MIDAC S.p.A.
CERTIFIED MANAGEMENT SYSTEM ISO 9001 - ISO 14001 - ISO 45001

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Capitale Sociale EURO 20.000.000,00 i.v. – e-mail: midac@midacbatteries.com – **www.midacbatteries.com**

Information for the safe handling of $LiFePO_4$ cells, monoblocks and battery pack

Using intact batteries there is no hazard to humans and the environment.
The battery is not a "substance" or a "preparation" according to Regulation (EC) no. 1907/2006, it is an "article" and no substance is intended to be released during the utilization.
There is therefore no obligation to provide a safety data sheet in accordance with the Regulation (EC) no. 1907/2006, article 31.

1. *Product and company identification*

Product: $LiFePO_4$ cells, modules, batteries and monoblocks

Relevant uses: Traction for industrial trucks and machines, stationary

Manufacturer: MIDAC S.p.A.
Address: Via A. Volta, 2 - Z.I. - 37038 Soave (VR) - *Italy*
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Emergency contact (MIDAC Europe): +39 045 6132 132
Emergency contact (MIDAC Australia): +61 02 4647 1422
Fire brigade and police: 000 (Australia only)
Poison Information Centre: 13 11 26 (Australia only)

2. Hazards identification

Not chemically dangerous during normal use. Do not dismantle, open, shred or burn $LiFePO_4$ cells and batteries. Exposure to the ingredients or their products contained within could be harmful.

Primary routes of exposure: These chemicals are contained in a sealed can. Risk of exposure occurs only if the battery is mechanically, thermally or electrically abused. If this occurs, exposure to the electrolyte solution contained within can occur by inhalation, ingestion, eye contact and skin contact.

Potential Health Effects (damaged cells):

Inhalation: Inhalation of materials from a sealed battery is not an expected route of exposure. Vapours or mists from a ruptured battery may cause respiratory tract and mucus membrane irritation.
Swallowing: Swallowing of materials from a sealed battery is not an expected route of exposure. Swallowing the contents of an open battery can cause serious chemical burns of mouth, oesophagus, and gastrointestinal tract.
Skin contact: Contact between the battery and skin will not cause any harm. Skin contact with contents of an open battery can cause severe irritation or burns to the skin.

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Skin absorption: *Ethylene carbonate, diethyl carbonate and dimethyl carbonate of an open battery may be absorbed through the skin causing localized inflammation.*
Eye contact: Contact between the battery and the eye will not cause any harm. Eye contact with contents of an open battery can cause severe irritation or burns to the eye.
Other hazards: No information available.

Potential Health Effects (assembled modules and batteries):

Low Voltage: Only authorized Midac personnel can work on or service the battery. Do not open the battery. Busbars and other components inside are live parts. Stationary batteries shall be kept in restricted access areas.
Temperature: Do not place the batteries on or near fires or other high-temperature locations (>60°C). Doing so may cause the batteries to overheat or ignite. Using the batteries in this manner may also result in a loss of performance and a shortened battery life.

Damaged cells hazard classes:

	Flammable gases, aerosols, liquids/solids Self-reactive substances and mixes Pyrophoric liquids and solids, cat. 1 Self-heating substances and mixes Substances and mixtures, which in contact with water emit flammable gases
	*Skin corrosion, cat. 1B*
	Specific target organ toxicity Acute toxicity, cat. 4 Skin and eye irritation Skin sensitization, cat. 1 Respiratory tract irritation Narcotic effects
	Aspiration hazard, cat. 1
	Hazardous to the aquatic environment, cat. 1

3. Composition and information on ingredients

Classification system: The classification is according to the latest editions of the EU-lists, and extended by company and literature data.

No substance is released under standard storage and application conditions.

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$LiFePO_4$ cell/battery is a mixture of:

