SAFETY DATA SHEET LITHIUM IRON PHOSPHATE (LiFePO4)

This Data Sheet is not intended to be a comprehensive exposition of the properties of Lithium Iron Phosphate batteries. No guarantee or warranty of any kind, express or implied, is made with respect to the information contained herein.

1. COMPANY AND PRODUCT IDENTIFICATION

Product Name: LiFePO4 Rechargeable Battery
Chemical System: LiFePO4

Common Name: Lithium Iron Phosphate Battery (LiFePO4)
Product Use: Electric Storage Battery

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2. HAZARDS IDENTIFICATION

Emergency Overview:

Lithium Iron Batteries are not dangerous with normal use. The materials within the battery may only represent a hazard if the structural integrity of the battery is compromised or the battery is subjected to extreme miss-use. Do not expose the batteries to fire or open flame. Do not mix batteries of varying sizes, chemistries, or types. Do not short circuit, puncture, incinerate, crush, over-charge, over discharge, or expose the batteries to temperatures above or below the declared limit. Damage to the batteries may result in the risk of fire or explosion, which could release dangerous hydrogen fluoride gas and exposure to the ingredients contained within.

Potential Health Effects:

Acute (Short Term): see Section 8 for Exposure Controls and Personal Protection. If the battery is disassembled or ruptured, the electrolyte in the cells is corrosive and can cause burns to the skin and eyes.

Potential Health Effects: Inhalation

If the battery remains sealed, there is no expected exposure. If the battery has been ruptured, vapors or mists can cause respiratory issues.

Potential Health Effects: Ingestion

If the battery remains sealed, there is no expected exposure to any chemical or hazard to be ingested. If the battery has been ruptured, mists and vapors can enter the mouth and may cause respiratory irritation/ chemical burns of the mouth and gastrointestinal tract irritation.

Potential Health Effects: Skin

Contact with a sealed battery by skin will cause no harm from any internal chemicals. Skin contact with positive and

negative terminals of high voltages may cause burns to the skin. Skin contact with a ruptured battery can cause skin irritation.

Potential Health Effects: Eyes

Eye contact with the contents of a ruptured battery can cause severe irritation to the eye.

HMIS Ratings: Health: 0 Fire: 0 HMIS Reactivity: 0

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

3. COMPOSITION / INFORMATION ON INGREDIENTS

IMPORTANT NOTE: Safety information is given for exposure to the product as sold. Intended use of the product should not result in exposure to the chemical substance. The battery cell should not be opened or exposed to heat as exposure to the following ingredients contained within could be harmful under some circumstances.

Concentration %	Component	CAS No.
25-30	Lithium Iron Phosphate ($LiFePO_4$)	15365-14-7
10-20	Graphite(C)	7440-44-0
4-9	Aluminum	7429-90-5
8-12	Copper	7440-50-8
12-22	Electrolyte:	n/a
	Ethylene carbonate	96-49-1
	Dimethyl carbonate	616-38-6
	Ethyl methyl carbonate	623-53-0
	Lithium Hexafluorophosphate	21324-40-3

*Concentration % is a trade secret and exact measurements cannot be supplied.

4. FIRST-AID MEASURES

Skin Contact:
Contact with internal contents may cause burns. If skin contact with internal contents occurs, remove affected articles of clothing. Wash affected area with lukewarm water for at least 30 minutes. If irritation or pain persists, seek medical attention. Decontaminate affected articles of clothing before reuse or discard.

Eye Contact:
Contact with internal contents may cause burns. If eye contact with internal contents occurs, wash out affected eye with gentle flowing lukewarm water while holding eyelids open for at least 30 minutes. Rinse with neutral saline solution if possible. Use caution not to rinse contaminated water into the unaffected eye, nose, mouth, or onto the face. Seek medical attention.

Inhalation:
If internal contents are inhaled, move victim to fresh air and remove source of contamination from area. Seek medical advice.

Ingestion:
If ingestion of internal contents occurs, rinse mouth thoroughly with water. DO NOT INDUCE VOMITING. If vomiting occurs naturally, have victim lean forward to reduce risk of aspiration and continue to rinse mouth with water. Seek medical attention immediately.

Caution:
In all cases evacuate the contaminated area. If irritation persists, seek medical assistance at once.

5. Fire-Fighting Measures

Suitable Extinguishing Media:
Lithium-ion batteries (including $LiFePO_4$, etc...) are a rechargeable type of lithium battery. Because these batteries do not contain a high concentration of lithium metal, you can use water, class ABC fire extinguisher, or CO_2 extinguisher. Do not use a class D extinguisher with Lithium-ion batteries. Water, carbon dioxide, dry chemical powder and foam are most effective means to extinguish a battery fire.

