 3090

Note: The cell or battery described in this MSDS is a hermetically sealed stainless steel unit. There are no contacts or exposures from handling or using this cell or battery under normal conditions. Contact or exposure to the internal components can only occur if the cell or battery has leaked, been crushed, vented, or exploded.

OSHA Status: The internal component (thionyl chloride) is hazardous under the criteria of the Federal OSHA Hazard Communication Standard 29 CFR 1920.1200.

DANGER:

- CELLS AND/OR BATTERIES AND/OR BATTERY PACKS IN PRESSURIZED HOUSING SHOULD NEVER UNDER ANY CIRCUMSTANCES BE SUBJECT TO ANY HEATING PROCESS IN AREAS ACCESSIBLE BY PERSONNEL. ANY SUCH HEATING CAN CAUSE AN EXPLOSION RESULTING IN SEVERE INJURY OR DEATH.
- INTERNAL CONTENTS ARE EXTREMELY HAZARDOUS. LEAKING FLUID IS CORROSIVE AND DANGEROUS TO INHALE.

- BATTERIES ARE EXPLOSIVE AT HIGHER TEMPERATURES (ABOVE 180 °C / 365 °F), EXPOSED TO FIRE, CHARGED, SHORT CIRCUITED, OR CRUSHED. WARNING: IT IS DANGEROUS TO APPLY EXTRERNAL HEAT SOURCES TO BATTERIES. EXPLOSION MAY RESULT IN SEVERE INJURY OR DEATH.
- DO NOT EXPOSE TO TEMPERATURES ABOVE TEMPERATURE RATING OF CELL (150 °C / 302 °F) AS SPECIFIED BY MANUFACTURER, DUE TO LEAK AND EXPLOSION HAZARD. DO NOT LET INTERNAL COMPONENTS ENTER MARINE ENVIRONMENTS. AVOID RELEASES INTO WATERWAYS, WASTEWATER OR GROUND WATER.
- DEPASSIVATION WARNING: Depassivate using resistance loading only. Battery may be placed in warm sunlight or in a warm room. Do not expose to any heat source other than ambient heat. Depassivation techniques can vary significantly with the user. Vitzrocell will work with each customer's unique situation on a case-by-case basis. Depassivation information may be obtained from VitzrocellUSA, Inc. (+1-508-824-0015).
- DUE TO POTENTIAL UNRELIABILITY, IMPRECISION AND FAILURE POTENTIAL OF HEATING DEVICES, THE USE OF AN ADDED EXTERNAL HEAT SOURCE POSES A VERY REAL RISK OF PERSONAL INJURY OR DEATH TO PERSONS IN THE VICINITY OF A BATTERY BEING HEATED.
- IF CELL LEAKS OR VENTS:
 - Primary Routes of Entry:** Inhalation
 - 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 large quantities of thionyl chloride may 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, other respiratory disorders, skin allergies, and eczema.

Section 3 – COMPOSITION, INFORMATION ON INGREDIENTS

<u>Hazardous Components</u>	<u>Approx. %</u>	<u>Non-Hazardous Components</u>	<u>Approx. %</u>
Lithium	3-4.5%	Stainless Steel	40-46%
Thionyl Chloride	30-45%	Nickel	1-5%
Gallium Chloride (GaCl ₃), or Aluminum Chloride (AlCl ₃)	2-4%	Glass Separator	1-3%
Lithium Chloride	1-2%	Carbon	3-4.5%
		Other	3-6%

Thionyl Chloride CAS# 7719-09-17	OSHA: None Established ACGIH: 1.0 ppm (5.0 mg/m³) ceiling
Aluminum Chloride CAS # 7446-70-0 or Gallium (III) Chloride CAS # 13450-90-3	OSHA: None Established ACGIH: None Established NIOSH / Vitzrocell Recommended based on AlCl₃: 2 mg/m³ REL (8 h recommended exposure limit) for airborne exposure of dusts or fumes.
Lithium CAS # 7439-93-2	OSHA: None Established ACGIH: None Established
Lithium Chloride CAS # 7447-41-8	OSHA: None Established ACGIH: None Established

Section 4 – FIRST AID MEASURES

Signs and Symptoms of Exposure: Eye and mucous membrane irritation.

Medical Conditions Generally Aggravated by Exposure: Asthma, other respiratory disorders, cough/throat irritation, skin allergies, and eczema.

Eye Contact: Flush with running water for at least 15 minutes. Hold eyelids apart. Seek immediate medical attention. Contact results in acidic burns.

Skin Contact: Rinse with large amounts of running water. Avoid hot water and rubbing skin. A baking soda paste applied to the contact will assist in neutralizing any acid present. If burns develop, seek medical attention. Contact results in acidic burns from decomposition products HCl and SO₂.