Component	**% w/w**	**CAS Number**	**LD50 (mg/kg) (oral-rat)**	**LC50 (mg/L)**	**Hazards identification**
Aluminium foil	4-20	7429-90-5	N/AV	N/AV	H228-H261 
Copper foil	5-20	7440-50-8	3.5 (ipr-mouse)	N/AV	Not dangerous
Lithium Iron Phosphate $LiFePO_4$	*15*-40	15365-14-7	*N*/AV	N/AV	H304-H336-H411/H413
Graphite, powder	*7*-30	7782-42-5	N/AV	N/AV	H304-H336-H411/H413
Vinylidene fluoride-hexafluoropropylene polymer	*0-15*	*9011-17-0*	*N/AV*	*N/AV*	*H411* 
Polyvinylidene fluoride (PVFD)	*0*-2	24937-79-9	N/AV	N/AV	H225-H304-H315-H336-H411/H413 
Lithium Hexafluorophosphate $LiPF_6$	*0*-5	21324-40-3	1702	Rat: >20	H225-H304-*H314*-H315-H336-H411/H413 
Diethyl Carbonate	*0-15*	105-58-8	8500	N/AV	H225-H304-H315-H336-H411/H413 
Dimethyl Carbonate	*0-15*	616-38-6	13000	N/AV	H225-H304-H315-H336-H411/H413 
Ethyl Methyl Carbonate	*0-15*	*623-53-0*	*N/AV*	*N/AV*	*H225* 
Ethylene Carbonate	*0-15*	96-49-1	10000	N/AV	H225-H304-H315-H336-H411/H413 
Propylene Carbonate	*0-15*	*108-32-7*	*N/AV*	*N/AV*	*H319* 
Acetylene Black	*0-2*	*1333-86-4*	*N/AV*	*N/AV*	*Not dangerous*
Polypropylene (PP)	0.5-1	9003-07-0	N/APP	N/APP	Not dangerous
Polyethylene (PE)	0.5-1	9002-88-4	N/APP	N/APP	Not dangerous
Stainless Steel	18-19	12597-68-1	N/APP	N/APP	Not dangerous

Depending on the type of battery system, the battery may contain either a glycol-ethylene-based coolant or a refrigerated coolant.

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4. First aid measures

Not anticipated under normal use. Only if exposed to the content of damaged cells.

Description of first aid measures

General information: No special measures required.

Skin contact: Remove contaminated clothing and shoes. Immediately wash with water and soap for at least 15 minutes, and rinse thoroughly. Wash clothing and shoes before reuse. If irritation occurs, get medical attention.

Eye contact: Immediately flush eyes with plenty of water for at least 15 minutes while holding eyelids open. Get medical attention if irritation persists.

Inhalation: Remove victim to fresh air. Administer artificial respiration if breathing is difficult. Seek immediate medical attention.

Ingestion: If swallowed, seek emergency medical aid. Do not induce vomiting. If the patient is choking or partially breathing, encourage the patient to cough. Do not strike patient's back: this may lodge solid objects further in throat. If the patient is not breathing, perform standing Heimlich maneuver until object is dislodged or patient starts breathing.

5. Fire-fighting measures

Not anticipated under normal use.

Flammability: NO

Conditions: Organic components will burn if cell incinerated. Combustion of cell contents will cause evolution of Hydrogen Fluoride.

Extinguishing media:
- Small fires: use dry chemical powder, inert gas (for instance blend of argon and nitrogen), CO_2, foam, graphite-based or type-D fire extinguishers specific for lithium fires.
- Large fires: use large quantities of water for the surrounding fire and to prevent propagation. Water can be used to cool down the battery tray being careful to prevent water from flooding the interior, to avoid short circuits. It is permissible to use any class of extinguishing medium specified above on these batteries or their packing material. Do not use water directly on the battery if it doesn't have an external tray or casing.

Advice for firefighters: Fire fighters should wear self-contained breathing apparatus *(SCBA)* to avoid breathing toxic fumes. Wear protective clothing and equipment to prevent potential body, skin and eye contact with electrolyte solution. Cool exterior of batteries if exposed to fire to prevent overpressure and thermal runaway. Extremely corrosive hydrogen fluoride gas is produced upon combustion of cell contents.

Special hazards arising from the substance/mixture: Cells/batteries can spout vaporized or decomposed electrolyte fumes with fire when being heated over +125°C or disposed of in fire. Solvents within the electrolyte are flammable liquids and must be kept away from any kind of ignition source.

Hazardous combustion products: Hydrogen Fluoride, Phosphorous Oxides, Carbon Monoxide, Carbon Dioxide, Lithium Hydroxide, Aluminium Oxide, possible fluorine-compounds, Carbon soot.

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6. Accidental release measures

Not anticipated under normal use. In case of emergency:

Person-related safety precautions: Wear protective equipment. Keep unprotected persons away. Evacuate the personnel from the contaminated area until fumes disperse. Provide maximum ventilation to clear out hazardous gases. In case of electrolyte leakage from a cell or battery, avoid inhaling the gas. In case of skin or eye contact, inhalation or ingestion, follow the measures described in Section 4.

Measures for environmental protection: Do not allow product to reach sewage system or any water course. Inform competent authorities in case of seepage into water course or sewage system. Do not allow to enter sewers, surface or ground water. Sweep up using a method that does not generate dust. Avoid ground and atmosphere contamination.

