CARBEST
INNOVATIONS FOR MOBILE LIFE

LiFePO4 Battery 12 V 100 Ah | 60 Ah | 20 Ah

81209/81208/81207

UK – INSTRUCTION MANUAL

CONTENT

CHAPTER 1

ABOUT THIS DOCUMENT

This chapter includes the following sections:

- Overview
- Purpose of this document
- How this document is organized

OVERVIEW

The LiFePO4 battery modules are designed as a drop-in replacement for the 12 V lead acid batteries that typically serve as a standby power source in many high-availability and service-critical applications. Each battery pack combines LiFePO4 battery cells in series with integrated cell protection and balancing circuitry. An integrated microprocessor protects the battery pack from over-voltage, under-voltage and over-temperature (BMS).

PURPOSE OF THIS DOCUMENT

This manual provides detailed specifications as well as guidance on the safe and effective operation.

HOW THIS DOCUMENT IS ORGANIZED

This document is divided into the following parts:

Regulations
Discusses the safety EMC environmental and transportation regulations applicable to the battery module.

Applications
Discusses various applications

Troubleshooting
Discusses the unique behavior of the LiFePO4 battery modules compared to traditional lead-acid batteries, and how to operate the battery in those circumstances.

Glossary
Glossary of terms.

WARRANTY:

The warranty period is 24 months. Reimo reserves the right to rectify eventual defaults. The guarantee is excluded for all damages caused by faulty use or improper handling Liability limitations:

In no case Reimo will be reliable for collateral-, secondary- or indirect damages, costs, expenditure, missed benefits or missed earnings. The indicated sales price of the product is representing the equivalent value of Reimo's liability limitations.

CHAPTER 2

REGULATIONS

The chapter discusses the safety, EMC, environmental and transportation regulations applicable to the battery module. The transportation material presented here is not all-inclusive of the regulations required to ship a product, but is meant to inform you of the complexity involved in doing so. Anyone involved in the integration of Lithium Ion battery packs into a host product must review the regulations cited here to meet compliance standards with industry regulations.

This chapter includes the following sections:

- Safety Regulations
- Transporting Lithium Ion batteries
- Environmental Regulations

SAFETY REGULATIONS

- CE – EU consumer safety, health and environmental regulations. Signifies conformity with EMC directive (2014/30/EU)
- RoHS – Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment. Signifies conformity with directive (2011/65/EU)
- UN38.3 – requirements for safe transportation of Lithium Ion batteries.

TRANSPORTING LITHIUM ION BATTERIES

This section discusses the regulations governing the transportation of Lithium Ion cells and batteries. You should read and understand all relevant regulations discussed in this section before shipping batteries.

This section includes the following sections:

- Overview
- Regulations by Cell/Battery Size
- Following UN and DOT Regulations

NOTICE!

The regulations discussed in this manual apply to Lithium Ion cells and batteries. Once the LiFePo4 battery is integrated into a host product, the host product may be subject to additional transportation regulations that require additional certification testing. You must verify that your battery-powered host product is compliant with all applicable regulations. Refer the Table on page 6 for a list of UN numbers to reference to find applicable regulations for your application.

OVERVIEW OF PACKAGING AND TRANSPORT INSTRUCTIONS

According to Packing Instructions 965~967 of IATA DGR 58th Edition for transportation, the specuial provision 230of IMDG (inc Amdt 38-16). The batteries should be securely packed and protected against short-cirquits. Examine whether the package of the containers are integrate and tighten closed before transport. Take in a cargo of them without falling, dropping and breakage. Prevent colapse of cargo piles. Don't put the goods together with oxidizer and chief food chemicals. The transport vehicle and ship should be clean and sterilized before transport. During transport, the vehicle should prevent exposure, rain and high temperature. For stopovers, the vehicle should be away from fire and heat sources. When transported by sea, the assamble place should keep away from bedroom and kitchen, and isolated from the engine room, power and fire source. Under the condition of Road Transportation, the driver should drive in accordance with regulated route, don't stop over in the residential area and congested area.

REGULATIONS BY CELL/BATTERY SIZE

Lithium Lion batteries and cells are considered Class 9 which is one of nine classes of hazardous materials or dangerous goods defined in the UN, US and other regulations. As a class 9 material, cells and batteries must meet UN testing and packing requirements as well as shipping regulations. The chart below provides a synopsis of the regulations now in effect for both the US and Internationally.

SHIPPING AND PACKING REGULATIONS BY CELL/BATTERY SIZE

Regulation	Lithium Ion Cell/Batterie	Shipping Classification/ Testing	Special Packing/ Markings	Battery Size
USA	1.5 grams/ 8.0 grams Max. ELC (1)	Excepted/T1-T8(2)	Yes(5)	Small
	5.0 grams/25 grams Max. ELC(1)	Class 9/T1-T8(3)	Yes(6)	Medium
	>5.0 grams/ >25 grams Max. ELC(1)	Class 9/T1-T8(4)	Yes(6)	Large (more than)
International	20 Wh/100 Wh Max. Watt hours	Expected /T1-T8(7)	Yes	
	>20 Wh/100Wh	Class 9/T1-T8(4)	Yes(8)	

(1) Equivalent Lithium Content (ELC) in grams = rated capacity (Ah) x 0.3
(2) All cells and batteries must pass UN T1-T8 Tests
(3) Cells and batteries must pass UN T1-T8 Tests and must be shipped as Class 9 hazardous materials unless transported by motor vehicle or rail car
(4) Must pass UN T1-T8 Tests and be shipped as a Class 9 hazardous material
(5) Packages containing more than 12 batteries or 24 cells must meet certain packaging, marking, and shipping paper requirements
(6) Requires Class 9 marking, label, specification packaging, and shipping papers unless transported by motor vehicle or rail car
(7) Cells and batteries must pass UN T1-T8 Tests. Cells and batteries that pass UN Tests are expected from regulation. NOTE: The IMDG Code contains a grandfather clause for testing »small« cells and batteries until December 31, 2013
(8) Requires Class 9 markings, label, specification packaging, and shipping papers

FOLLOWING UN AND DOT REGULATIONS

Failure to comply with UN and DOT regulations while transporting Class 9 Hazardous Materials (Dangerous Goods) may result in substantial civil and criminal penalties. Following table outlines a process that you can follow to help ensure that cells and batteries are shipped per the required regulations.

SUGGESTED STEPS FOR REGULATORY COMPLIANCE

Step Number	Process step	Comments
1	Insure use of UN certified packaging if applicable	All dangerous goods must be shipped in UN certified packaging
2	Packaging of cell or battery	Pack per regulations
3	Package labeling(1)	Insure that packaging container has all required labeling
4	Fill out proper shipping documentation	Shippers declaration for dangerous goods, airway bill, etc
5	Ship package	Ensure that shipping company can ship DG

1) refer the next table for proper shipping names and UN numbers for Lithium ion batteries

PROPER SHIPPING NAMES AND UN NUMBERS

Proper Shipping Name	UN-Number
Lithium ion batteries	UN 3480
Lithium ion batteries packed with equipment	UN 3481
Lithium ion batteries contained in equipment	UN 3481

ENVIRONMENTAL REGULATIONS

The battery pack is compliant with the following environment regulations:

- EU Directive 2002/95/EC for Restriction of Hazardous Substances (RoHS)
- EU Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators
- Management Methods for Controlling Pollution Caused by Electronic Information Products Regulation (China RoHS)

CHAPTER 3

LIFEPO4 BATTERY MODULES

The batteries leverages LiFePo4 for the following key advantages over lead-acid alternatives:

- Longer life in applications requiring repeated discharge and recharge cycles
- Higher power capability, both during discharge and subsequent recharge
- More energy during applications requiring four hours of runtime or less
- Greater degree of safety due to the fact that the batteries are continually monitored by an integral microprocessor

CONFIGURATION AND OPERATION

This chapter discusses configuring, charging and discharging the batteries in the following sections:

- Terminology
- Configuration Options
- Integrated Module Protection

TERMINOLOGY

This chapter discusses configuring and operating 12 V LiFePO4 battery modules using the following terminology:

Terminology	Definition
Cell	Refers to an individual LiFePO4 cell that is the basis for the TI 12 V/110 battery module.
Module or Battery Module	LiFePO4 battery module

CONFIGURATION OPTIONS

We don't recommend to connect several modules in series or parallel, we suggest single module usage. Please do not build battery banks!

ATTENTION!

Do not connect the LiFePO4 battery modules in parallel, as the battery with higher voltage will charge the battery with lower voltage when two battery voltages are inconsistent, in which the charge current is too large may burn the batteries. Do not connect the modules to battery modules of other chemistries or 12 V battery modules of different capacities. For example, do not connect a 12 V 100Ah LiFePO4 battery to a lead-acid 12 V 100Ah or a LiFePO4 12 V 20/60 Ah.

RELATIONSHIP BETWEEN CHARGE LIMITS AND TEMPERATURE

Due to the chemistry of lithium Ion cells, the cells cannot accept as much charge current at lower temperatures without risking permanent loss of capacity. As the cell's temperature rises during the charging process, they can gradually accept higher currents.

CHARGE RATE BY TEMPERATURE

Temperature (°C)	Charge rate
-20~ -10	< 0,1 C
0~ 10	< 0,2 C
10~ 25	< 0,3 C

Maximum recommended continuous charge rate is 0,2 C.

INTEGRATED MODULE PROTECTION

The LiFePO4 battery module includes integrated protection circuitry to prevent the battery module from exceeding its voltage limits. The module's circuitry interrupts either charging or discharging current if the battery is in danger of exceeding upper or lower voltage or temperature limits.

Over Voltage and Under Voltage

The modules circuitry continuously monitors cell voltage and can interrupt either charge or discharge current in the event that a cell's voltage exceeds safe operating limits. The over voltage and under voltage protection include software/hardware protection.

Over voltage

MOSFET are used to control and will turn OFF and interrupt the charge current when meet over voltage protection (The protection circuitry interrupts current if the voltage on any single cell rises above 3.9 V.

For hardware protection: over voltage protection threshold is 3.9 V, the over voltage protection recovers when voltage drops to 3.6 V.

Under voltage

MOSFET are used to control and will turn OFF and interrupt the discharge current when meet under voltage protection (The protection circuitry interrupts current if the voltage on any single cell falls below 2.3 V or 2.0 V

Hardware protection:

During discharging, when any cell's voltage falls below 2.0 V, the discharge MOSFET turns OFF. Interrupt discharge current and under voltage protection will recover when voltage reaches to 2.5 V.

NOTE!

Under-voltage protection creates an open circuit, removing voltage from the terminals. With a lead-acid battery, finding no voltage at the terminals often indicates the battery has reached the end of its life. With the LifePo4 module, low voltage at the terminals typically means the cell protection circuitry has interrupted current to protect the battery module. Simply connect the module to a charger to restore voltage to the terminals.

OVER TEMPERATURE

A battery module has one temperature sensor to measure every cell bank's temperature and one PCBA to measure MOSFET temperature.

- The ideal hardware over temperature protection threshold of cell is around +65°C
- The ideal hardware over temperature protection threshold of MOSFET is around +85°C

During charging and discharging, when any cell banks temperature >60°C, software over temperature protection appears, charge and discharges MOSFETS turn OFF. When any cell banks temperature <55°C, over temperature protection disappear, charge and discharges MOSFETS turn ON again.

When any cell banks temperature >65°C, hardware over temperature protection appear, charge and discharge MOSFETS turn OFF. When the temperature decreases to 55°C, the charge and discharge MOSFETS turn ON again.

BALANCING

Over time, the cells inside a battery pack diverge in both capacity and SOC. An advantage of the module is the circuitry continuously monitors the capacity and SOC of each individual cell and balances the battery module to ensure maximum capacity.

CHAPTER 4

TROUBLESHOOTING

The LiFePO4 battery module is an extremely reliable battery module that provides greater useful life than comparable 12V lead-acid batteries. Despite the high reliability, you may encounter situations where the battery module does not operate as expected. These situations are typically the result of misuse, abuse or a non-optimal operating or storage environment. This chapter details potential issues you may encounter with and the appropriate troubleshooting procedures.

CHARGER TRIPS USING CC & CV

Problem

chargers trips when charging the battery module. This is due to the low impedance of the module creating a current inrush.

Solution

Reset the charger and try again.

TERMINAL VOLTAGE ABSENT OR LOW

Problem

Using a multi-meter to check terminal voltage shows the terminal voltage is low. Possible causes for this problem are:

- The voltage of a cell within the module dropped below 2.3V, causing the microprocessor to enable under-voltage protection.
- The module overheated, causing the microprocessor to enable over-temperature protection.

Solution

To resolve situations where terminal voltage is absent or low:

1. Allow the battery to cool and then recheck terminal voltage.
2. Connect the battery to a charger to wake the battery and recover terminal voltage. Depending on the module's voltage and state of balance it may take up to 48 hours to completely charge and balance the module.

BATTERY RAPIDLY DEPLETES ENERGY BETWEEN CHARGES

Problem

The battery module rapidly depletes its energy between charging. Possible causes for this problem are:

- The battery pack is out-of-balance.
- The battery pack has reached the end of its useful service life.

Solution

To resolve situations where the battery rapidly depletes its energy between charges:

1. Use a CC & CV charger for 48 hours to balance the battery packs cells.
2. Replace the battery pack.

BATTERY CURRENT DISAPPEARS WHEN CHARGING

Problem

Battery current disappears when charging. Possible causes for this problem are:

- The battery overheated, enabling over-temperature protection.
- The battery pack is out-of-balance.
- Charger voltage is too high.

Solution

To resolve situations where current disappears when charging:

1. Allow the battery to cool.
2. Use a CC & CV charger for 48 hours to balance the battery packs cells.
3. Reduce charger voltage to 14.6 V or less.

VOLTAGE DROPS ABRUPTLY

Problem

Battery voltage appears constant, then drops abruptly.

Solution

This is normal for this product. Constant voltage throughout the batterys SOC ensures maximum usable life. Once the voltage of a cell within the module drops below 2.3 V, the module‘s circuitry enables under-voltage protection, which creates an open circuit at the terminals.

APPENDIX A

GLOSSARY

This appendix contains the following sections:

TERMINOLOGY TABLE

The following table describes the terminology used in this document.