Inhalation: Remove to fresh air. If breathing is difficult, administer oxygen. If not breathing, give artificial respiration. Inhalation of large quantities of thionyl chloride may result in pulmonary edema.

Ingestion: Drink copious amounts of water (or milk if available). Do not induce vomiting. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. Immediately seek medical attention.

Section 5 – FIRE FIGHTING MEASURES

Danger - Do not use water. Burning lithium will react violently with water, causing a fireball and spreading burning lithium (apx. 1000 °C, 1832 °F) up to 75 feet in all directions.

Extinguisher Media: Cover with copper powder (Navy 125s), Lith-X powder, Class D fire extinguisher, Dry Sodium Chloride, Graphite Powder, Pyrene G-1.

Special Fire Fighting Procedures: Cover with copper powder (Navy 125s), Lith-X powder, Class D fire extinguisher, dry lithium chloride, or graphite powder.

DO NOT USE: Water, moist sand, CO₂, Class ABC, soda ash extinguisher, or AFFF (Aqueous Film Forming Foam) extinguisher. Wear protective breathing apparatus; a positive pressure Self Contained Breathing Apparatus (SCBA), or Air Purifying Respirator (APR).

Flash Point: N/A

Auto-Ignition Temp: N/A

Flammable Limits: N/A

Unusual Fire and Explosion Hazards: Do not short circuit, recharge, over discharge (discharge below 0.0 Volts), puncture, crush or expose to temperatures above 150 °C, 302 °F. Cell may leak, vent, or explode. If a bright white flame is present, lithium content is exposed and on fire, use a Class D fire extinguisher, or media above. **Do not use water.**

Section 6 – ACCIDENTAL RELEASE MEASURES

Accidental Releases: Do not breathe vapors or touch liquid with bare hands (see section 2). See section 8 for PPE (Personal Protective Equipment) necessary for cleaning or containing an accidental leak.

Waste Disposal Methods: Evacuate area. If possible, a trained person should attempt to stop or contain the leak by neutralizing spill with soda lime or baking soda. A NIOSH Approved Acid Gas Filter Mask or Self-Contained Breathing Apparatus should be worn. Seal leaking battery and soda lime or baking soda in a plastic bag and dispose of as hazardous waste.

Aquatic Toxicity: Do not let internal components enter marine environments. Avoid releases into waterways, wastewater or groundwater.

Other: Follow North American Emergency Response Guide (NAERG) #138 for cells involved in an accident, cells that have vented, or have exploded.

Section 7 – HANDLING AND STORAGE

Storage: Cells should be stored at room temperature, approx. 21°C (70°F). Store cells in the original shipping containers where and when possible.

Precautions: Do not short circuit or expose to temperatures above **150°C, 302 °F**. Do not recharge, over discharge, puncture or crush.

Other Conditions: Do not store cells in high humidity environments for long periods of time.

Handling: The cells and batteries are electrical storage devices. To avoid short circuiting the cell (and activating fuse, if equipped), remove all metallic jewelry, watches, etc from hands or wear gloves. Only handle cells on non-conductive surfaces such as wood, plastic, etc. to avoid shorting the cell. Make sure cells are not exposed to temperatures above 150 °C, 302 °F from heat-shrink gun, solder iron, resistance welding, etc. Contact Vitzrocell for specific handling and use concerns or questions. Recommended cells remain in their provided packaging containers until ready for use/installation.

Recycling/Disposal: Should be conducted only by professionals trained in the handling, disposal, transport and recycling of this material.

Section 8 – EXPOSURE CONTROLS / PERSONAL PROTECTION

When handling internal components:

Respiratory Protection: NIOSH Approved Acid Gas Filter Mask, or Self-Contained Breathing Apparatus.

Protective Gloves: Outer Gloves Nitrile 15 mil (0.015 in), or thicker Inner gloves disposable nitrile. 15 mil PVC provides limited protection. Other glove materials will decompose quickly in contact with thionyl chloride electrolyte and are not recommended.

Eye Protection: Chemical Worker Safety Glasses, lab goggles, or face shield.

Ventilation To Be Used: Negative pressure chemical fume hood.

Other Protective Clothing & Equipment: Protective Apron, Acid Resistant Protective Clothing, and face shield.

Hygienic Work Practices: Use good chemical hygiene practice. Do not eat or drink when handling contents. Avoid unnecessary contact.