Measures for cleaning/collecting: Use protective glasses and gloves. Absorb any exuded material with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust, earth or vermiculite). Seal leaking battery (if hot wait until it cools down) and contaminated absorbent material in plastic bag and dispose of as hazardous waste in accordance with local regulations. It is recommended to discharge the battery to the end. Ensure adequate ventilation.

7. Handling and storage

Important notice: Batteries shall not be opened, destroyed or incinerated, since they may cause fire and the ingredients contained in cells could be harmful if exposed. Do not short circuit terminals, or over charge the battery, force over-discharge, throw to fire. Charge the battery before storing it, and at least once every four months if not used for long periods. Do not crush or puncture the battery. Keep away from water.

Precautions to be taken in handling and storing

Storage: Store in a cool, dry and ventilated area which is subject to little temperature change. Elevated temperatures can shorten battery life. Do not store the battery near heating equipment, nor expose to direct sunlight for long periods. Keep batteries in original packaging until first use. Store at -10°C to 35°C (optimal temperature between 0°C and 15°C).

Incompatibilities: Store away from explosives, oxidisable materials, organic peroxides, radioactive substances, combustible materials and sources of ignition.

Handling: Avoid mechanical or electrical abuse:

- Do not short (+) and (-) terminal with conductors
- Do not short terminals and cell casing with conductors
- Do not reverse the polarity
- Do not connect batteries in series or in parallel
- *Do not mix different types of batteries*
- Do not open the battery, or disassemble modules
- Do not use the unit without its electronic management system (BMS)
- Do not submit to excessive mechanical stress
- Do not expose the unit to water or condensation, *do not immerse in liquids*
- Do not directly heat, do not solder, weld or throw into fire. Such unsuitable use can cause leakage or spout vaporized electrolyte fumes and may cause fire or explosion.
- Immediately disconnect the batteries if, during operation, they emit an unusual smell, feel hot, change shape, or appear abnormal in any other way. Contact MIDAC SpA if any of these problems are observed.

Charging/Discharging: Charge only with charger designed specifically for this battery. Do not overcharge as venting and combustion can occur. Do not over-discharge. Discharge limits are dependent on the specific product. Refer to MIDAC SpA instructions.

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8. Exposure controls and personal protection

No exposure standards are applicable to this product as delivered and in normal use.

Personal protective equipment:

- **Hand protection**: Not required for individual cells handling. Use polypropylene, polyethylene, rubber or Viton gloves when handling leaking or ruptured cells. Use fabric gloves for battery pack handling.
- **Respiratory *protection*:** Not required under normal use and handling. SCBA required for fires.
- **Eye*/face* protection**: Not required under normal use. In case of incident or after an abusive use, in case of handling leaking or ruptured cells, wear safety glasses with protected side shields or a mask covering the whole face. Use protective eyewear against short circuits.
- **Clothing**: Standard industrial clothing under normal use. In the event of leaking or ruptured cells, wear rubber apron and protective clothes. Wear impervious suit in fires.
- **Footwear**: Wear protective footwear for battery pack handling.

Engineering controls: Use local exhaust ventilation or other engineering controls to control sources of dust, mist, fumes and vapor. Keep away from heat and open flames. Store in a cool, dry place.

Handling procedures/equipment: Store in a cool, dry place away from sparks and flames. Keep above -10°C and below 35°C (optimal storage temperature range between 0°C and +15°C). Charge between 0°C and 45°C and use between -10°C and +55°C. Use only approved charging equipment. Do not disassemble or tamper battery pack, cells, electronics devices or other components. Do not puncture, crush or dispose of in fire.

Leak and spill procedure: Evacuate area if fire present or likely. Wear SCBA for fire-related emergencies. Using gloves, pick up or sweep up fire-damaged cells, bag individually in plastic bags and place in closed metal containers. For cells, 205-Litre lined Aluminium drums are appropriate. Cardboard boxes may be used for small quantities. Avoid raising dust while sweeping. Move the containers outdoor. Hold burnt cells and fires clean-up solids for disposal as hazardous waste. Unburnt cells are not hazardous waste. A fire with over 100kg of cells burnt will likely require reporting to environment officials.

Waste disposal: Always consult and obey all international, national, and local hazardous waste disposal laws. Some jurisdictions require recycling of this spent product.

9. Physical and chemical properties

Lithium-Ion cells/batteries are sealed when offered for sale. It is a manufactured “article” and does not expose the user to hazardous chemicals when used in accordance with the manufacturer specifications.