DEFINITIONS AND ACRONYMS

Term/Acronym	Meaning
ACR	Alternating Current Resistance
Ah	Amp- Hour is a unit of measure of charge that can be stored or delivered to/from a battery.
Batterie / Akku	One or more cells which are electrically connected together by permanent means, including case, terminals and markings
BCM	Battery Control Module – The Battery Control Module is necessary to aggregate information from modules and communicate with the system the ESS resides in.
BMS	Battery Management System – The Battery Management System refer to the collection of electronics responsible for monitoring and controlling the ESS.
C-Rate	An electrical current corresponding to that which will fill or empty a cell in one hour.
CC	Constant Current – A method to charge or discharge a battery in which the current is held constant independent of the battery‘s terminal voltage.
CE	Consultants Europe – Tests and Certifies safe and compliant product operation in Europe.
Cell	A single encased electrochemical unit (one positive and one negative electrode) which exhibits a voltage differential across two terminals.
CID	Current Interrupt Device – A small device integrated into a cell designed to interrupt the flow of current through its terminal when too much pressure or current exists in the cell.
CV	Constant Voltage – A method to charge a battery in which the terminal voltage is held constant and the current is determined by the power path impedance or some active current limiting
DVT	Design Verification Testing
ESS	Energy Storage System
iSOC	Current based SOC algorithm
OCV	Open Circuit Voltage – voltage reading of a battery when there is no current going in or out of it.
vSOC	Voltage based SOC algorithm

PRODUCT SPECIFICATION

1 TECHNICAL DATA

This product is LiFePO4 battery pack (including BMS).
The 12 V 100 Ah LiFePO4 battery Pack is combined by 20 pcs F20 (3.2 V 20 Ah) battery cells in a 4S x 5P cell configuration **(81209)**

Electrical Characteristics	Nominal Voltage	12 V
	Nominal Capacity	100 Ah
	Energy	1200 Wh
	Cycle Life	> 2000 cycles@1C 100% DOD
	Months Self Discharge	< 3%
Standard Charge	Charge Current	20 A
	Charge Mode	0.2C5A constnat current (CC) charge to 14.6 V, then contant voltage (CV) 14.6 V charge till charge current decline to ≤ 0.05 C5A
	Charging cutt-off voltage	
Standard Discharge	Continuous Current	
	Max. Discharge Current	
	Discharge cut-off voltage	
Environmental	Recommended Operation Temperature Range	Charge: 0~45 °C, Discharge -20~60 °C at 60 ± 25% R.H
	Recommended Storage Temperature Range	0~45 °C at 60 ± 25% R.H
Mechanical	Cell & Methode	20 Ah 4S5P
	Platic Case	ABS
	Dimensions (mm)	305 x 170 x 210 mm
	Weight (kg./lbs.)	13.5 kg
	Terminal	M8

The 12 V 60 Ah LiFePO4 battery Pack is combined by 28 pcs F8.5 (3.2 V 8.5 Ah) battery cells in a 4S x 7P cell configuration **(81208)**

Electrical Characteristics	Nominal Voltage	12 V
	Nominal Capacity	60 Ah
	Energy	720 Wh
	Cycle Life	> 2000 cycles@1C 100% DOD
	Months Self Discharge	<3 %
Standard Charge	Charge Current	12 A
	Charge Mode	0.2C5A constnat current (CC) charge to 14.6 V, then constant voltage (CV) 14.6 V charge till charge current decline to ≤0.05 C5A
	Charging cutt-off voltage	14.6 ± 0.2 V
Standard Discharge	Continuous Current	60 A
	Max. Discharge Current	80 A
	Discharge cut-off voltage	9.2 V
Environmental	Recommended Operation Temperature Range	Charge: 0~45 °C, Discharge -20~60 °C at 60 ± 25% R.H
	Recommended Storage Temperature Range	0~45 °C at 60 ± 25% R.H
Mechanical	Cell & Methode	8.5 Ah 4S7P
	Platic Case	ABS
	Dimensions (mm)	195 x 165 x 180 mm
	Weight (kg./lbs.)	7,2 kg
	Terminal	M8

The 12 V 20 Ah LiFePO4 battery Pack is combined by 16 pcs F5 (3.2 V 5 Ah) battery cells in a 4S x 4P cell configuration **(81207)**

Electrical Characteristics	Nominal Voltage	12 V
	Nominal Capacity	20 Ah
	Energy	240 Wh
	Cycle Life	> 2000 cycles@1C 100% DOD
	Months Self Discharge	<3 %
Standard Charge	Charge Current	4 A
	Charge Mode	0.2C5A constant current (CC) charge to 14.6 V, then constant voltage (CV) 14.6 V charge till charge current decline to ≤0.05 C5A
	Charging cutt-off voltage	14.6 ± 0.2 V
Standard Discharge	Continuous Current	20 A
	Max. Discharge Current	40 A
	Discharge cut-off voltage	9.2 V
Environmental	Recommended Operation Temperature Range	Charge: 0~45 °C, Discharge -20~60 °C at 60 ± 25% R.H
	Recommended Storage Temperature Range	0~45 °C at 60 ± 25% R.H
Mechanical	Cell & Methode	5 Ah 4S4P
	Platic Case	ABS
	Dimensions (mm)	180 x 75 x 165 mm
	Weight (kg./lbs.)	2,7 kg
	Terminal	M6

2 ELECTRICAL INTERCONNECT

The battery module has a positive terminal and a negative terminal. The positive terminal is connected directly to the positive electrode of the top cell bank, while the negative terminal is connected to the negative electrode of the bottom cell bank.

3 THE BATTERY PROTECTION

The battery has a built in BMS which can protect the battery from over-charge, over-discharge, over-current, short-circuit, cell balancing and battery over temperature protection.

81207

CARBEST
INNOVATIONS FOR MOBILE LIFE

SAFETY DATA SHEET

Safety Data Sheet according to Directive 1907/2006/EC, Article 31, Annex II, and TRGS 220 (Germany)
Product name: **LiFePO4 Battery 12V/20Ah**
Date of issue: 31 January 2018
Date of last revision:

SECTION 1: Product and Company Identification

Trade name:	**LiFePO4 Battery 12V/20Ah**
Product utilisation:	Battery for living quarters in caravan trailers and mobile homes.
Manufacturer/Supplier:	**Reimo Reisemobil-Center GmbH** D-63329 Egelsbach, Boschring 10, Germany Ph.: +49 (0) 6103 4005-21 oder -22 Fax: +49 (0) 6150 8662 177 E-mail: service@reimo.com Internet: www.reimo.com
Person in charge:	Technical advice, ph.: +49 (0) 6103-4005-28 Fax: +49 (0) 6150 8662 177
Emergency telephone code:	+49 (0) 6201 989 956 (Mr. Volker Müller)

SECTION 2: Hazards Identification

2.1 Classification and labelling according to Regulation (EC) No 1272/2008 (Directive 1272/2008/EC)

None.

2.2 Information pertaining to particular dangers to man and the environment:

No harmful effects on human health or on the environment are to be expected, if the product is used as specified and as long as the housing of the battery is tight.

Though, the product contains harmful ingredients, which are hermetically and impermeably sealed and will stay sealed upon foreseeable extraneous causes.

According to the UN Manual of Tests and Criteria ST/SG/AC.10/11/Rev. 5, 38.1, the product is tested for impermeability, for consistency against low pressure up to 116 hPa, for mechanical compression up to 13 kN, for temperature stability between -42°C to +72°C, for vibration stability between 7 Hz and 200 Hz, for shock stability up to 150 G (gavitational acceleration), for short circuit stability (0.1 Ω at 55°C), for electrical excess charge at 29.2V and 20 A, etc. (Report Nr. SZAB20160607UAM701 der Guangzhou MCM Certification and Testing Co. Ltd. of 6 July 2016).

There are considerable hazards for human health and for the environment (refer to SECTION 4, 11 and 12), if the ingredients are set free by fire, by exceptional extraneous causes, by targeted breakup of the housing (refer also to SECTION 7) or whatsoever.

Ion batteries are hazardous waste, and are to be disposed specifically (refer to SECTION 13).

Combustible, may explode when burning or overheating.

SECTION 3: Composition / Information on Ingredients

3.1 Characterization:	Lithium ion battery on the basis of phosphoric acid, iron(2+) lithium salt (1:1:1) with copper and graphite as main components, electrolytes and different polymers. The ingredients are hermetically and impermeably sealed. The housing consists of a acrylnitril/butadiene/styrene Copolymer.

3.2 Ingredients:

Substance	CAS No.	EINECS No.	Characterization	Mass%
Phosphoric acid, iron(2+) lithium salt (1:1:1)	15365-14-7	not existent	Mixed phosphate	< 23
Copper, foil	7440-50-8	231-159-6	Metal	< 11
Graphite, powder	7782-42-5	231-955-3	Crystalline Carbon	< 10
ABS rubber housing	not applicable	not applicable	Copolymer acrylnitril/butadiene/styrene	< 20
1,3-Dioxolan-2-one *Synonyms: Ethylene carbonate; Cyclic ethylene carbonate; 1,3-Dioxacyclopentan-2-one; Glycol carbonate; Ethylene glycol, cyclic carbonate.*	96-49-1	202-510-0	Polymer	< 7.5
Lithium hexafluoro-phosphate	21324-40-3	244-334-7	Fluorinated lithium phosphate	< 7.5
Dimethyl carbonate *Synonyms: Carbonic acid, dimethyl ester; Dimethyl carbonate*	616-38-6	210-478-4	Ester of carbonic acid	< 7.5
Aluminium, foil	7429-90-5	231-072-3	Metal	< 6
Polypropylene *Synonyms: 1-Propene, homopolymer; Propylene polymer*	9003-07-0	not existent	Polymer	< 4.5
Polyethylene *Synonyms: Ethene, homopolymer; Ethylene polymer*	9002-88-4	not existent	Polymer	< 4.5
Polyvinylidene fluoride Synonyms: *PVDF; Ethene, 1,1-difluoro-, homopolymer*	24937-79-9	not existent	Fluorinated Polymer	< 1.7
Carboxymethylcellulose sodium *Synonyme: Sodium CMC; Cellulose, carboxymethyl ether; Sodium carboxymethyl cellulose*	9004-32-4	not existent	modified Cellulose	< 0.5
Benzene, ethenyl-, polymer with 1,3-butadiene Synonyms: *1,3-Butadiene, polymer with styrene; 1,3-Butadiene-ethenylbenzene copolymer; 1,3-Butadiene-styrene copolymer; Butadiene-styrene rubber; Polybutadiene-polystyrene copolymer*	9003-55-8	not existent	Polymer	< 0.5
Colour	not applicable	not applicable	not specified	< 0.2
Soldering flux	not applicable	not applicable	mixture of hydrcarbons	< 0.2

This product does not contain substances of very high concern according to directive 1907/2006/EC, article 57.

3.2 Hazardous ingredients:

*Classification of the **pure** ingredients according to Directive 1272/2008/EC (GHS)*

Common or chemical name:

1,3-Dioxolan-2-one Eye Irrit. 2 (Eye irritation, Category 2): H319

Signal word: "Warning"

H319: Causes serious eye irritation.

Lithium hexafluorophosphate Acute tox. (oral) 3 (Acute toxicity if ingested, Hazard Category 3): H301
Skin corrosion/irritation 1A, (Hazard Category 1A): H314
STOT RE 1 [Specific organ toxicity (repeated exposure), Hazard Category 1]: H372

Signal word: "Danger"

H301: Toxic if swallowed.
H314: Causes severe skin burns and eye damage.
H372: Causes damage to organs (bones, teeth) through prolonged or repeated exposure.

Dimethyl carbonate Flammable liquids 2 (Hazard Category 2): H225

Signal word: "Danger"

H225: Highly flammable liquid and vapour.

SECTION 4: First Aid Measures

General information: As long as the housing of the battery is tight no first aid measures are necessary.

If the housing of the battery is damaged and ingredients are leaking the following first aid measures are appropriate:

Inhalation of aerosols

or vapours:	Move the affected person into fresh air. If symptoms persist give oxygen or artificial respiration and seek medical attention.
Skin:	Wash skin with plenty of water and soap. Change contaminated clothing. If symptoms persist seek medical attention.
Eyes:	Rinse with plenty of water for at least 15 minutes. If symptoms persist seek medical attention.
Ingestion:	If the patient is conscious have him rinse his mouth with water, spit it out and then have him drink water or milk. In case of persisting symptoms put him in a recovery position and - if the patient is conscious - let him vomit. Seek medical attention.
Information for doctor:	None

SECTION 5: Fire Fighting Measures

General information:	Most parts of the product are combustible including the housing (see also „Special hazards“ below).
Extinguishing agents:	Carbon dioxide, foam, dry chemical. Use water spray only if the housing is tight and the battery is not loaded to prevent short circuit.
Not suitable extinguishing agents for safety reasons:	Water jet. Water in general, if the housing is damaged or the battery is loaded and is not protected against short circuit.
Special hazards:	In case of burning the battery might explode! In case of exposure above 80°C or in case of damage of the housing, the battery may leak or spout vaporized electrolytes or their decomposed products, such as very toxic fluorides and hydrofluoric acid, hydrocarbons, carbon monoxide and phosphorous oxides. The electrolytes are partly inflammable and may cause serious eye damage and severe skin burns by contact or by aerosols, and severe irritation of the respiratory tract by inhaling aerosols or by inhaling vapours specially when the product is burning.
Special protective equipment for fire-fighters:	Use self-contained breathing apparatus and protection clothes.
Further notice:	In case of fire in the surroundings immediately remove battery to a safe place or at least try to cool the battery, but take care of the possibility of a short circuit by water.

SECTION 6: Accidental Measures after Release of Ingredients

General information:	Only if the battery is damaged and ingredients are set free or after a short circuit , accidental measures may be necessary.
Personal precaution:	Leave the endangered area immediately and warn co-workers. Ventilate the area until aerosols and vapours are gone before entering the area with protective clothing, chemical resistant gloves (refer to SECTION 8.3) and safety goggles with side shield. Otherwise use fine dust respirator (P2 or P3) or a ventilated breathing hood.
Environmental precaution:	Do not let the ingredients enter surface water, groundwater or soil. Prevent large amounts of ingredients from entering the sewage system.

81207

SAFETY DATA SHEET

CARBEST
INNOVATIONS FOR MOBILE LIFE

Safety Data Sheet according to Directive 1907/2006/EC, Article 31, Annex II, and TRGS 220 (Germany)
Product name: **LiFePO4 Battery 12V/20Ah**
Date of issue: 31 January 2018
Date of last revision:

Methods for cleaning up: Prevent generation of aerosols. Pack solid parts into container to be labelled. Take up liquids with liquid-adsorbent material (sand, clay, cat litter, etc.). Fill contaminated adsorbent material into container. Finally clean area with water and soap. Discharge contaminated material according to SECTION 13.

SECTION 7: Handling and Storage

Handling: Under no circumstances, do not open the housing, do not throw the battery into fire, prevent the battery from heating-up and from direct sunlight, do not cause short circuit. If the battery becomes hot (< 80°C), remove it to a safe place or at least try to cool the battery, but take care of the possibility of a short circuit by water, if the battery is loaded. If the battery is heated above 80°C leave the endangered area immediately and warn co-workers (refer to SECTION 5, „*Special hazards", and SECTION 6, „Personal precaution"*). Prevent battery from exceeding vibrations.