Fire Fighting Procedure:
Wear fully protective gear, including self-contained positive pressure breathing apparatus, goggles, fireproofing jacket and gloves. Caution is advised during application of water because burning particles may be ejected from the fire.

Unusual Fire and Explosion Hazards:
Exposing battery cell to excessive heat, fire or over voltage condition may cause a leak, fire, hazardous vapors and hazardous decomposition products. Damaged or opened cells or batteries can result in rapid heating and the release of flammable vapors and potentially dangerous gases that may be heavier than air and could travel along the ground or be moved by ventilation to an ignition source

6. Accidental Release Measures

Personal Precautions:
Hazardous material contained within the battery's cells will only be expelled if the battery is damaged or abused. If an accidental release occurs, personnel in the immediate vicinity should ensure containment measures and evacuation procedures are performed rapidly before any clean up. All non-required personnel for containment and clean up should observe the evacuation procedures.

Evacuation Procedures:
If an accidental release occurs, evacuate the area, except for required containment and clean up personnel. Maintain a minimum clearance of 25 meters (75 feet) in all directions. Stay upwind of the release, keep out of low areas, and ventilate closed areas before re-entering.

Environmental Precautions:
Prevent released material from contaminating soil or entering sewers or waterways by capping drains or placing up barriers.

Containment Procedures:
Stop the release if safe to do so. Contain any spilled liquid with dry sand, earth, or vermiculite. Move the damaged object to an isolated area, containment chamber, or cover with a fireproof containment blanket if safe to do so. Clean up spills immediately.

Clean Up Procedures:
Wear adequate personal protective equipment as indicated in Section 8. Absorb spilled liquid material with an inert absorbent (dry sand, earth, or vermiculite) material. Collect all debris and contaminated absorbent into an acceptable waste container and dispose of according to directions in Section 13. Scrub the spill area with detergent and water; collect all contaminated wash water for proper disposal.

7. Handling and Storage

Handling Precautions:
Do not expose battery or cell to extreme temperatures or fire. Do not disassemble, crush or puncture battery. Do not overcharge or over discharge the battery. Do not mix batteries of varying types or sizes. Do not connect (short circuit) positive and negative terminals or place the batteries on conductive metal.

Safe Storage Recommendations:
Insulate positive and negative terminals, when not in use, to avoid short circuit. Ensure sufficient clearance between batteries and other surfaces. Store in a dry, cool (70°F +/-5°F) and well-ventilated area. Elevated temperatures can result in reduced battery life and venting of flammable liquid and gases. Keep out of reach of children.

8. Exposure Controls/Personal Protection

Personal Protection:
Respiratory Protection: Not necessary under normal use. In case of battery rupture, provide as much ventilation as possible. Avoid confined areas where cells are venting. Use a self-contained full-face respirator mask.

Skin Protection: Not necessary under normal use. Wear rubber apron and gloves if handling a ruptured or leaking cell.

Eye Protection: Not necessary under normal use. Wear safety goggles if handling ruptured or leaking cells.

Engineering Controls: Use local exhaust ventilation and keep out of confined areas with ruptured or leaking batteries.

9. Physical and Chemical Properties

Appearance: Cell Battery	Physical State: Solid
Color: Not Applicable	pH: Not Applicable
Odor Type: Odorless	Odor Threshold: Not Applicable
Freezing Point: Not Applicable	Melting Point: Not Applicable
Boiling Point: Not Applicable	Boiling Range: Not Applicable
Flash Point and Method (CO): Not Applicable	Evaporative Rate: Not Applicable
Flammability: Not Applicable	Flammability/Explosive Limits (%):Not Applicable
Decomposition Temperature:	Viscosity: Not Applicable
Relative Density: Not Applicable	Auto Ignition Temperature (CO): Not Applicable
Solubility in Water: Not Applicable	Vapor Pressure: Not Applicable
Partition Coefficient: Not Applicable	Vapor Density: Not Applicable

10. Stability and Reactivity

Reactivity: Not Available

Chemical Stability: Product is stable under conditions described in Section 7.

Other: Possibility of producing hazardous gas in reaction with water.

Conditions to Avoid: Do not expose to high temperatures, incinerate, deform, mutilate, crush, pierce, short circuit, disassemble, or humid conditions (for long periods).

Incompatible Materials: Oxidizing agents, alkalis, and water.

Hazardous Decomposition Products: Toxic fumes and possible peroxides.

11. Toxicological Information

Likely routes of exposure: Normal use will result in unlikely routes to any exposure.

Delayed, Immediate, or Chronic effects from exposure: Normal use will result in no known effects from exposure.