Section 9 – PHYSICAL AND CHEMICAL PROPERTIES

NOT Properties of the Cell

Properties of Internal Components

Thionyl Chloride

Appearance:	Thionyl Chloride – Colorless to pale yellow.
Physical State:	Liquid
Odor/Odor Threshold:	Sharp, pungent chlorine and/or sulfur type odors.
pH Level:	Inorganic liquid. No pH. When mixed with water, $\text{pH} \leq 1$
Freezing/Melting Point:	Thionyl Chloride: -105 °C, 221 °F
Boiling Point:	Thionyl Chloride: 77 °C, 170.6 °F
Flash Point:	N/A
Evaporation Rate:	N/A
Flammability (Solid/Gas)	Not flammable
Vapor Pressure:	Thionyl Chloride: 92mm @ 20 °C, 68 °F
Vapor Density:	Thionyl Chloride: 4.1
Relative Density:	1.6310g/cm ³
Solubility in Water:	Thionyl Chloride: Decomposes violently on contact with water to produce HCl and SO ₂ .
Partition Coefficient:	100% Aqueous
Auto-Ignition Temperature:	NA
Decomposition Temperature:	140 °C, 284 °F
Specific Gravity:	Thionyl Chloride: 1.63
Water Reactive:	Thionyl Chloride hydrolyzes to form SO ₂ and HCl gasses and strongly acidic wastewater.

Lithium

Appearance:	Lithium Metal – Soft silver – white metal. The metal turns yellow, brown, and then black upon exposure to moist air.
Physical State:	Solid

Odor/Odor Threshold:	Lithium metal has no odor.
pH Level:	NA
Freezing/Melting Point:	Lithium Metal: 180.5 °C or 365 °F
Boiling Point:	Lithium Metal: 1336 °C or 2437 °F. Auto Ignition in air varies based on conditions. Low of 200 °C (392 °F) and High of 600 °C (1112 °F) have been reported.
Flash Point:	NA
Evaporation Rate:	NA
Flammability (Solid/Gas):	Solid
Vapor Pressure:	Lithium Metal: NA at 25 °C or 77 °F
Vapor Density:	Lithium Metal: NA at 25 °C or 77 °F
Relative Density:	0.534 g/ml
Solubility in Water:	Lithium Metal: Decomposes violently on contact with water to produce flammable hydrogen gas. Lithium may also ignite as a result of water contact.
Partition Coefficient:	100% Aqueous & Basic Lithium Hydroxide (LiOH).
Auto-Ignition Temperature:	200 °C, 392 °F to 600 °C, 1112 °F
Decomposition Temperature:	NA
Specific Gravity:	Lithium Metal: 0.543 g / mL
Water Reactive:	Lithium Metal Reacts with water to form hydrogen gas, caustic Lithium Hydroxide, and basic wastewater.

Section 10 – STABILITY & REACTIVITY

Stability: Stable

Conditions to Avoid: Temperatures in excess of 150 °C, 302 °F. High humidity for extended periods. Do not expose inner materials to water, flame or excessive heat.

Incompatibility: N/A

Hazardous Decomposition Products: Sulfur Dioxide (g), Hydrogen Chloride (g).

Hazardous Polymerization: Will not occur.

Other: N/A

Section 11 – TOXICOLOGICAL INFORMATION

Acute Toxicity:

Thionyl Chloride

LC₅₀ (Inhalation):	1274 ppm (rat 1-hr) Lung Irritant
LD₅₀:	N/A
Eye Effects:	Corrosive Eye Irritant
Skin Effects:	Corrosive Skin Irritant

**Aluminum (III)
Chloride**

LD₅₀ Oral:	380 mg / kg (Rat)
LD₅₀ Dermal:	2 g / kg (Rabbit)
Eye Effects:	Corrosive
Other Effects:	Corrosive

Gallium (III) Chloride

LCL₀ Inhalation:	316 mg / m ³ / 3 h (Rat)
LD₅₀ Intravenous:	47 mg / Kg (Rat)
Eye Effects:	Corrosive
Other Effects:	Corrosive

Section 12 – ECOLOGICAL INFORMATION

Aquatic Toxicity: Do not let internal components enter marine environments. Avoid releases into waterways, wastewater or groundwater.

Bioaccumulative potential: None.

Mobility in soil: Unknown

Persistence and degradability: Degrades to non-hazardous components.

Section 13 – DISPOSAL CONSIDERATIONS

Proper Shipping Name: Waste Lithium Metal Batteries

UN Number: 3090

Hazard Classification: Class 9 (Misc.)

Packing Group: II

Labels Required: MISCELLANEOUS Hazard Class 9, HAZARDOUS WASTE

Waste Disposal Code: D003

Waste Management: Vitzrocell Cells may be managed as universal waste, confirm with your local, state, or provincial regulators.

Other: All lithium thionyl chloride batteries should be disposed of by a certified hazardous waste disposal facility. Contact Vitzrocell USA for recommended disposal facilities.