Notes for prevention of fire and explosion: Prevent battery from heat above 80°C, and prevent short circuit.

Storage: Store at a dry and cool place, possibly below 20°, but not below freezing point. The higher the temperature of storage the sooner the loading capacity will drop. Prevent short circuit by covering the electrical poles with plastics. Do not store together with inflammable substances. Keep loaded and used batteries separated. German VCI-class of storage: 12 (combustible solids, TRGS 510).

SECTION 8: Exposure Controls / Personal Protection

8.1 Technical protection: Opening of the housing of the battery should only be done by trained personnal. In this case use closed plant with exhaust. Otherwise use at least exhaust and monitor the occupational exposure limit. Avoid generation of aerosols.

8.2 Ingredients with occupational exposure limit values, if ingredients of the battery are set free:

General Limit for Dusts

- *CAS No.:*	Not applicable.
- *Exposure limit value:*	1.25 mg/m^3 alveolar dust or alveolar aerosols 10 mg/m^3 inhalable dust or aerosols
- *Short term limit value:*	2 (II)
- *Origin:*	AGW
- *BLV:*	None; old BLV for aluminium: 60 µg creatinine in urine, not obligatory any more
- *Remarks:*	H (for lithium hexafluorophosphate), C (for copper and lithium hexafluorophosphate)
- *Year:*	2017

Explanations:

- *AGW*	Exposure limit value (refer to TRGS 900, Germany)
- *BLV:*	Biological limit value (refer to TRGS 903, Germany)

- Short term limit values:	Exceeding factor X: Exposure may exceed the exposure limit value by the factor X for not longer than 15 minutes. 4 measurements at intervals of 1 hour. Exceeding factor =X=: Exposure must never exceed the exposure limit value by more than the factor X (instantaneous value). (I): Category I: substances for which the exposure limit value is based on local effects or sensitizing substances. (II): Category II: substances effective by resorption.
- Remarks::	H : Substances effective by resorption through skin S = Sensitizing substance C: There is no teratogenic risk if the exposure limit value and the BLV are maintained.

8.4 Personal Protection:

The following protection measures apply, if ingredients of the battery are set free:

Respiratory protection:	Use respiratory protection apparatus or ventilated breathing hood.
Hand protection:	If contact with hands cannot be avoided use protection gloves tested according to DIN EN 374. Seek advice from manufacturers of protection gloves. If gloves cannot be used for safety reasons (e. g. while working at rotating machines) use skin-protective barrier cream. Consult the company medical officer for the type of barrier cream to be used. Comment: In contrary to the European ordinance 1907/2006/EC (REACH), it is not sufficient to specify only the protective glove material. The break-through-times are dependent not only on the material but also on the manufacturing technique. It is therefore essential to consult the manufacturers of protective gloves. For the ingredients of the battery the following materials should be appropriate: for short-time contact (few minutes) rubber or plastic is sufficient, for long-time contact use gloves of nitrile/latex rubber - NBR (0.35 mm).
Eye protection:	Safety glasses with side shield.
Skin protection:	Use chemical resistant protective clothing if contamination of clothing cannot be avoided. Change contaminated clothing immediately.
General protective measures:	Avoid contact with eyes and skin. Do not inhale aerosols or vapours.
Industrial hygiene:	Wash hands or skin after contact immediately. Do not eat, drink, smoke or take snuff at work.

SECTION 9: Physical and Chemical Properties

9.1 Appearance

Physical state:	Solid.
Colour:	Black.
Odour:	None.

9.2 Relevant data for Safety and Health for the product:

Data which should be mentioned in this SECTION are not relevant for the product. Refer to SECTIONS 2, 6, 7, and 10 for safety-related information.

Nominal Voltage: 24 V
Loading capacity: 20 Ah

SECTION 10: Stability and Reactivity

Thermal decomposition:	Danger of explosion above 130°C.
Conditions to be avoided:	Heating above 70°C. Short circuit. Damage of the housing. Long-time storage under humid conditions.
Substances to be avoided:	Strong oxidizing agents (halogenes, nitriles, hydrogen peroxide, perchloric acid, aqua regia, etc.), strong acids, strong lyes.
Dangerous reactions:	Ingredients may form very toxic fluorides and hydrofluoric acid with strong acids.
Hazardous decomposition products:	Very toxic fluorides and hydrofluoric acid, hydrocarbons, carbon monoxide and phosphorous oxides.
Dangerous polymerisations:	None.

SECTION 11: Toxicological Information

11.1 Product

As long as the housing of the battery is tight and no ingredients are set free, no harmful effects on human health are to be expected.

The following information is valid for all ingredients:

Sensitization:	No sensitizing effects are known.
Mutagenicity:	No mutagenic effects are known.
Cancer:	No carcinogenic effects are known. All ingredients are not mentioned as carcinogenic in the lists of ACGIH, NIOSH, IARC or TRGS 905.
Reproductive toxicity:	No toxic effects on reproduction are known.

Toxic effects after repeated exposure (subacute to chronic toxicity):

No symptoms after repeated occupational exposure (chronic or subchronic) are known.

Practical experience: There are no reports of symptoms of poisoning after handling the ingredients.

11.2 Toxicological information on the pure ingredients:

11.2.1 Phosphoric acid, iron(2+) lithium salt (1:1:1)

The toxicology of this substance is yet hardly investigated. There are no experimental animal data (refer to MSDS of Sigma-Aldrich Inc.). In analogy to iron (III) phosphate no noteworthy hazards to

the human health are to be exspected, because the substance is unsoluable and therefore is hardly resorbed in the body.

11.2.2 Graphite

Toxikokinetics, metabolism and distribution:

Resorption in the body is negligible.

Acute toxicity:

There are no LD_{50}-values of animal experiments. There were no deaths of rats after injection of suspensions of graphite (HSDB).

Practical experiences with occupational exposures of graphite (HSDB):

After inhalation:	Slight irritation of the respiratory tract.
After skin contact:	No symptoms.
After eye contact:	Physical irritation.
After ingestion:	No experiences.
Chronic toxicity:	Bronchitis and lung damage after repeated and prolonged inhalation.

11.2.3 1,3-Dioxolan-2-one

Toxikokinetics, metabolism and distribution:

Inhalation and absorption through skin are the main routes of occupational exposure. There is no further information available.

Acute toxicity:

LD_{50} (rat, oral):	> 5,000 mg / kg (Merck)
LD_{50} (rabbit, dermal):	> 2,000 mg / kg (OECD guideline 402)
LC_{50} (female rat, inhalation):	1,268 mg / L / 7 h (Sigma-Aldrich)
After inhalation:	No information is available.
After skin contact:	Slight irritation (rabbit, OECD guideline 402).
After eye contact:	Serious eye irritation.
After ingestion:	No information is available.
Sensitization:	No sensitizing effects were found. (Bühler-Test with guinea pig; OECD guideline 406, Sigma-Aldrich)
Mutagenicity:	No mutagenic effects were found. Mutagenicity of bacteria: Ames-Test negative (Merck); in-vitro-test on gene mutation of lymphocytes of mice: negative (Sigma-Aldrich).
Reproduktionstoxizität:	Refer to SECTION 11.1.
Cancer:	Refer to SECTION 11.1.
Chronic toxicity:	No information.

11.2.4 Lithium hexafluorophosphate

Toxikokinetics, metabolism and distribution:

No information is available.

Acute toxicity:

LD_{50} (female rat, oral):	> 50 mg/kg (OECD guideline 423, Sigma-Aldrich)
After inhalation:	Severe irritation of the respiratory tract.
After skin contact:	Severe irritation up to chemical burn (test with artificial skin, Sigma-Aldrich).
After eye contact:	Severe irritation, risk of serious, irreversible eye damage (rabbit, OECD guideline 405).
After ingestion:	Toxic. Severe irritation of the oral cavity, of the oesophagus and the stomach.
Sensitization:	No sensitizing effects were found. In-vitro-test with mouse: negative (OECD guideline 429, Sigma-Aldrich).
Mutagenicity:	No mutagenic effects were found. Mutagenicity of germ cells: Ames-Test with salmonella typhimurium: negativ (Sigma-Aldrich).
Cancer:	Refer to SECTION 11.1.
Reproductive toxicity:	Refer to SECTION 11.1.
Chronic toxicity:	After repeated and prolonged exposure hazardous to bones and teeth.
Further information:	Fire or strong acids may set free fluorides and hydrofluoric acid, which cause severe health problems.

11.2.5 Dimethyl carbonate

Toxikokinetics, metabolism and distribution:

Inhalation is the main route of occupational exposure. Absorption through skin is low (animal studies, HSDB). There is no further information available.

Acute toxicity:

LD_{50} (rat, oral):	9,000 mg/kg (Merck)
LD_{50} (rat, oral):	13,000 mg/kg (HSDB)
LD_{50} (mouse, oral):	6,000 mg/kg (HSDB)
LD_{50} (rabbit, dermal):	> 5,000 mg/kg (Merck)
LD_{50} (guinea pig, dermal):	> 9,350 mg/kg (HSDB)
LC_{50} (rat, inhalation):	> 140 mg / L / 4 h (Merck, HSDB)
After inhalation:	Irritant to mucous membranes (Merck).
After skin contact:	Not irritant (Merck)
After eye contact:	Slight irritations (Merck)
After ingestion:	Animal experiment: weakness, tremor, unconsciousness (HSDB)
Sensitization:	Not sensitizing effects were found (Patch-Test with humans, Merck).

Mutagenicity:	No mutagenic effects were found. Mutagenicity of bacteria: Ames-Test negative (Merck); gene toxicity in animal experiments was not found (HSDB).
Cancer:	Refer to SECTION 11.1.
Reproductive toxicity:	Refer to SECTION 11.1.
Chronic toxicity:	Animal studies showed no chronic toxicity (HSDB).

11.2.6 Polyvinylidene fluoride

The toxicology of this substance is not completely investigated. There are no experimental animal data. The supplier, Sigma-Aldrich Ltd., states the following possible human hazards:

After inhalation:	May be hazardous to health. May irritate the respiratory tract.
After skin contact:	May be hazardous to health after absorption through skin. May be irritant to skin.
After eye contact:	May be irritating to eyes.
After ingestion:	May be hazardous to health.

The monomer, vinylidene fluoride, should be more toxic than the polymer. Though, concentrations up to 65.5 g/m^3 in animal experiments showed no symptoms. The monomer is classified as cancerogenic category 3 in TRGS 904, but need not be labelled as carcinogenic.

11.2.7 All other infredients

The toxicities of the remaining ingredients are negligible in comparison to the substances mentioned in this SECTION, specially because aluminium and copper are not powdery.

SECTION 12: Ecological Information

12.1 Product:

The product as delivered and in normal use causes no environmental hazards. If the product is disposed into the environment the housing will leak after a long period of time or after outside impact, and the ingredients will finally end up in the environment. On behalf of the ingredients the product must be classified as highly water polluting (WGK 3) according to AwSV (Germany). But as long as the battery is in good order and is used as intended it is not water polluting (WGK 0).

*12.2 Information on the **pure** ingredients:*

12.2.1 Phosphoric acid, iron(2+) lithium salt (1:1:1)

Ecotoxic effects:	Not biodegradable. On account of its sparing solubility in water no efficient ecotoxic effects are to be expected. Triphylin, Li(Fe, Mn)[PO_4], is a natural mineral, where the iron-II-ions of phosphoric acid, iron(2+) lithium salt (1:1:1) are partly replaced by manganese-II-ions.
Ecotoxic data:	There are no experimental animal data.
Biodegradation:	As a anorganic substance a potential of biodegradation is not expected.

Abiotic degradation: On a long term scale a transformation to lithium oxide and iron-III-phosphate is to be expected.

WGK (Water Pollution Category,Germany): 1 (slightly water polluting) (classification by analogy to trilithium phosphate and to iron phoshate (both WGK 1).

12.2.2 Graphite

Ecotoxic effects: Not biodegradable. As a natural substance no ecotoxic effects are to be expected.

Ecotoxic data: There are no experimental animal data.

WGK (Water Pollution Category,Germany): 0 (not water polluting) (BAnz. AT, idendification no.: 801)

12.2.3 Copper

Ecotoxic effects: Bioaccumulation is not to be expected. Metallic copper is mobilised below p_H 2.8. Oxidised and water soluble copper ions are not mobile in soil, because copper ions are strongly adsorbed by solids (HSDB).

WGK (Water Pollution Category,Germany): 0 (not water polluting) (BAnz. AT, idendification no.: 1443)

12.2.4 1,3-Dioxolan-2-one

Ecotoxic effects: Readily biodegradable. No noteworthy bioaccumulation is to be expected.

Ecotoxic data (Merck):

Fish toxicity:	Leuciscus idus:	LC_{50}: > 1,000 mg/l / 96 h
Daphnia toxicity:	Daphnia magna:	EC_{50}: > 100 mg/l / 48 h
Bacterial toxicity:	Pseudomonas putida:	EC_{50}: > 10,000 mg/l / 17 h

Further information:

Biodegradation: 86.9% / 29 d (aerob, Sigma-Aldrich)

Distribution: log P(o/w) = -0.34 (Merck)

WGK (Water Pollution Category,Germany): 1 (slightly water polluting), (BAnz. AT, idendification no.: 2268)

12.2.5 Lithium hexafluorophosphate

Ecotoxic effects: No information is available.

Ecotoxic data (Sigma-Aldrich):

Daphnia toxicity:	Daphnia magna:	EC_{50}:	> 100 mg/l / 48 h (OECD guideline 202)
Bacterial toxicity:	Pseudomonas putida:	EC_{50}:	> 1,000 mg/l / 3 h (OECD guideline 209)
Algae toxicity:	Pseudokirchneriella subcap.:	EC_{50}:	> 100 mg/l / 76 h (OECD guideline 201)

Further information:

WGK (Water Pollution Category,Germany): 3 (highly water polluting), (classification by Sigma-Aldrich)

12.2.6 Dimethyl carbonate

Ecotoxic effects: Readily biodegradable. Bioaccumulation is expected to be low. In the atmosphere dimethyl carbonate is decomposed with a half-time of 24.6 days. High mobility in soil. Vaporation to the atmosphere (HSDB).

Ecotoxic data (Merck):

Fish toxicity: Leuciscus idus: LC_{50}: > 1,000 mg/l / 96 h

Further information:

Biodegradation: 88% / 28 d (Merck); > 90% / 28 d (MITI-Test, HSDB)

Bioconcentration factor: 3.2 (HSDB)

Distribution: log P(o/w) = -0.23 (Gestis, Merck)

WGK (Water Pollution Category,Germany): 1 (slightly water polluting), (BAnz. AT, idendification no.: 4077)

12.2.7 Aluminium

Ecotoxic effects: Not biodegradable. Aluminium is insoluble, but in acid soil (pH < 4.5) aluminium is slowly oxidised to soluble ions, which are toxic to water organisms.