Other Toxicity and Effect Information:

Irritation: Risk of irritation only occurs if battery cells are mechanically, thermally, or electrically damaged and the enclosure is compromised. If this occurs, irritation to the skin, eyes, and respiratory tract may occur.

Sensitization: Nervous system and organs may be sensitized by exposure to compromised battery cell enclosure.

Carcinogenicity: Normal use will not result in exposure to substances that are considered human carcinogens by IARC (International Agency for Research on Cancer), ACGIH (American Conference of Governmental Industrial Hygienists), OSHA or NTP (National Toxicology Program).

The information of the internal cell materials is as follows:

Lithium Iron Phosphate (LiFePO4)
Acute toxicity: No applicable data. Local effects: Unknown. Sensitization: The nervous system of respiratory organs may become sensitive. Chronic toxicity/Long term toxicity: No applicable data. Skin causticity: Although it is very rare, a rash of the skin and allergic erythema may result.
Aluminum
Local effects: Aluminum itself has no toxicity. When it goes into a wound, dermatitis may be caused. Chronic toxicity/Long term toxicity: By the long-term inhalation of coarse particulate or fume, it is possible to cause lung damage (aluminum lungs).
Graphite
Acute toxicity: Unknown. Local effects: When it goes into the eyes, it stimulates the eyes; conjunctivitis, thickening of corneal epithelium or edematous inflammation palpebra may be caused. Chronic toxicity/Long term toxicity: Since the long-term inhalation of high levels of graphite coarse particulate may become a cause of a lung disease or a tracheal disease. Carcinogenicity: Graphite is not recognized as a cause of cancer by research organizations and natural toxic substance research organizations of cancer.
Copper
Acute toxicity: 60-100mg sized coarse particulate causes a gastrointestinal disturbance with nausea and inflammation. TDLo, hypodermic - Rabbit 375mg/kg Local effects: Coarse particulate stimulates the nose and throat. Eyes will become red and painful if contact is made. Sensitization: Sensitization of the skin may be caused by long-term or repetitive contact. Reproductive effects: TDLo, oral - Rat 152mg/kg

12. Ecological Information (non-mandatory)

Mammalian effects: None known at this time.

Eco-toxicity: None known at this time.

Bioaccumulation potential: Slowly Bio-degradable.

Environmental Fate: None known environmental hazards at this time.

13. Disposal Considerations

Waste Disposal Method: Recycling is encouraged. Do NOT dump into sewage or water bodies. Dispose of in accordance with local, state, and federal laws and regulations. DO NOT Incinerate.

Special Precautions: Discharge batteries fully and cap terminals before disposal. Handle according to Section 7 and Section 8 to minimize exposure.

Regional Regulations:

USA: Dispose of in accordance with local, state, and federal laws and regulations.

Other: Dispose of in accordance with local, state and federal laws and regulations.

14. Transportation Information (non-mandatory)

IATA Classification: (International Air Transportation Association)
UN Number: UN3480
UN Proper Shipping Name: LITHIUM ION BATTERIES
Transport Hazard Class: Class 9
Packing Group Number: Packing Group IA
Notes and Exceptions: Packaging, markings, and documentation requirements are defined in the International Air Transport Association (IATA) Dangerous Goods Regulations (DGR) Packing Instructions 965.
IMDG Classification: {International Maritime Dangerous Goods}
UN Number: UN3480
UN Proper Shipping Name: LITHIUM ION BATTERIES
Transport Hazard Class: Class 9
Packing Group Number: Packing Group IA
Notes and Exceptions: Packaging, markings, and documentation requirements are defined in the IMDG code Packing Instructions P903.
U.S. HMR Classification: {United States Hazardous Materials Regulations}
UN Number: UN3090
UN Proper Shipping Name: LITHIUM BATTERY
Transport Hazard Class: Class 9
Packing Group Number: Packing Group IA
Notes and Exceptions: Packaging, markings, and documentation requirements are defined in Title 49 of the Code of Federal Regulations (CFR), Section 173.185. of the U.S. HMR.

15. Regulatory Information (non-mandatory)

USA
OSHA HCS: This SDS complies with requirements of the Hazard Communication Standard {HCS} 29 CFR 1910.1200{g} and Appendix D
EPA TSCA Status: All ingredients in the product are listed on the TSCA inventory.
EPA SARA Title III:
Sec. 302/304: None
Sec. 311/312: None
Sec. 313: None
EPA CERCLA RQ: None
California Prop 65: This product does not contain chemicals known to the State of California to cause cancer or reproductive toxicity.

16. Other Information

This information has been compiled from sources considered to be dependable and is, to the best of our knowledge and belief, accurate and reliable as of the date compiled. However, no representation, warranty (either expressed or implied) or guarantee is made to the accuracy, reliability or completeness of the information contained herein.