Physical state: Solid
Odour: Odourless
Melting/Freezing point: Not applicable
Boiling point and boiling range: Not applicable
Flammability: *Not applicable*
pH: Not applicable
Solubility: *Not applicable*
Vapor pressure: Not applicable
Vapor density: Not applicable
Relative density: Not applicable
Evaporation rate: Not applicable
Impact sensitive: No
Static discharge sensitive: No

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10. Stability and reactivity

Reactivity: None known.

Stability: The product is stable under normal conditions *(see Section 7)*. Hazardous polymerization will not occur. Spontaneous decomposition at normal temperatures will not occur.

Conditions to avoid: Avoid exposing battery to fire or high temperature (>60°C). Do not disassemble, crush, puncture, incinerate, immerse in water or short-circuit. *Do not over charge or force over-discharge.* Do not install with incorrect polarity. Aluminium casing of cells slowly dissolves in strong mineral acids.

Incompatible materials: Oxidizing agents, acids, bases and reducing agents.

Hazardous decomposition products: Hydrogen Fluoride, Carbon Monoxide, Carbon Dioxide, Lithium Hydroxide, Aluminium Oxide, possible fluorine-compounds, Carbon soot.

Lithium hexafluorophosphate may react with water in the atmosphere and produce some traces of hydrogen fluoride. Thermal decomposition of the cell may release electrolyte liquid and vapour, harmful materials, and dusts.

11. Toxicological information

Inhalation, skin contact and eye contact are possible when the cell/battery is opened, damaged or mechanically, thermally, electrically abused to the point of compromising the integrity of the enclosure. Exposure to internal contents and corrosive fumes is very irritating to skin, eyes and mucous membranes. Overexposure can cause symptoms of non-fibrotic lung injury and membrane irritation.

Routes of *exposure*				
Skin contact: NO	Skin absorption: NO	Eye contact: NO	Inhalation: NO	Ingestion: NO

Acute Exposure	
Skin *contact:*	No effect noticed in routine handling of product.
Eye *contact:*	The solid bulk has no effects on eyes.
Inhalation:	Not anticipated.
Ingestion:	Ingestion is not likely, given the physical size and state of the cell.

Chronic Exposure	
Skin *contact:*	Not anticipated.
Eye *contact:*	Not anticipated.
Inhalation:	Not anticipated.
Ingestion:	Ingestion is not a likely exposure route.

Exposure Limits: None	**Irritancy**: None	**Sensitization**: Not anticipated	**Carcinogenicity**: Not anticipated
Teratogenicity: Not anticipated	**Mutagenicity**: Not anticipated	**Reproductive toxicity**: Not anticipated	**Interactive effects**: None expected

12. Ecological information

When promptly used or disposed, the battery does not present environmental hazard. When disposed, keep away from water, rain and snow. See Section 2.

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Ecotoxicity:	Not available
Mobility:	Not available
Persistence and degradability:	Not readily biodegradable
Bio accumulative potential:	Not available
Other adverse effects:	Solid cells released into the natural environment will slowly degrade and may release harmful or toxic substances.

13. Disposal considerations

- Do not disassemble or modify the cell or battery.
- Do not throw out battery or cells.
- *Do not incinerate or subject cells to temperature >70°C. This can result in leakages and/or cell explosion.*
- Recycle it through authorized recycling companies following the law of each country.

If batteries are still fully charged or only partially discharged, they must be considered a reactive hazardous waste because of significant amount of uncreated, or unconsumed lithium remaining in the spent battery. Batteries must be neutralized through an approved secondary treatment facility prior to disposal as hazardous waste. Battery recycling can be done in authorized facilities.
Battery recycling is either mandatory (European Directive 2006/66/EC) or recommended. Batteries should be fully discharged prior to disposal and terminals should be protected.
Dispose in accordance with European directives, international and local laws and regulations.
Do not dump into any sewers, on the ground or into any water bodies.

For any question about Li-ion battery disposal procedure, please refer to Midac Service Center.
Find your nearest Midac Service Center on http://www.midacbatteries.com/en/filiali.html

14. Transport information

Overview

Persons offering Lithium cells or batteries for transport need to properly determine the applicable provisions and instructions. More information is available in the official documentation for this purpose at http://www.unece.org/trans/danger/danger.html.
Consideration must inter alia be given to:

- The mode of transport: air, sea or road/rail
- The country of origin and destination
- The applicable UN code and related description
- The status of the good: new batteries, waste cells or batteries, damaged or defective cells or batteries, prototype for testing/short production run or commercial series product
- UN test certification status of the cell or the battery: if it has been tested according to Manual of Tests and Criteria, subsection 38.3 (UN 38.3)

Regulatory Framework

Shipment of new and used Lithium-ion cells and batteries is classified as Dangerous Goods under the UN model regulation.