Ecotoxic data of dissolved aluminium ions:

Fish toxicity:		LC_{50}:	0.12 - 5.2 mg/l, median value: 1.55mg/l (Gestis)
Daphnia toxicity:	Daphnia magna:		toxic above 136 mg/l (Merck)
Algae toxicity:	Scenedesmus quadricauta:		toxic above 1.5 mg/l (Merck)

Further information:

WGK (Water Pollution Category,Germany): 0 (not water polluting) (BAnz. AT, idendification no.: 1443)

12.2.8 Polyvinylidene fluoride

Ecotoxic effects: There is no ecotoxic information for the polymer. For the gaseous monomer, vinylidine fluoride, the ecotoxicity of which should be considerably higher than that of the polymer, a half-time in the atmosphere of 8 to 60 days is stated. Due to the slight water solubility in water the mobility in soil and water is low. For the polymer, mobility should be even lower. The biodegradability of the monomer is low. For the polymer the biodegradability should be even lower. An estimation of the bioconcentration factor is 3 and is described as low (log P(o/w): 1.24). The bioconcentration factor of the polymer should be even lower (HSDB).

Ecotoxic data: No ecotoxic data are available.

WGK (Water Pollution Category,Germany): 1 (slightly water polluting), (BAnz. AT, idendification no.: 766)

12.2.9 Carboxymethylcellulose sodium

Ecotoxic effects: No information is available.

Ecotoxic data:

Crustacean toxicity: EC_{50}: 87.3 mg/l / 48 h (Gestis)

WGK (Water Pollution Category,Germany): 1 (slightly water polluting), (BAnz. AT, idendification no.: 829)

12.2.10 All other ingredients

The remaining ingredients are polymers, which are hardly biodegradable and hardly ecotoxic because of their insolubility.

For all the remaining ingredients:

WGK (Water Pollution Category,Germany): 0 (not water polluting) (BAnz. AT, idendification no.: 766)

Do not allow the product to enter water supplies, waste water or soil (refer to SECTION 12.1 and 13.1).

SECTION 13: Disposal Considerations

13.1 Product: For disposal the product has not to be supervised. But before disposal the battery must be pretreated and the ingredients must be partly recovered (BattGDV bzw. RL 2006/66EG). The battery may be returned to the supplier or must be left over for a disposal company. It is not allowed to dispose the battery either as household waste nor as hazardous waste. This applies also, if the housing of the battery is damaged or/and part of the ingredients together with contaminated adsorbent and filter materials are collected in a container.

Waste code: 16 06 05

Waste name: Other batteries and accumulators

13.2 Packing materials :

a) Packing materials made of plastics:
Waste code: 15 01 02
Waste name: Packing materials made of plastics

b) Packing materials made of metal:
Waste code: 15 01 04
Waste name: Packing materials made of metal

Waste-codes in accordance with the European Waste Register Ordinance.

SECTION 14: Transport Information

Tansportation by land ADR/RID/GGVSE

ADR/RID/GGVSE Class:	9
UN No.:	3480
UN proper technical name:	Lithium Ion Batteries
Hazard label for posting*:	Class 9 (also after 31 Dec. 2018)
Hazard label (for packages):	Class 9 Miscellaneous (permitted until 31 Dec. 2018)
Hazard label (for packages):	Class 9A Lithium Ion Batteries (of 01 Jan. 2019 obligatory)
Packaging group:	II
Packing instruction:	PI 910
Max. gross weight per package:	30 kg
Tunnel category:	E
Classification code:	M4 Lithium Battery
Limited quantity:	LQ: 0.0

* e. g. for truck or container

The special instructions SV 310 und SV 376 for transport of batteries with damaged housing, the special instructions SV 310 und SV 377 for the transport of batteries for disaposal, and packing instructions PI 908 bzw. 909 are to be complied with.

Shipping by air ICAO-TI und IATA-DGR 58 edition 2017:

ICAO-TI und IATA-Class:	9
UN/ID No.:	3480
IATA proper shipping name:	Lithium Ion Batteries
Marine Pollutant:	No
Hazard label:	Class 9 Miscellaneous (RMD) (permitted until 31 Dec. 2018)
Hazard label:	Class 9A Lithium Battery (of 01 Jan. 2019 obligatory)
Packing instruction:	965 Part IA
Max. gross weight per package:	35 kg
Additional hazard label on outer case:	
Special instructions:	A88, A99, A154, A164, A182, A183, A185, A201, A206, A331

The transport with passenger aircrafts is for bidden. Batteries must not be damaged. The battery terminals must be protected against short circuit. The state of charge must not exeed 30% of each battery. The energy content (Wh) must be specified on the type plate. Note that the different airline companies request different terms for transportation (refer to Addendum 1 of IATA-DGR 58 edition 2017).

Shipping by sea IMDG/GGVSee:

IMDG/GGVSee Class:	9
UN No.:	3480
Proper shipping name:	Lithium Ion Batteries
Hazard label for posting*:	Class 9 (also after 31 Dec. 2018)
Hazard label (for packages):	Class 9 Miscellaneous (permitted until 31 Dec. 2018)
Hazard label (for packages):	Class 9A Lithium Ion Batteries (of 01 Jan. 2019 obligatory)
IMDG-Code:	38 - 16
EMS:	F-A, S-I
Packaging group:	II
Packing instruction:	PI 910
Max. gross weight per package:	30 kg
Marine Pollutant:	No

The special instructions SV 310 und SV 376 for transport of batteries with damaged housing and the special instructions SV 310 und SV 377 for the transport of batteries for disaposal are to be complied with.

SECTION 15: Regulatory Information

15.1 There are no safety reports according to 1907/2006/EC (REACH) available.

15.2 *Substances of very high concern (SVHC):*

This product does not contain substances of very high concern according to directive 1907/2006/EC, article 57.

All other relevant regulations are mentioned elsewhere in this Safety Data Sheet.

15.3 National Regulations, Germany:

15.3.1	*StörfallV:*	Annex I, lower threshold: 10 t; upper threshold: 50 t (applies only to dimethyl carbonate)
15.3.2	*TA-Luft:*	Clause 5.2.1 Total dust including fine dusts: max. mass concentration: 20 mg/m^3 or max. mass flow: 0,20 kg/h (at a max. mass concentration of 150 mg/m^3). Clause 5.2.5: Organic substances apart from particulate matter: max. mass concentration: 50 mg/m^3 or max. mass flow: 0.50 kg/h (calculated as total carbon)
15.3.3	*VCI Storage Class:*	11 (combustible solids, TRGS 510)
15.4.4	*AwSV:*	Batteries with damaged housing are WGK 3 (highly water polluting, German Water Pollution Category 3), batteries in good order are WGK 0 (not water polluting, German Water Pollution Category 0), as long as damaging can be excluded, e. g. by traffic of staplers.

15.3.5	*Volatile components:*	Water, dimethyl carbonate (boiling point: 90°C, VOC: < 8,5%, only relevant, if the housing is untight)
15.4	*Further regulations and restrictions:*	Occupational restrictions: Take note of Directive 94/33/EC on the protection of young people at work.

SECTION 16: Other Information

Abbreviations:

ACGIH: American Conference of Governmental Industrial Hygienists
AwSV: Verordnung über Anlagen zum Umgang mit wassergefährdenden Stoffen vom 18 April 2017 (ordinance about facilities for handling with substances hazardous to water of 18 April 2017)
BAnz. AT: Liste der wassergefährdenden Stoffe, veröffentlicht im Bundesanzeiger AT vom 10.08.2017 (list of water polluting substances, published in Bundesanzeiger AT of 8 Aug. 2017)
BOD: Biochemical oxygen demand
ChemIDplus: Database of the United States National Library of Medicine
COD: Chemical oxygen demand
DNEL Derived No-Effect Level
DIN; DIN/ISO: German standard
DOC: Dissolved organic carbon
EN: European standard
EINECS: European Inventory of Existing Commercial Substances
GESTIS: Data base of Berufsgenossenschaftliches Institut für Arbeitsschutz, Germany
IARC: International Agency for Research on Cancer (World Health Organisation)
IRT: Inhalation risk test
IUCLID: International Uniform ChemicaL Information Database
LOEC: Lowest Observed Effect Concentration
MAK: Maximale Arbeitsplatzkonzentration (maximum concentration in the workplace, out of date)
Merck, Sigma-Aldrich, etc.: Actual MSDS of Merck, Darmstadt, Germany, Sigma-Aldrich, Germany, etc.
MITI: Ministry of International Trade and Industry, Japan
MSDS: Material Safety Data Sheet
NIOSH: National Institute for Occupational Safety and Health (USA)
NOAEL: No Observed Adverse Effect Level
NOEC: No Observed Effect Concentration
NOEL: No Observed Effect Level
OECD: Organisation for Economic Co-operation and Development
OSHA: Occupational Safety and Health Adminstration (USA)
PNEC: Predicted No-Effect Concentration
RTECS: Register of Toxic Effects of Chemical Substances
TG: Test-Guideline
TOC: Total organic carbon
TOD: Theoretical oxygen demand
TRGS: Technische Regel für Gefahrstoffe (Technical rules for hazardous substances, Germany)
TRK: Technische Richtkonzentration (technical concentration in the workplace to comply with [for cancerogenic substances], out of date)
TTC: 2,3,5-Triphenyl, tetrazoliumchloride
VCI: Verband der Chemischen Industrie e.V. (Chemical Industry Association, Germany)
VwVwS: Ordinance on water polluting substances, Germany
VOC: Volatile organic carbons
WGK: Wassergefährdungsklasse (Water Pollution Category, Germany)

As of the date of issuance, we are providing available information relevant to the handling of this material in the workplace. All information contained herein is offered in good faith in the belief that it is accurate. This material safety data sheet shall not be deemed to constitute or imply any warranty of

81207

SAFETY DATA SHEET

CARBEST
INNOVATIONS FOR MOBILE LIFE

any kind. In the event of an adverse incident associated with this material, this safety data sheet is not intended as a substitute for consultation with appropriately trained personnel (refer to SECTION 1). Nor is this safety data sheet intended to be a substitute for any product literature which may accompany the finished product.

81208

CARBEST
INNOVATIONS FOR MOBILE LIFE

SAFETY DATA SHEET

Safety Data Sheet according to Directive 1907/2006/EC, Article 31, Annex II, and TRGS 220 (Germany)
Product name: **LiFePO4 Battery 12V/60Ah**
Date of issue: 31 January 2018
Date of last revision:

SECTION 1: Product and Company Identification

Trade name:	**LiFePO4 Battery 12V/60Ah**
Product utilisation:	Battery for living quarters in caravan trailers and mobile homes.
Manufacturer/Supplier:	**Reimo Reisemobil-Center GmbH** D-63329 Egelsbach, Boschring 10, Germany Ph.: +49 (0) 6103 4005-21 oder -22 Fax: +49 (0) 6150 8662 177 E-mail: service@reimo.com Internet: www.reimo.com
Person in charge:	Technical advice, ph.: +49 (0) 6103-4005-28 Fax: +49 (0) 6150 8662 177
Emergency telephone code:	+49 (0) 6201 989 956 (Mr. Volker Müller)

SECTION 2: Hazards Identification

2.1 Classification and labelling according to Regulation (EC) No 1272/2008 (Directive 1272/2008/EC)

None.

2.2 Information pertaining to particular dangers to man and the environment:

No harmful effects on human health or on the environment are to be expected, if the product is used as specified and as long as the housing of the battery is tight.

Though, the product contains harmful ingredients, which are hermetically and impermeably sealed and will stay sealed upon foreseeable extraneous causes.

According to the UN Manual of Tests and Criteria ST/SG/AC.10/11/Rev. 5, 38.1, the product is tested for impermeability, for consistency against low pressure up to 116 hPa, for mechanical compression up to 13 kN, for temperature stability between -42°C to +72°C, for vibration stability between 7 Hz and 200 Hz, for shock stability up to 150 G (gavitational acceleration), for short circuit stability (0.1 Ω at 55°C), for electrical excess charge at 29.2V and 20 A, etc. (Report Nr. SZAB20160607UAM701 der Guangzhou MCM Certification and Testing Co. Ltd. of 6 July 2016).

There are considerable hazards for human health and for the environment (refer to SECTION 4, 11 and 12), if the ingredients are set free by fire, by exceptional extraneous causes, by targeted breakup of the housing (refer also to SECTION 7) or whatsoever.

Ion batteries are hazardous waste, and are to be disposed specifically (refer to SECTION 13).

Combustible, may explode when burning or overheating.

SECTION 3: Composition / Information on Ingredients

3.1 Characterization:	Lithium ion battery on the basis of phosphoric acid, iron(2+) lithium salt (1:1:1) with copper and graphite as main components, electrolytes and different polymers. The ingredients are hermetically and impermeably sealed. The housing consists of a acrylnitril/butadiene/styrene Copolymer.

3.2 Ingredients:

Substance	CAS No.	EINECS No.	Characterization	Mass%
Phosphoric acid, iron(2+) lithium salt (1:1:1)	15365-14-7	not existent	Mixed phosphate	< 24
Copper, foil	7440-50-8	231-159-6	Metal	< 11
Graphite, powder	7782-42-5	231-955-3	Crystalline Carbon	10
ABS rubber housing	not applicable	not applicable	Copolymer acrylnitril/butadiene/styrene	< 17
1,3-Dioxolan-2-one *Synonyms: Ethylene carbonate; Cyclic ethylene carbonate; 1,3-Dioxacyclopentan-2-one; Glycol carbonate; Ethylene glycol, cyclic carbonate.*	96-49-1	202-510-0	Polymer	< 8
Lithium hexafluoro-phosphate	21324-40-3	244-334-7	Fluorinated lithium phosphate	< 8
Dimethyl carbonate *Synonyms: Carbonic acid, dimethyl ester; Dimethyl carbonate*	616-38-6	210-478-4	Ester of carbonic acid	< 8
Aluminium, foil	7429-90-5	231-072-3	Metal	< 6
Polypropylene *Synonyms: 1-Propene, homopolymer; Propylene polymer*	9003-07-0	not existent	Polymer	< 4.5
Polyethylene *Synonyms: Ethene, homopolymer; Ethylene polymer*	9002-88-4	not existent	Polymer	< 4.5
Polyvinylidene fluoride Synonyms: *PVDF; Ethene, 1,1-difluoro-, homopolymer*	24937-79-9	not existent	Fluorinated Polymer	< 1.7
Carboxymethylcellulose sodium *Synonyme: Sodium CMC; Cellulose, carboxymethyl ether; Sodium carboxymethyl cellulose*	9004-32-4	not existent	modified Cellulose	< 0.5
Benzene, ethenyl-, polymer with 1,3-butadiene Synonyms: *1,3-Butadiene, polymer with styrene; 1,3-Butadiene-ethenylbenzene copolymer; 1,3-Butadiene-styrene copolymer; Butadiene-styrene rubber; Polybutadiene-polystyrene copolymer*	9003-55-8	not existent	Polymer	< 0.5
Colour	not applicable	not applicable	not specified	< 0.2
Soldering flux	not applicable	not applicable	mixture of hydrcarbons	< 0.2

This product does not contain substances of very high concern according to directive 1907/2006/EC, article 57.