Section 14 – TRANSPORT INFORMATION

US DOT (per CFR 172.101) and IATA/ICAO

UN Testing Procedure: UN Manual of Test and Criteria Chapter 38.3 Revision 4.0 – This product has been properly tested to ensure product is safe for all means of transport.

Proper Shipping Name Per IATA: Lithium Metal Batteries.

UN Number: UN 3090

Hazard Classification: Class 9 (Misc.) – See IATA 7.4.8 label specifications

Packing Group: II

Packing Instructions: IATA 968, 969, and 970 - To ensure safe transport, it is highly recommended all personnel involved with the packaging, marking, labeling and shipping of this material review these specific packaging procedures to reduce the possibility for an incident to occur while product is in transport. The repercussions of a Lithium Battery incident while in transport could be severe.

Labels Required: MISCELLANEOUS HAZARD CLASS 9 with tab to indicate proper shipping name and UN number (Lithium Metal Battery, UN 3090).

Other Label Requirements:

- CARGO AIRCRAFT ONLY – This label is required if operator or state regulations specify quantity of material exceeds or is deemed unacceptable for transport via passenger aircraft
- Primary Lithium Batteries – As required by the US DOT, an addition label using the design specifications listed in CFR 49 Part 173.185.b.5 must be applied to each shipping container to identify product as Primary Lithium Batteries.
- Caution Label – As required by IATA regulations, a caution label MUST be applied to each package identifying the enclosed product (Lithium Batteries) and the special procedure to be followed in the event that the package is damaged

Emergency Services: All shipments of hazardous materials MUST include a 24/7 contact number for use in the event of an emergency.

Hazardous Materials Transport Instructional Materials:

- All personal who will package, label, mark and ship hazardous materials MUST be correctly trained with the below material in order to legally and safety transport hazardous materials.
- IATA Dangerous Goods Regulations – Most recent edition available. This document will provide the clearest understanding of handling hazardous materials shipping procedures, and is a MUST if your company will transport hazardous material via AIR.
- USDOT CFR 49 Parts 100 – 185 – covers all methods of hazardous material transport with the USA.
- Additional research may be required due to specific procedures required by individual operators (carriers) and states (Countries).

Section 15 – REGULATORY INFORMATION

OSHA Status: The internal component (thionyl chloride) is hazardous under the criteria of the Federal OSHA Hazard Communication Standard 29 CFR 1920.1200.

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 Vitzrocell cells and batteries. However, abuse or mishandling of lithium batteries can result in hazardous conditions. The information provided here is intended to give users some guidelines to safe handling and use of lithium batteries.

Battery Abuse

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

- Exposure to External Heat Sources
- 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.

Battery 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 one of the largest single causes 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 battery.
- 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 batteries are removed from their original packages for inspection, they should be neatly arranged to preclude shorting.
- Batteries should be transported in plastic trays set on pushcarts. This will reduce the chances of batteries 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 nonconductive tape.
- Batteries should be inspected for physical damage. Batteries with dented cases or terminal caps should be inspected for electrolyte leakage. Electrolyte leaks typically have a sharp chlorine and/or sulfur odor, and leaking areas may form white/yellow crystals or solids. If any are noted, the battery should be disposed of in the proper manner.

Battery Storage

Batteries should be stored in their original containers. Store batteries in a well ventilated, cool, dry area. Store batteries 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 battery case.

Handling During Product Assembly

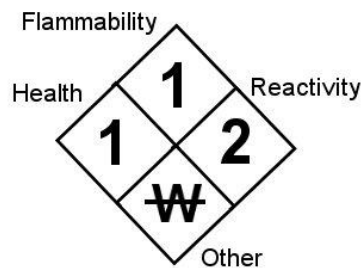
All personnel handling batteries should wear appropriate protective equipment such as safety glasses.

- 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, causing an electrolyte leak.
- All ovens or environmental chambers used for testing cells or batteries should be equipped with an independent over-temperature controller to protect against excessive heat. Heating batteries is dangerous, and can result in cell explosions or leaks.
- 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.
- Cell and Battery testing ovens must be isolated from personnel. Strong barriers must be in place separating batteries from personnel. No persons should be in vicinity of batteries being tested while under heat. There is a possibility of an explosion due to the potential for unreliability, imprecision, and possibly failure of most commercially available heating devices. DEATH or SERIOUS INJURY may result from an explosion of batteries.
- 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 cells and batteries together.

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. **VitrocellUSA, Inc. +1-832-850-7095**

NFPA RATING



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

Prepared by: Vitrocell USA, Inc.
 Date: 07/13/2015
 Updated: 04/11/2016