- If shipped as such: UN 3480 “Lithium ion batteries”
- If shipped contained in equipment or packed with equipment: UN 3481 “Lithium ion batteries contained in equipment” or “Lithium ion batteries packed with equipment”
- If shipped contained in a vehicle, the vehicle is category UN 3171 “Battery powered vehicle” (for all-electric vehicles) or UN 3166 (for hybrid vehicles).

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Transport under following regulations:

Road / Rail

- ADR (European Agreement concerning the International Carriage of Dangerous Goods by Road)
- RID (International Statutory Order on the Conveyance of Dangerous Goods by Rail)
- ADG (Australian Code for the Transport of Dangerous Goods by Road & Rail) (Australia)
- US Department of Transportation 49 CFR (Code of Federal Regulations) (USA)

Air

- IATA (International Air Transport Association): DGR (Dangerous Goods Regulations)
- ICAO (International Civil Aviation Organization): TI (Technical Instructions for Safety Transport of Dangerous Goods by Air)

Marine

- IMO (International Maritime Organization): IMDG (International Maritime Dangerous Goods) Code.

UN Number: 3480
Proper shipping name: LITHIUM ION BATTERIES
Transport hazard class(es): 9 Miscellaneous dangerous substances and articles
Packing Group: Not assigned
Special precautions during transport: Protect from short-circuiting. They should be packed in strong packaging for support during transport. Prevent the damage of the product by handling the cargo carefully without dropping, falling, breaking, or wetting by rain. Prevent collapse of cargo piles.
Hazchem Code (Australia): 4W

15. Regulatory information

The battery is not a “substance” or a “preparation” according to Regulation (EC) no. 1907/2006, it is an “article” and no substance is intended to be released during the utilization. There is therefore no obligation to provide a safety data sheet in accordance with the Regulation (EC) no. 1907/2006, article 31.

Australia and New Zealand:
SUSMP: Not applicable
AICS: All ingredients are on the AICS list.
HSNO Approval number: Not applicable
HSNO Group Title: Not applicable

United States Federal and State Regulations:
TSCA: All ingredients in these products are listed on the TSCA inventory

Composition	CAS#	TSCA	EC#	EINECS
Lithium Iron Phosphate	15365-14-7	Listed	604-917-2	Listed
Lithium Hexafluorophosphate	21324-40-3	Listed	244-334-7	Listed
Graphite	7782-42-5	Listed	231-955-3	Listed
Aluminium	7429-90-5	Listed	231-072-3	Listed
Copper	7440-50-8	Listed	231-159-6	Listed

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16. Other information

This information has been compiled from sources considered to be dependable and is, to the best of our knowledge, accurate and reliable as of the date compiled. However, neither complete exhaustiveness nor perfect reliability can be granted. The communication of this information does not constitute an implicit or specific warranty.

This information relates to the specific products it is applicable to and may be invalid for these products when used in combination with any other equipment or in any process. It is user's responsibility to satisfy himself as to the suitability and completeness of this information for his particular use.

Midac SpA does not accept liability for any loss or damage that may occur, whether direct, indirect, incidental or consequential, from the use of this battery information sheet provided as a service to our customers. Midac SpA does not offer warranty against patent infringement.

Hazard statements (purely indicative as not applicable to this product, but only to some of its components):
H225 – Highly flammable liquid and vapour
H228 – Flammable solid
H261 – In contact with water releases flammable gases
H304 – May be fatal if swallowed and enters airways
H314 – Causes severe skin burns and eye damage
H315 – Causes skin irritation
H319 – Causes serious eye irritation
H336 – May cause drowsiness or dizziness
H411 – Toxic to aquatic life with long lasting effects
H413 – May cause long lasting harmful effects to aquatic life.

Key abbreviations or acronyms used:

AICS:	Australian Inventory of Chemical Substances
ADG:	Australian Code for the Transport of Dangerous Goods by Road & Rail
ADR:	European Agreement concerning the International Carriage of Dangerous Goods by Road
CAS:	Chemical Abstracts Service
CFR:	Code of Federal Regulations
DGR:	Dangerous goods regulations
EC:	European Community
HSNO:	New Zealand's Hazardous Substances and New Organisms Act
IATA:	International Air Transport Association
ICAO:	International Civil Aviation Organization
IMDG:	International Maritime Dangerous Goods
IMO:	International Maritime Organization
N/AV:	Not available
N/APP:	Not applicable
SDS:	Safety Data Sheet
SUSMP:	Poisons Standard
TSCA:	Toxic Substances Control Act
TI:	Technical Instructions for Safety Transport of Dangerous Goods by Air

Date of preparation of review: *07/07/2022*