SAFETY DATA SHEET

CARBEST
INNOVATIONS FOR MOBILE LIFE

3.2 Hazardous ingredients:

*Classification of the **pure** ingredients according to Directive 1272/2008/EC (GHS)*

Common or chemical name:

1,3-Dioxolan-2-one Eye Irrit. 2 (Eye irritation, Category 2): H319

Signal word: "Warning"

H319: Causes serious eye irritation.

Lithium hexafluorophosphate Acute tox. (oral) 3 (Acute toxicity if ingested, Hazard Category 3): H301
Skin corrosion/irritation 1A, (Hazard Category 1A): H314
STOT RE 1 [Specific organ toxicity (repeated exposure), Hazard Category 1: H372

Signal word: "Danger"

H301: Toxic if swallowed.
H314: Causes severe skin burns and eye damage.
H372: Causes damage to organs (bones, teeth) through prolonged or repeated exposure.

Dimethyl carbonate Flammable liquids 2 (Hazard Category 2): H225

Signal word: "Danger"

H225: Highly flammable liquid and vapour.

SECTION 4: First Aid Measures

General information: As long as the housing of the battery is tight no first aid measures are necessary.

If the housing of the battery is damaged and ingredients are leaking the following first aid measures are appropriate:

Inhalation of aerosols

or vapours:	Move the affected person into fresh air. If symptoms persist give oxygen or artificial respiration and seek medical attention.
Skin:	Wash skin with plenty of water and soap. Change contaminated clothing. If symptoms persist seek medical attention.
Eyes:	Rinse with plenty of water for at least 15 minutes. If symptoms persist seek medical attention.
Ingestion:	If the patient is conscious have him rinse his mouth with water, spit it out and then have him drink water or milk. In case of persisting symptoms put him in a recovery position and - if the patient is conscious - let him vomit. Seek medical attention.
Information for doctor:	None

SECTION 5: Fire Fighting Measures

General information:	Most parts of the product are combustible including the housing (see also „Special hazards“ below).
Extinguishing agents:	Carbon dioxide, foam, dry chemical. Use water spray only if the housing is tight and the battery is not loaded to prevent short circuit.
Not suitable extinguishing agents for safety reasons:	Water jet. Water in general, if the housing is damaged or the battery is loaded and is not protected against short circuit.
Special hazards:	In case of burning the battery might explode! In case of exposure above 80°C or in case of damage of the housing, the battery may leak or spout vaporized electrolytes or their decomposed products, such as very toxic fluorides and hydrofluoric acid, hydrocarbons, carbon monoxide and phosphorous oxides. The electrolytes are partly inflammable and may cause serious eye damage and severe skin burns by contact or by aerosols, and severe irritation of the respiratory tract by inhaling aerosols or by inhaling vapours specially when the product is burning.
Special protective equipment for fire-fighters:	Use self-contained breathing apparatus and protection clothes.
Further notice:	In case of fire in the surroundings immediately remove battery to a safe place or at least try to cool the battery, but take care of the possibility of a short circuit by water.

SECTION 6: Accidental Measures after Release of Ingredients

General information:	Only if the battery is damaged and ingredients are set free or after a short circuit , accidental measures may be necessary.
Personal precaution:	Leave the endangered area immediately and warn co-workers. Ventilate the area until aerosols and vapours are gone before entering the area with protective clothing, chemical resistant gloves (refer to SECTION 8.3) and safety goggles with side shield. Otherwise use fine dust respirator (P2 or P3) or a ventilated breathing hood.
Environmental precaution:	Do not let the ingredients enter surface water, groundwater or soil. Prevent large amounts of ingredients from entering the sewage system.

Methods for cleaning up: Prevent generation of aerosols. Pack solid parts into container to be labelled. Take up liquids with liquid-adsorbent material (sand, clay, cat litter, etc.). Fill contaminated adsorbent material into container. Finally clean area with water and soap. Discharge contaminated material according to SECTION 13.

SECTION 7: Handling and Storage

Handling: Under no circumstances, do not open the housing, do not throw the battery into fire, prevent the battery from heating-up and from direct sunlight, do not cause short circuit. If the battery becomes hot (< 80°C), remove it to a safe place or at least try to cool the battery, but take care of the possibility of a short circuit by water, if the battery is loaded. If the battery is heated above 80°C leave the endangered area immediately and warn co-workers (refer to SECTION 5, „*Special hazards", and SECTION 6, „Personal precaution"*). Prevent battery from exceeding vibrations.

Notes for prevention of fire and explosion: Prevent battery from heat above 80°C, and prevent short circuit.

Storage: Store at a dry and cool place, possibly below 20°, but not below freezing point. The higher the temperature of storage the sooner the loading capacity will drop. Prevent short circuit by covering the electrical poles with plastics. Do not store together with inflammable substances. Keep loaded and used batteries separated. German VCI-class of storage: 12 (combustible solids, TRGS 510).

SECTION 8: Exposure Controls / Personal Protection

8.1 Technical protection: Opening of the housing of the battery should only be done by trained personnal. In this case use closed plant with exhaust. Otherwise use at least exhaust and monitor the occupational exposure limit. Avoid generation of aerosols.

8.2 Ingredients with occupational exposure limit values, if ingredients of the battery are set free:

General Limit for Dusts

- *CAS No.:*	Not applicable.
- *Exposure limit value:*	1.25 mg/m^3 alveolar dust or alveolar aerosols 10 mg/m^3 inhalable dust or aerosols
- *Short term limit value:*	2 (II)
- *Origin:*	AGW
- *BLV:*	None; old BLV for aluminium: 60 µg creatinine in urine, not obligatory any more
- *Remarks:*	H (for lithium hexafluorophosphate), C (for copper and lithium hexafluorophosphate)
- *Year:*	2017

Explanations:

- *AGW*	Exposure limit value (refer to TRGS 900, Germany)
- *BLV:*	Biological limit value (refer to TRGS 903, Germany)

- Short term limit values:	Exceeding factor X: Exposure may exceed the exposure limit value by the factor X for not longer than 15 minutes. 4 measurements at intervals of 1 hour. Exceeding factor =X=: Exposure must never exceed the exposure limit value by more than the factor X (instantaneous value). (I): Category I: substances for which the exposure limit value is based on local effects or sensitizing substances. (II): Category II: substances effective by resorption.
- Remarks::	H : Substances effective by resorption through skin S = Sensitizing substance C: There is no teratogenic risk if the exposure limit value and the BLV are maintained.

8.4 Personal Protection:

The following protection measures apply, if ingredients of the battery are set free:

Respiratory protection:	Use respiratory protection apparatus or ventilated breathing hood.
Hand protection:	If contact with hands cannot be avoided use protection gloves tested according to DIN EN 374. Seek advice from manufacturers of protection gloves. If gloves cannot be used for safety reasons (e. g. while working at rotating machines) use skin-protective barrier cream. Consult the company medical officer for the type of barrier cream to be used. Comment: In contrary to the European ordinance 1907/2006/EC (REACH), it is not sufficient to specify only the protective glove material. The break-through-times are dependent not only on the material but also on the manufacturing technique. It is therefore essential to consult the manufacturers of protective gloves. For the ingredients of the battery the following materials should be appropriate: for short-time contact (few minutes) rubber or plastic is sufficient, for long-time contact use gloves of nitrile/latex rubber - NBR (0.35 mm).
Eye protection:	Safety glasses with side shield.
Skin protection:	Use chemical resistant protective clothing if contamination of clothing cannot be avoided. Change contaminated clothing immediately.
General protective measures:	Avoid contact with eyes and skin. Do not inhale aerosols or vapours.
Industrial hygiene:	Wash hands or skin after contact immediately. Do not eat, drink, smoke or take snuff at work.

SECTION 9: Physical and Chemical Properties

9.1 Appearance

Physical state:	Solid.
Colour:	Black.
Odour:	None.

9.2 Relevant data for Safety and Health for the product:

Data which should be mentioned in this SECTION are not relevant for the product. Refer to SECTIONS 2, 6, 7, and 10 for safety-related information.

Nominal Voltage:	24 V
Loading capacity:	60 Ah

SECTION 10: Stability and Reactivity

Thermal decomposition:	Danger of explosion above 130°C.
Conditions to be avoided:	Heating above 70°C. Short circuit. Damage of the housing. Long-time storage under humid conditions.
Substances to be avoided:	Strong oxidizing agents (halogenes, nitriles, hydrogen peroxide, perchloric acid, aqua regia, etc.), strong acids, strong lyes.
Dangerous reactions:	Ingredients may form very toxic fluorides and hydrofluoric acid with strong acids.
Hazardous decomposition products:	Very toxic fluorides and hydrofluoric acid, hydrocarbons, carbon monoxide and phosphorous oxides.
Dangerous polymerisations:	None.

SECTION 11: Toxicological Information

11.1 Product

As long as the housing of the battery is tight and no ingredients are set free, no harmful effects on human health are to be expected.

The following information is valid for all ingredients:

Sensitization:	No sensitizing effects are known.
Mutagenicity:	No mutagenic effects are known.
Cancer:	No carcinogenic effects are known. All ingredients are not mentioned as carcinogenic in the lists of ACGIH, NIOSH, IARC or TRGS 905.
Reproductive toxicity:	No toxic effects on reproduction are known.

Toxic effects after repeated exposure (subacute to chronic toxicity):

No symptoms after repeated occupational exposure (chronic or subchronic) are known.

Practical experience: There are no reports of symptoms of poisoning after handling the ingredients.

11.2 Toxicological information on the pure ingredients:

11.2.1 Phosphoric acid, iron(2+) lithium salt (1:1:1)

The toxicology of this substance is yet hardly investigated. There are no experimental animal data (refer to MSDS of Sigma-Aldrich Inc.). In analogy to iron (III) phosphate no noteworthy hazards to

the human health are to be exspected, because the substance is unsoluable and therefore is hardly resorbed in the body.

11.2.2 Graphite

Toxikokinetics, metabolism and distribution:

Resorption in the body is negligible.

Acute toxicity:

There are no LD_{50}-values of animal experiments. There were no deaths of rats after injection of suspensions of graphite (HSDB).

Practical experiences with occupational exposures of graphite (HSDB):

After inhalation:	Slight irritation of the respiratory tract.
After skin contact:	No symptoms.
After eye contact:	Physical irritation.
After ingestion:	No experiences.
Chronic toxicity:	Bronchitis and lung damage after repeated and prolonged inhalation.

11.2.3 1,3-Dioxolan-2-one

Toxikokinetics, metabolism and distribution:

Inhalation and absorption through skin are the main routes of occupational exposure. There is no further information available.

Acute toxicity:

LD_{50} (rat, oral):	> 5,000 mg / kg (Merck)
LD_{50} (rabbit, dermal):	> 2,000 mg / kg (OECD guideline 402)
LC_{50} (female rat, inhalation):	1,268 mg / L / 7 h (Sigma-Aldrich)
After inhalation:	No information is available.
After skin contact:	Slight irritation (rabbit, OECD guideline 402).
After eye contact:	Serious eye irritation.
After ingestion:	No information is available.
Sensitization:	No sensitizing effects were found. (Bühler-Test with guinea pig; OECD guideline 406, Sigma-Aldrich)
Mutagenicity:	No mutagenic effects were found. Mutagenicity of bacteria: Ames-Test negative (Merck); in-vitro-test on gene mutation of lymphocytes of mice: negative (Sigma-Aldrich).
Reproduktionstoxizität:	Refer to SECTION 11.1.
Cancer:	Refer to SECTION 11.1.
Chronic toxicity:	No information.

11.2.4 Lithium hexafluorophosphate

Toxikokinetics, metabolism and distribution:

No information is available.

Acute toxicity:

LD_{50} (female rat, oral):	> 50 mg/kg (OECD guideline 423, Sigma-Aldrich)
After inhalation:	Severe irritation of the respiratory tract.
After skin contact:	Severe irritation up to chemical burn (test with artificial skin, Sigma-Aldrich).
After eye contact:	Severe irritation, risk of serious, irreversible eye damage (rabbit, OECD guideline 405).
After ingestion:	Toxic. Severe irritation of the oral cavity, of the oesophagus and the stomach.
Sensitization:	No sensitizing effects were found. In-vitro-test with mouse: negative (OECD guideline 429, Sigma-Aldrich).
Mutagenicity:	No mutagenic effects were found. Mutagenicity of germ cells: Ames-Test with salmonella typhimurium: negativ (Sigma-Aldrich).
Cancer:	Refer to SECTION 11.1.
Reproductive toxicity:	Refer to SECTION 11.1.
Chronic toxicity:	After repeated and prolonged exposure hazardous to bones and teeth.
Further information:	Fire or strong acids may set free fluorides and hydrofluoric acid, which cause severe health problems.

11.2.5 Dimethyl carbonate

Toxikokinetics, metabolism and distribution:

Inhalation is the main route of occupational exposure. Absorption through skin is low (animal studies, HSDB). There is no further information available.

Acute toxicity:

LD_{50} (rat, oral):	9,000 mg/kg (Merck)
LD_{50} (rat, oral):	13,000 mg/kg (HSDB)
LD_{50} (mouse, oral):	6,000 mg/kg (HSDB)
LD_{50} (rabbit, dermal):	> 5,000 mg/kg (Merck)
LD_{50} (guinea pig, dermal):	> 9,350 mg/kg (HSDB)
LC_{50} (rat, inhalation):	> 140 mg / L / 4 h (Merck, HSDB)
After inhalation:	Irritant to mucous membranes (Merck).
After skin contact:	Not irritant (Merck)
After eye contact:	Slight irritations (Merck)
After ingestion:	Animal experiment: weakness, tremor, unconsciousness (HSDB)
Sensitization:	Not sensitizing effects were found (Patch-Test with humans, Merck).

Mutagenicity:	No mutagenic effects were found. Mutagenicity of bacteria: Ames-Test negative (Merck); gene toxicity in animal experiments was not found (HSDB).
Cancer:	Refer to SECTION 11.1.
Reproductive toxicity:	Refer to SECTION 11.1.
Chronic toxicity:	Animal studies showed no chronic toxicity (HSDB).

11.2.6 Polyvinylidene fluoride

The toxicology of this substance is not completely investigated. There are no experimental animal data. The supplier, Sigma-Aldrich Ltd., states the following possible human hazards:

After inhalation:	May be hazardous to health. May irritate the respiratory tract.
After skin contact:	May be hazardous to health after absorption through skin. May be irritant to skin.
After eye contact:	May be irritating to eyes.
After ingestion:	May be hazardous to health.

The monomer, vinylidene fluoride, should be more toxic than the polymer. Though, concentrations up to 65.5 g/m^3 in animal experiments showed no symptoms. The monomer is classified as cancerogenic category 3 in TRGS 904, but need not be labelled as carcinogenic.

11.2.7 All other infredients

The toxicities of the remaining ingredients are negligible in comparison to the substances mentioned in this SECTION, specially because aluminium and copper are not powdery.

SECTION 12: Ecological Information

12.1 Product:

The product as delivered and in normal use causes no environmental hazards. If the product is disposed into the environment the housing will leak after a long period of time or after outside impact, and the ingredients will finally end up in the environment. On behalf of the ingredients the product must be classified as highly water polluting (WGK 3) according to AwSV (Germany). But as long as the battery is in good order and is used as intended it is not water polluting (WGK 0).

*12.2 Information on the **pure** ingredients:*

12.2.1 Phosphoric acid, iron(2+) lithium salt (1:1:1)

Ecotoxic effects:	Not biodegradable. On account of its sparing solubility in water no efficient ecotoxic effects are to be expected. Triphylin, Li(Fe, Mn)[PO_4], is a natural mineral, where the iron-II-ions of phosphoric acid, iron(2+) lithium salt (1:1:1) are partly replaced by manganese-II-ions.
Ecotoxic data:	There are no experimental animal data.
Biodegradation:	As a anorganic substance a potential of biodegradation is not expected.

Abiotic degradation: On a long term scale a transformation to lithium oxide and iron-III-phosphate is to be expected.

WGK (Water Pollution Category,Germany): 1 (slightly water polluting) (classification by analogy to trilithium phosphate and to iron phoshate (both WGK 1).

12.2.2 Graphite

Ecotoxic effects: Not biodegradable. As a natural substance no ecotoxic effects are to be expected.

Ecotoxic data: There are no experimental animal data.

WGK (Water Pollution Category,Germany): 0 (not water polluting) (BAnz. AT, idendification no.: 801)

12.2.3 Copper

Ecotoxic effects: Bioaccumulation is not to be expected. Metallic copper is mobilised below p_H 2.8. Oxidised and water soluble copper ions are not mobile in soil, because copper ions are strongly adsorbed by solids (HSDB).

WGK (Water Pollution Category,Germany): 0 (not water polluting) (BAnz. AT, idendification no.: 1443)

12.2.4 1,3-Dioxolan-2-one

Ecotoxic effects: Readily biodegradable. No noteworthy bioaccumulation is to be expected.

Ecotoxic data (Merck):

Fish toxicity:	Leuciscus idus:	LC_{50}: > 1,000 mg/l / 96 h
Daphnia toxicity:	Daphnia magna:	EC_{50}: > 100 mg/l / 48 h
Bacterial toxicity:	Pseudomonas putida:	EC_{50}: > 10,000 mg/l / 17 h

Further information:

Biodegradation: 86.9% / 29 d (aerob, Sigma-Aldrich)

Distribution: log P(o/w) = -0.34 (Merck)

WGK (Water Pollution Category,Germany): 1 (slightly water polluting), (BAnz. AT, idendification no.: 2268)

12.2.5 Lithium hexafluorophosphate

Ecotoxic effects: No information is available.

Ecotoxic data (Sigma-Aldrich):

Daphnia toxicity:	Daphnia magna:	EC_{50}:	> 100 mg/l / 48 h (OECD guideline 202)
Bacterial toxicity:	Pseudomonas putida:	EC_{50}:	> 1,000 mg/l / 3 h (OECD guideline 209)
Algae toxicity:	Pseudokirchneriella subcap.:	EC_{50}:	> 100 mg/l / 76 h (OECD guideline 201)

Further information:

WGK (Water Pollution Category,Germany): 3 (highly water polluting), (classification by Sigma-Aldrich)

12.2.6 Dimethyl carbonate

Ecotoxic effects: Readily biodegradable. Bioaccumulation is expected to be low. In the atmosphere dimethyl carbonate is decomposed with a half-time of 24.6 days. High mobility in soil. Vaporation to the atmosphere (HSDB).

Ecotoxic data (Merck):

Fish toxicity: Leuciscus idus: LC_{50}: > 1,000 mg/l / 96 h

Further information:

Biodegradation: 88% / 28 d (Merck); > 90% / 28 d (MITI-Test, HSDB)

Bioconcentration factor: 3.2 (HSDB)

Distribution: log P(o/w) = -0.23 (Gestis, Merck)

WGK (Water Pollution Category,Germany): 1 (slightly water polluting), (BAnz. AT, idendification no.: 4077)

12.2.7 Aluminium

Ecotoxic effects: Not biodegradable. Aluminium is insoluble, but in acid soil (pH < 4.5) aluminium is slowly oxidised to soluble ions, which are toxic to water organisms.

Ecotoxic data of dissolved aluminium ions:

Fish toxicity:		LC_{50}:	0.12 - 5.2 mg/l, median value: 1.55mg/l (Gestis)
Daphnia toxicity:	Daphnia magna:	toxic above 136 mg/l (Merck)	
Algae toxicity:	Scenedesmus quadricauta:	toxic above 1.5 mg/l (Merck)	

Further information:

WGK (Water Pollution Category,Germany): 0 (not water polluting) (BAnz. AT, idendification no.: 1443)

12.2.8 Polyvinylidene fluoride

Ecotoxic effects: There is no ecotoxic information for the polymer. For the gaseous monomer, vinylidine fluoride, the ecotoxicity of which should be considerably higher than that of the polymer, a half-time in the atmosphere of 8 to 60 days is stated. Due to the slight water solubility in water the mobility in soil and water is low. For the polymer, mobility should be even lower. The biodegradability of the monomer is low. For the polymer the biodegradability should be even lower. An estimation of the bioconcentration factor is 3 and is described as low (log P(o/w): 1.24). The bioconcentration factor of the polymer should be even lower (HSDB).

Ecotoxic data: No ecotoxic data are available.

WGK (Water Pollution Category,Germany): 1 (slightly water polluting), (BAnz. AT, idendification no.: 766)

12.2.9 Carboxymethylcellulose sodium

Ecotoxic effects: No information is available.

Ecotoxic data:

Crustacean toxicity: EC_{50}: 87.3 mg/l / 48 h (Gestis)

WGK (Water Pollution Category,Germany): 1 (slightly water polluting), (BAnz. AT, idendification no.: 829)

12.2.10 All other ingredients

The remaining ingredients are polymers, which are hardly biodegradable and hardly ecotoxic because of their insolubility.

For all the remaining ingredients:

WGK (Water Pollution Category,Germany): 0 (not water polluting) (BAnz. AT, idendification no.: 766)

Do not allow the product to enter water supplies, waste water or soil (refer to SECTION 12.1 and 13.1).

SECTION 13: Disposal Considerations

13.1 Product: For disposal the product has not to be supervised. But before disposal the battery must be pretreated and the ingredients must be partly recovered (BattGDV bzw. RL 2006/66EG). The battery may be returned to the supplier or must be left over for a disposal company. It is not allowed to dispose the battery either as household waste nor as hazardous waste. This applies also, if the housing of the battery is damaged or/and part of the ingredients together with contaminated adsorbent and filter materials are collected in a container.

Waste code: 16 06 05

Waste name: Other batteries and accumulators

13.2 Packing materials :

a) Packing materials made of plastics:
Waste code: 15 01 02
Waste name: Packing materials made of plastics

b) Packing materials made of metal:
Waste code: 15 01 04
Waste name: Packing materials made of metal

Waste-codes in accordance with the European Waste Register Ordinance.

SECTION 14: Transport Information

Tansportation by land ADR/RID/GGVSE

ADR/RID/GGVSE Class:	9
UN No.:	3480
UN proper technical name:	Lithium Ion Batteries
Hazard label for posting*:	Class 9 (also after 31 Dec. 2018)
Hazard label (for packages):	Class 9 Miscellaneous (permitted until 31 Dec. 2018)
Hazard label (for packages):	Class 9A Lithium Ion Batteries (of 01 Jan. 2019 obligatory)
Packaging group:	II
Packing instruction:	PI 910
Max. gross weight per package:	30 kg
Tunnel category:	E
Classification code:	M4 Lithium Battery
Limited quantity:	LQ: 0.0

* e. g. for truck or container

The special instructions SV 310 und SV 376 for transport of batteries with damaged housing, the special instructions SV 310 und SV 377 for the transport of batteries for disaposal, and packing instructions PI 908 bzw. 909 are to be complied with.

Shipping by air ICAO-TI und IATA-DGR 58 edition 2017:

ICAO-TI und IATA-Class:	9
UN/ID No.:	3480
IATA proper shipping name:	Lithium Ion Batteries
Marine Pollutant:	No
Hazard label:	Class 9 Miscellaneous (RMD) (permitted until 31 Dec. 2018)
Hazard label:	Class 9A Lithium Battery (of 01 Jan. 2019 obligatory)
Packing instruction:	965 Part IA
Max. gross weight per package:	35 kg
Additional hazard label on outer case:	
Special instructions:	A88, A99, A154, A164, A182, A183, A185, A201, A206, A331

The transport with passenger aircrafts is for bidden. Batteries must not be damaged. The battery terminals must be protected against short circuit. The state of charge must not exeed 30% of each battery. The energy content (Wh) must be specified on the type plate. Note that the different airline companies request different terms for transportation (refer to Addendum 1 of IATA-DGR 58 edition 2017).

Shipping by sea IMDG/GGVSee:

IMDG/GGVSee Class:	9
UN No.:	3480
Proper shipping name:	Lithium Ion Batteries
Hazard label for posting*:	Class 9 (also after 31 Dec. 2018)
Hazard label (for packages):	Class 9 Miscellaneous (permitted until 31 Dec. 2018)
Hazard label (for packages):	Class 9A Lithium Ion Batteries (of 01 Jan. 2019 obligatory)
IMDG-Code:	38 - 16
EMS:	F-A, S-I
Packaging group:	II
Packing instruction:	PI 910
Max. gross weight per package:	30 kg
Marine Pollutant:	No

The special instructions SV 310 und SV 376 for transport of batteries with damaged housing and the special instructions SV 310 und SV 377 for the transport of batteries for disaposal are to be complied with.

SECTION 15: Regulatory Information

15.1 There are no safety reports according to 1907/2006/EC (REACH) available.

15.2 *Substances of very high concern (SVHC):*

This product does not contain substances of very high concern according to directive 1907/2006/EC, article 57.

All other relevant regulations are mentioned elsewhere in this Safety Data Sheet.

15.3 National Regulations, Germany:

15.3.1	*StörfallV:*	Annex I, lower threshold: 10 t; upper threshold: 50 t (applies only to dimethyl carbonate)
15.3.2	*TA-Luft:*	Clause 5.2.1 Total dust including fine dusts: max. mass concentration: 20 mg/m^3 or max. mass flow: 0,20 kg/h (at a max. mass concentration of 150 mg/m^3). Clause 5.2.5: Organic substances apart from particulate matter: max. mass concentration: 50 mg/m^3 or max. mass flow: 0.50 kg/h (calculated as total carbon)
15.3.3	*VCI Storage Class:*	11 (combustible solids, TRGS 510)
15.4.4	*AwSV:*	Batteries with damaged housing are WGK 3 (highly water polluting, German Water Pollution Category 3), batteries in good order are WGK 0 (not water polluting, German Water Pollution Category 0), as long as damaging can be excluded, e. g. by traffic of staplers.

81208

SAFETY DATA SHEET

CARBEST
INNOVATIONS FOR MOBILE LIFE

Safety Data Sheet according to Directive 1907/2006/EC, Article 31, Annex II, and TRGS 220 (Germany)
Product name: **LiFePO4 Battery 12V/60Ah**
Date of issue: 31 January 2018
Date of last revision:

15.3.5	*Volatile components:*	Water, dimethyl carbonate (boiling point: 90°C, VOC: < 8,5%, only relevant, if the housing is untight)
15.4	*Further regulations and restrictions:*	Occupational restrictions: Take note of Directive 94/33/EC on the protection of young people at work.

SECTION 16: Other Information

Abbreviations:

ACGIH: American Conference of Governmental Industrial Hygienists
AwSV: Verordnung über Anlagen zum Umgang mit wassergefährdenden Stoffen vom 18 April 2017 (ordinance about facilities for handling with substances hazardous to water of 18 April 2017)
BAnz. AT: Liste der wassergefährdenden Stoffe, veröffentlicht im Bundesanzeiger AT vom 10.08.2017 (list of water polluting substances, published in Bundesanzeiger AT of 8 Aug. 2017)
BOD: Biochemical oxygen demand
ChemIDplus: Database of the United States National Library of Medicine
COD: Chemical oxygen demand
DNEL Derived No-Effect Level
DIN; DIN/ISO: German standard
DOC: Dissolved organic carbon
EN: European standard
EINECS: European Inventory of Existing Commercial Substances
GESTIS: Data base of Berufsgenossenschaftliches Institut für Arbeitsschutz, Germany
IARC: International Agency for Research on Cancer (World Health Organisation)
IRT: Inhalation risk test
IUCLID: International Uniform ChemicaL Information Database
LOEC: Lowest Observed Effect Concentration
MAK: Maximale Arbeitsplatzkonzentration (maximum concentration in the workplace, out of date)
Merck, Sigma-Aldrich, etc.: Actual MSDS of Merck, Darmstadt, Germany, Sigma-Aldrich, Germany, etc.
MITI: Ministry of International Trade and Industry, Japan
MSDS: Material Safety Data Sheet
NIOSH: National Institute for Occupational Safety and Health (USA)
NOAEL: No Observed Adverse Effect Level
NOEC: No Observed Effect Concentration
NOEL: No Observed Effect Level
OECD: Organisation for Economic Co-operation and Development
OSHA: Occupational Safety and Health Adminstration (USA)
PNEC: Predicted No-Effect Concentration
RTECS: Register of Toxic Effects of Chemical Substances
TG: Test-Guideline
TOC: Total organic carbon
TOD: Theoretical oxygen demand
TRGS: Technische Regel für Gefahrstoffe (Technical rules for hazardous substances, Germany)
TRK: Technische Richtkonzentration (technical concentration in the workplace to comply with [for cancerogenic substances], out of date)
TTC: 2,3,5-Triphenyl, tetrazoliumchloride
VCI: Verband der Chemischen Industrie e.V. (Chemical Industry Association, Germany)
VwVwS: Ordinance on water polluting substances, Germany
VOC: Volatile organic carbons
WGK: Wassergefährdungsklasse (Water Pollution Category, Germany)

As of the date of issuance, we are providing available information relevant to the handling of this material in the workplace. All information contained herein is offered in good faith in the belief that it is accurate. This material safety data sheet shall not be deemed to constitute or imply any warranty of

81208

SAFETY DATA SHEET

CARBEST
INNOVATIONS FOR MOBILE LIFE

any kind. In the event of an adverse incident associated with this material, this safety data sheet is not intended as a substitute for consultation with appropriately trained personnel (refer to SECTION 1). Nor is this safety data sheet intended to be a substitute for any product literature which may accompany the finished product.

81209

CARBEST
INNOVATIONS FOR MOBILE LIFE

SAFETY DATA SHEET

Safety Data Sheet according to Directive 1907/2006/EC, Article 31, Annex II, and TRGS 220 (Germany)
Product name: **LiFePO4 Battery 12V/100Ah**
Date of issue: 31 January 2018
Date of last revision:

SECTION 1: Product and Company Identification

Trade name:	**LiFePO4 Battery 12V/100Ah**
Product utilisation:	Battery for living quarters in caravan trailers and mobile homes.
Manufacturer/Supplier:	**Reimo Reisemobil-Center GmbH** D-63329 Egelsbach, Boschring 10, Germany Ph.: +49 (0) 6103 4005-21 oder -22 Fax: +49 (0) 6150 8662 177 E-mail: service@reimo.com Internet: www.reimo.com
Person in charge:	Technical advice, ph.: +49 (0) 6103-4005-28 Fax: +49 (0) 6150 8662 177
Emergency telephone code:	+49 (0) 6201 989 956 (Mr. Volker Müller)

SECTION 2: Hazards Identification

2.1 Classification and labelling according to Regulation (EC) No 1272/2008 (Directive 1272/2008/EC)

None.

2.2 Information pertaining to particular dangers to man and the environment:

No harmful effects on human health or on the environment are to be expected, if the product is used as specified and as long as the housing of the battery is tight.

Though, the product contains harmful ingredients, which are hermetically and impermeably sealed and will stay sealed upon foreseeable extraneous causes.

According to the UN Manual of Tests and Criteria ST/SG/AC.10/11/Rev. 5, 38.1, the product is tested for impermeability, for consistency against low pressure up to 116 hPa, for mechanical compression up to 13 kN, for temperature stability between -42°C to +72°C, for vibration stability between 7 Hz and 200 Hz, for shock stability up to 150 G (gavitational acceleration), for short circuit stability (0.1 Ω at 55°C), for electrical excess charge at 29.2V and 20 A, etc. (Report Nr. SZAB20160607UAM701 der Guangzhou MCM Certification and Testing Co. Ltd. of 6 July 2016).

There are considerable hazards for human health and for the environment (refer to SECTION 4, 11 and 12), if the ingredients are set free by fire, by exceptional extraneous causes, by targeted breakup of the housing (refer also to SECTION 7) or whatsoever.

Ion batteries are hazardous waste, and are to be disposed specifically (refer to SECTION 13).

Combustible, may explode when burning or overheating.

SECTION 3: Composition / Information on Ingredients

3.1 Characterization:	Lithium ion battery on the basis of phosphoric acid, iron(2+) lithium salt (1:1:1) with copper and graphite as main components, electrolytes and different polymers. The ingredients are hermetically and impermeably sealed. The housing consists of a acrylnitril/butadiene/styrene Copolymer.

3.2 Ingredients:

Substance	CAS No.	EINECS No.	Characterization	Mass%
Phosphoric acid, iron(2+) lithium salt (1:1:1)	15365-14-7	not existent	Mixed phosphate	< 26
Copper, foil	7440-50-8	231-159-6	Metal	< 12
Graphite, powder	7782-42-5	231-955-3	Crystalline Carbon	< 11
ABS rubber housing	not applicable	not applicable	Copolymer acrylnitril/butadiene/styrene	10
1,3-Dioxolan-2-one *Synonyms: Ethylene carbonate; Cyclic ethylene carbonate; 1,3-Dioxacyclopentan-2-one; Glycol carbonate; Ethylene glycol, cyclic carbonate.*	96-49-1	202-510-0	Polymer	< 8.5
Lithium hexafluoro-phosphate	21324-40-3	244-334-7	Fluorinated lithium phosphate	< 8.5
Dimethyl carbonate *Synonyms: Carbonic acid, dimethyl ester; Dimethyl carbonate*	616-38-6	210-478-4	Ester of carbonic acid	< 8.5
Aluminium, foil	7429-90-5	231-072-3	Metal	< 6.5
Polypropylene *Synonyms: 1-Propene, homopolymer; Propylene polymer*	9003-07-0	not existent	Polymer	4.5
Polyethylene *Synonyms: Ethene, homopolymer; Ethylene polymer*	9002-88-4	not existent	Polymer	4.5
Polyvinylidene fluoride Synonyms: *PVDF; Ethene, 1,1-difluoro-, homopolymer*	24937-79-9	not existent	Fluorinated Polymer	< 2
Carboxymethylcellulose sodium *Synonyme: Sodium CMC; Cellulose, carboxymethyl ether; Sodium carboxymethyl cellulose*	9004-32-4	not existent	modified Cellulose	< 0.5
Benzene, ethenyl-, polymer with 1,3-butadiene Synonyms: *1,3-Butadiene, polymer with styrene; 1,3-Butadiene-ethenylbenzene copolymer; 1,3-Butadiene-styrene copolymer; Butadiene-styrene rubber; Polybutadiene-polystyrene copolymer*	9003-55-8	not existent	Polymer	0.5
Colour	not applicable	not applicable	not specified	< 0.2
Soldering flux	not applicable	not applicable	mixture of hydrcarbons	< 0.2

This product does not contain substances of very high concern according to directive 1907/2006/EC, article 57.

3.3 Hazardous ingredients:

*Classification of the **pure** ingredients according to Directive 1272/2008/EC (GHS)*

Common or chemical name:

1,3-Dioxolan-2-one Eye Irrit. 2 (Eye irritation, Category 2): H319

Signal word: "Warning"

H319: Causes serious eye irritation.

Lithium hexafluorophosphate Acute tox. (oral) 3 (Acute toxicity if ingested, Hazard Category 3): H301
Skin corrosion/irritation 1A, (Hazard Category 1A): H314
STOT RE 1 [Specific organ toxicity (repeated exposure), Hazard Category 1]: H372

Signal word: "Danger"

H301: Toxic if swallowed.
H314: Causes severe skin burns and eye damage.
H372: Causes damage to organs (bones, teeth) through prolonged or repeated exposure.

Dimethyl carbonate Flammable liquids 2 (Hazard Category 2): H225

Signal word: "Danger"

H225: Highly flammable liquid and vapour.

SECTION 4: First Aid Measures

General information: As long as the housing of the battery is tight no first aid measures are necessary.

If the housing of the battery is damaged and ingredients are leaking the following first aid measures are appropriate:

Inhalation of aerosols or vapours:	Move the affected person into fresh air. If symptoms persist give oxygen or artificial respiration and seek medical attention.
Skin:	Wash skin with plenty of water and soap. Change contaminated clothing. If symptoms persist seek medical attention.
Eyes:	Rinse with plenty of water for at least 15 minutes. If symptoms persist seek medical attention.
Ingestion:	If the patient is conscious have him rinse his mouth with water, spit it out and then have him drink water or milk. In case of persisting symptoms put him in a recovery position and - if the patient is conscious - let him vomit. Seek medical attention.
Information for doctor:	None

SECTION 5: Fire Fighting Measures

General information:	Most parts of the product are combustible including the housing (see also „Special hazards“ below).
Extinguishing agents:	Carbon dioxide, foam, dry chemical. Use water spray only if the housing is tight and the battery is not loaded to prevent short circuit.
Not suitable extinguishing agents for safety reasons:	Water jet. Water in general, if the housing is damaged or the battery is loaded and is not protected against short circuit.
Special hazards:	In case of burning the battery might explode! In case of exposure above 80°C or in case of damage of the housing, the battery may leak or spout vaporized electrolytes or their decomposed products, such as very toxic fluorides and hydrofluoric acid, hydrocarbons, carbon monoxide and phosphorous oxides. The electrolytes are partly inflammable and may cause serious eye damage and severe skin burns by contact or by aerosols, and severe irritation of the respiratory tract by inhaling aerosols or by inhaling vapours specially when the product is burning.
Special protective equipment for fire-fighters:	Use self-contained breathing apparatus and protection clothes.
Further notice:	In case of fire in the surroundings immediately remove battery to a safe place or at least try to cool the battery, but take care of the possibility of a short circuit by water.

SECTION 6: Accidental Measures after Release of Ingredients

General information:	Only if the battery is damaged and ingredients are set free or after a short circuit , accidental measures may be necessary.
Personal precaution:	Leave the endangered area immediately and warn co-workers. Ventilate the area until aerosols and vapours are gone before entering the area with protective clothing, chemical resistant gloves (refer to SECTION 8.3) and safety goggles with side shield. Otherwise use fine dust respirator (P2 or P3) or a ventilated breathing hood.

Environmental precaution:	Do not let the ingredients enter surface water, groundwater or soil. Prevent large amounts of ingredients from entering the sewage system.
Methods for cleaning up:	Prevent generation of aerosols. Pack solid parts into container to be labelled. Take up liquids with liquid-adsorbent material (sand, clay, cat litter, etc.). Fill contaminated adsorbent material into container. Finally clean area with water and soap. Discharge contaminated material according to SECTION 13.

SECTION 7: Handling and Storage

Handling:	Under no circumstances, do not open the housing, do not throw the battery into fire, prevent the battery from heating-up and from direct sunlight, do not cause short circuit. If the battery becomes hot (< 80°C), remove it to a safe place or at least try to cool the battery, but take care of the possibility of a short circuit by water, if the battery is loaded. If the battery is heated above 80°C leave the endangered area immediately and warn co-workers (refer to SECTION 5, „*Special hazards", and SECTION 6, „Personal precaution"*). Prevent battery from exceeding vibrations.
Notes for prevention of fire and explosion:	Prevent battery from heat above 80°C, and prevent short circuit.
Storage:	Store at a dry and cool place, possibly below 20°, but not below freezing point. The higher the temperature of storage the sooner the loading capacity will drop. Prevent short circuit by covering the electrical poles with plastics. Do not store together with inflammable substances. Keep loaded and used batteries separated. German VCI-class of storage: 12 (combustible solids, TRGS 510).

SECTION 8: Exposure Controls / Personal Protection

8.1 Technical protection: Opening of the housing of the battery should only be done by trained personnal. In this case use closed plant with exhaust. Otherwise use at least exhaust and monitor the occupational exposure limit. Avoid generation of aerosols.

8.2 Ingredients with occupational exposure limit values, if ingredients of the battery are set free:

General Limit for Dusts

- *CAS No.:*	Not applicable.
- *Exposure limit value:*	1.25 mg/m^3 alveolar dust or alveolar aerosols 10 mg/m^3 inhalable dust or aerosols
- *Short term limit value:*	2 (II)
- *Origin:*	AGW
- *BLV:*	None; old BLV for aluminium: 60 µg creatinine in urine, not obligatory any more
- *Remarks:*	H (for lithium hexafluorophosphate), C (for copper and lithium hexafluorophosphate)
- *Year:*	2017

Explanations:

- *AGW*	Exposure limit value (refer to TRGS 900, Germany)
- *BLV:*	Biological limit value (refer to TRGS 903, Germany)

- Short term limit values:	Exceeding factor X: Exposure may exceed the exposure limit value by the factor X for not longer than 15 minutes. 4 measurements at intervals of 1 hour. Exceeding factor =X=: Exposure must never exceed the exposure limit value by more than the factor X (instantaneous value). (I): Category I: substances for which the exposure limit value is based on local effects or sensitizing substances. (II): Category II: substances effective by resorption.
- Remarks::	H : Substances effective by resorption through skin S = Sensitizing substance C: There is no teratogenic risk if the exposure limit value and the BLV are maintained.

8.4 Personal Protection:

The following protection measures apply, if ingredients of the battery are set free:

Respiratory protection:	Use respiratory protection apparatus or ventilated breathing hood.
Hand protection:	If contact with hands cannot be avoided use protection gloves tested according to DIN EN 374. Seek advice from manufacturers of protection gloves. If gloves cannot be used for safety reasons (e. g. while working at rotating machines) use skin-protective barrier cream. Consult the company medical officer for the type of barrier cream to be used. Comment: In contrary to the European ordinance 1907/2006/EC (REACH), it is not sufficient to specify only the protective glove material. The break-through-times are dependent not only on the material but also on the manufacturing technique. It is therefore essential to consult the manufacturers of protective gloves. For the ingredients of the battery the following materials should be appropriate: for short-time contact (few minutes) rubber or plastic is sufficient, for long-time contact use gloves of nitrile/latex rubber - NBR (0.35 mm).
Eye protection:	Safety glasses with side shield.
Skin protection:	Use chemical resistant protective clothing if contamination of clothing cannot be avoided. Change contaminated clothing immediately.
General protective measures:	Avoid contact with eyes and skin. Do not inhale aerosols or vapours.
Industrial hygiene:	Wash hands or skin after contact immediately. Do not eat, drink, smoke or take snuff at work.

SECTION 9: Physical and Chemical Properties

9.1 Appearance

Physical state:	Solid.
Colour:	Black.
Odour:	None.

81209

SAFETY DATA SHEET

CARBEST
INNOVATIONS FOR MOBILE LIFE

Safety Data Sheet according to Directive 1907/2006/EC, Article 31, Annex II, and TRGS 220 (Germany)
Product name: **LiFePO4 Battery 12V/100Ah**
Date of issue: 31 January 2018
Date of last revision:

9.2 Relevant data for Safety and Health for the product:

Data which should be mentioned in this SECTION are not relevant for the product. Refer to SECTIONS 2, 6, 7, and 10 for safety-related information.

Nominal Voltage:	24 V
Loading capacity:	100 Ah

SECTION 10: Stability and Reactivity

Thermal decomposition:	Danger of explosion above 130°C.
Conditions to be avoided:	Heating above 70°C. Short circuit. Damage of the housing. Long-time storage under humid conditions.
Substances to be avoided:	Strong oxidizing agents (halogenes, nitriles, hydrogen peroxide, perchloric acid, aqua regia, etc.), strong acids, strong lyes.
Dangerous reactions:	Ingredients may form very toxic fluorides and hydrofluoric acid with strong acids.
Hazardous decomposition products:	Very toxic fluorides and hydrofluoric acid, hydrocarbons, carbon monoxide and phosphorous oxides.
Dangerous polymerisations:	None.

SECTION 11: Toxicological Information

11.1 Product

As long as the housing of the battery is tight and no ingredients are set free, no harmful effects on human health are to be expected.

The following information is valid for all ingredients:

Sensitization:	No sensitizing effects are known.
Mutagenicity:	No mutagenic effects are known.
Cancer:	No carcinogenic effects are known. All ingredients are not mentioned as carcinogenic in the lists of ACGIH, NIOSH, IARC or TRGS 905.
Reproductive toxicity:	No toxic effects on reproduction are known.

Toxic effects after repeated exposure (subacute to chronic toxicity):

No symptoms after repeated occupational exposure (chronic or subchronic) are known.

Practical experience: There are no reports of symptoms of poisoning after handling the ingredients.

11.2 Toxicological information on the pure ingredients:

11.2.1 Phosphoric acid, iron(2+) lithium salt (1:1:1)

The toxicology of this substance is yet hardly investigated. There are no experimental animal data (refer to MSDS of Sigma-Aldrich Inc.). In analogy to iron (III) phosphate no noteworthy hazards to

the human health are to be exspected, because the substance is unsoluable and therefore is hardly resorbed in the body.

11.2.2 Graphite

Toxikokinetics, metabolism and distribution:

Resorption in the body is negligible.

Acute toxicity:

There are no LD_{50}-values of animal experiments. There were no deaths of rats after injection of suspensions of graphite (HSDB).

Practical experiences with occupational exposures of graphite (HSDB):

After inhalation:	Slight irritation of the respiratory tract.
After skin contact:	No symptoms.
After eye contact:	Physical irritation.
After ingestion:	No experiences.
Chronic toxicity:	Bronchitis and lung damage after repeated and prolonged inhalation.

11.2.3 1,3-Dioxolan-2-one

Toxikokinetics, metabolism and distribution:

Inhalation and absorption through skin are the main routes of occupational exposure. There is no further information available.

Acute toxicity:

LD_{50} (rat, oral):	> 5,000 mg / kg (Merck)
LD_{50} (rabbit, dermal):	> 2,000 mg / kg (OECD guideline 402)
LC_{50} (female rat, inhalation):	1,268 mg / L / 7 h (Sigma-Aldrich)
After inhalation:	No information is available.
After skin contact:	Slight irritation (rabbit, OECD guideline 402).
After eye contact:	Serious eye irritation.
After ingestion:	No information is available.
Sensitization:	No sensitizing effects were found. (Bühler-Test with guinea pig; OECD guideline 406, Sigma-Aldrich)
Mutagenicity:	No mutagenic effects were found. Mutagenicity of bacteria: Ames-Test negative (Merck); in-vitro-test on gene mutation of lymphocytes of mice: negative (Sigma-Aldrich).
Reproduktionstoxizität:	Refer to SECTION 11.1.
Cancer:	Refer to SECTION 11.1.
Chronic toxicity:	No information.

11.2.4 Lithium hexafluorophosphate

Toxikokinetics, metabolism and distribution:

No information is available.

Acute toxicity:

LD_{50} (female rat, oral):	> 50 mg/kg (OECD guideline 423, Sigma-Aldrich)
After inhalation:	Severe irritation of the respiratory tract.
After skin contact:	Severe irritation up to chemical burn (test with artificial skin, Sigma-Aldrich).
After eye contact:	Severe irritation, risk of serious, irreversible eye damage (rabbit, OECD guideline 405).
After ingestion:	Toxic. Severe irritation of the oral cavity, of the oesophagus and the stomach.
Sensitization:	No sensitizing effects were found. In-vitro-test with mouse: negative (OECD guideline 429, Sigma-Aldrich).
Mutagenicity:	No mutagenic effects were found. Mutagenicity of germ cells: Ames-Test with salmonella typhimurium: negativ (Sigma-Aldrich).
Cancer:	Refer to SECTION 11.1.
Reproductive toxicity:	Refer to SECTION 11.1.
Chronic toxicity:	After repeated and prolonged exposure hazardous to bones and teeth.
Further information:	Fire or strong acids may set free fluorides and hydrofluoric acid, which cause severe health problems.

11.2.5 Dimethyl carbonate

Toxikokinetics, metabolism and distribution:

Inhalation is the main route of occupational exposure. Absorption through skin is low (animal studies, HSDB). There is no further information available.

Acute toxicity:

LD_{50} (rat, oral):	9,000 mg/kg (Merck)
LD_{50} (rat, oral):	13,000 mg/kg (HSDB)
LD_{50} (mouse, oral):	6,000 mg/kg (HSDB)
LD_{50} (rabbit, dermal):	> 5,000 mg/kg (Merck)
LD_{50} (guinea pig, dermal):	> 9,350 mg/kg (HSDB)
LC_{50} (rat, inhalation):	> 140 mg / L / 4 h (Merck, HSDB)
After inhalation:	Irritant to mucous membranes (Merck).
After skin contact:	Not irritant (Merck)
After eye contact:	Slight irritations (Merck)
After ingestion:	Animal experiment: weakness, tremor, unconsciousness (HSDB)
Sensitization:	Not sensitizing effects were found (Patch-Test with humans, Merck).

Mutagenicity:	No mutagenic effects were found. Mutagenicity of bacteria: Ames-Test negative (Merck); gene toxicity in animal experiments was not found (HSDB).
Cancer:	Refer to SECTION 11.1.
Reproductive toxicity:	Refer to SECTION 11.1.
Chronic toxicity:	Animal studies showed no chronic toxicity (HSDB).

11.2.6 Polyvinylidene fluoride

The toxicology of this substance is not completely investigated. There are no experimental animal data. The supplier, Sigma-Aldrich Ltd., states the following possible human hazards:

After inhalation:	May be hazardous to health. May irritate the respiratory tract.
After skin contact:	May be hazardous to health after absorption through skin. May be irritant to skin.
After eye contact:	May be irritating to eyes.
After ingestion:	May be hazardous to health.

The monomer, vinylidene fluoride, should be more toxic than the polymer. Though, concentrations up to 65.5 g/m^3 in animal experiments showed no symptoms. The monomer is classified as cancerogenic category 3 in TRGS 904, but need not be labelled as carcinogenic.

11.2.7 All other infredients

The toxicities of the remaining ingredients are negligible in comparison to the substances mentioned in this SECTION, specially because aluminium and copper are not powdery.

SECTION 12: Ecological Information

12.1 Product:

The product as delivered and in normal use causes no environmental hazards. If the product is disposed into the environment the housing will leak after a long period of time or after outside impact, and the ingredients will finally end up in the environment. On behalf of the ingredients the product must be classified as highly water polluting (WGK 3) according to AwSV (Germany). But as long as the battery is in good order and is used as intended it is not water polluting (WGK 0).

*12.2 Information on the **pure** ingredients:*

12.2.1 Phosphoric acid, iron(2+) lithium salt (1:1:1)

Ecotoxic effects:	Not biodegradable. On account of its sparing solubility in water no efficient ecotoxic effects are to be expected. Triphylin, Li(Fe, Mn)[PO_4], is a natural mineral, where the iron-II-ions of phosphoric acid, iron(2+) lithium salt (1:1:1) are partly replaced by manganese-II-ions.
Ecotoxic data:	There are no experimental animal data.
Biodegradation:	As a anorganic substance a potential of biodegradation is not expected.

Abiotic degradation: On a long term scale a transformation to lithium oxide and iron-III-phosphate is to be expected.

WGK (Water Pollution Category,Germany): 1 (slightly water polluting) (classification by analogy to trilithium phosphate and to iron phoshate (both WGK 1).

12.2.2 Graphite

Ecotoxic effects: Not biodegradable. As a natural substance no ecotoxic effects are to be expected.

Ecotoxic data: There are no experimental animal data.

WGK (Water Pollution Category,Germany): 0 (not water polluting) (BAnz. AT, idendification no.: 801)

12.2.3 Copper

Ecotoxic effects: Bioaccumulation is not to be expected. Metallic copper is mobilised below p_H 2.8. Oxidised and water soluble copper ions are not mobile in soil, because copper ions are strongly adsorbed by solids (HSDB).

WGK (Water Pollution Category,Germany): 0 (not water polluting) (BAnz. AT, idendification no.: 1443)

12.2.4 1,3-Dioxolan-2-one

Ecotoxic effects: Readily biodegradable. No noteworthy bioaccumulation is to be expected.

Ecotoxic data (Merck):

Fish toxicity:	Leuciscus idus:	LC_{50}: > 1,000 mg/l / 96 h
Daphnia toxicity:	Daphnia magna:	EC_{50}: > 100 mg/l / 48 h
Bacterial toxicity:	Pseudomonas putida:	EC_{50}: > 10,000 mg/l / 17 h

Further information:

Biodegradation: 86.9% / 29 d (aerob, Sigma-Aldrich)

Distribution: log P(o/w) = -0.34 (Merck)

WGK (Water Pollution Category,Germany): 1 (slightly water polluting), (BAnz. AT, idendification no.: 2268)

12.2.5 Lithium hexafluorophosphate

Ecotoxic effects: No information is available.

Ecotoxic data (Sigma-Aldrich):

Daphnia toxicity:	Daphnia magna:	EC_{50}:	> 100 mg/l / 48 h (OECD guideline 202)
Bacterial toxicity:	Pseudomonas putida:	EC_{50}:	> 1,000 mg/l / 3 h (OECD guideline 209)
Algae toxicity:	Pseudokirchneriella subcap.:	EC_{50}:	> 100 mg/l / 76 h (OECD guideline 201)

Further information:

WGK (Water Pollution Category,Germany): 3 (highly water polluting), (classification by Sigma-Aldrich)

12.2.6 Dimethyl carbonate

Ecotoxic effects: Readily biodegradable. Bioaccumulation is expected to be low. In the atmosphere dimethyl carbonate is decomposed with a half-time of 24.6 days. High mobility in soil. Vaporation to the atmosphere (HSDB).

Ecotoxic data (Merck):

Fish toxicity: Leuciscus idus: LC_{50}: > 1,000 mg/l / 96 h

Further information:

Biodegradation: 88% / 28 d (Merck); > 90% / 28 d (MITI-Test, HSDB)

Bioconcentration factor: 3.2 (HSDB)

Distribution: log P(o/w) = -0.23 (Gestis, Merck)

WGK (Water Pollution Category,Germany): 1 (slightly water polluting), (BAnz. AT, idendification no.: 4077)

12.2.7 Aluminium

Ecotoxic effects: Not biodegradable. Aluminium is insoluble, but in acid soil (pH < 4.5) aluminium is slowly oxidised to soluble ions, which are toxic to water organisms.

Ecotoxic data of dissolved aluminium ions:

Fish toxicity:		LC_{50}:	0.12 - 5.2 mg/l, median value: 1.55mg/l (Gestis)
Daphnia toxicity:	Daphnia magna:	toxic above 136 mg/l (Merck)	
Algae toxicity:	Scenedesmus quadricauta:	toxic above 1.5 mg/l (Merck)	

Further information:

WGK (Water Pollution Category,Germany): 0 (not water polluting) (BAnz. AT, idendification no.: 1443)

12.2.8 Polyvinylidene fluoride

Ecotoxic effects: There is no ecotoxic information for the polymer. For the gaseous monomer, vinylidine fluoride, the ecotoxicity of which should be considerably higher than that of the polymer, a half-time in the atmosphere of 8 to 60 days is stated. Due to the slight water solubility in water the mobility in soil and water is low. For the polymer, mobility should be even lower. The biodegradability of the monomer is low. For the polymer the biodegradability should be even lower. An estimation of the bioconcentration factor is 3 and is described as low (log P(o/w): 1.24). The bioconcentration factor of the polymer should be even lower (HSDB).

Ecotoxic data: No ecotoxic data are available.

WGK (Water Pollution Category,Germany): 1 (slightly water polluting), (BAnz. AT, idendification no.: 766)

12.2.9 Carboxymethylcellulose sodium

Ecotoxic effects: No information is available.

Ecotoxic data:

Crustacean toxicity: EC_{50}: 87.3 mg/l / 48 h (Gestis)

WGK (Water Pollution Category,Germany): 1 (slightly water polluting), (BAnz. AT, idendification no.: 829)

12.2.10 All other ingredients

The remaining ingredients are polymers, which are hardly biodegradable and hardly ecotoxic because of their insolubility.

For all the remaining ingredients:

WGK (Water Pollution Category,Germany): 0 (not water polluting) (BAnz. AT, idendification no.: 766)

Do not allow the product to enter water supplies, waste water or soil (refer to SECTION 12.1 and 13.1).

SECTION 13: Disposal Considerations

13.1 Product: For disposal the product has not to be supervised. But before disposal the battery must be pretreated and the ingredients must be partly recovered (BattGDV bzw. RL 2006/66EG). The battery may be returned to the supplier or must be left over for a disposal company. It is not allowed to dispose the battery either as household waste nor as hazardous waste. This applies also, if the housing of the battery is damaged or/and part of the ingredients together with contaminated adsorbent and filter materials are collected in a container.

Waste code: 16 06 05

Waste name: Other batteries and accumulators

13.2 Packing materials :

a) Packing materials made of plastics:
Waste code: 15 01 02
Waste name: Packing materials made of plastics

b) Packing materials made of metal:
Waste code: 15 01 04
Waste name: Packing materials made of metal

Waste-codes in accordance with the European Waste Register Ordinance.

SECTION 14: Transport Information

Tansportation by land ADR/RID/GGVSE

ADR/RID/GGVSE Class:	9
UN No.:	3480
UN proper technical name:	Lithium Ion Batteries
Hazard label for posting*:	Class 9 (also after 31 Dec. 2018)
Hazard label (for packages):	Class 9 Miscellaneous (permitted until 31 Dec. 2018)
Hazard label (for packages):	Class 9A Lithium Ion Batteries (of 01 Jan. 2019 obligatory)
Packaging group:	II
Packing instruction:	PI 910
Max. gross weight per package:	30 kg
Tunnel category:	E
Classification code:	M4 Lithium Battery
Limited quantity:	LQ: 0.0

* e. g. for truck or container

The special instructions SV 310 und SV 376 for transport of batteries with damaged housing, the special instructions SV 310 und SV 377 for the transport of batteries for disaposal, and packing instructions PI 908 bzw. 909 are to be complied with.

Shipping by air ICAO-TI und IATA-DGR 58 edition 2017:

ICAO-TI und IATA-Class:	9
UN/ID No.:	3480
IATA proper shipping name:	Lithium Ion Batteries
Marine Pollutant:	No
Hazard label:	Class 9 Miscellaneous (RMD) (permitted until 31 Dec. 2018)
Hazard label:	Class 9A Lithium Battery (of 01 Jan. 2019 obligatory)
Packing instruction:	965 Part IA
Max. gross weight per package:	35 kg
Additional hazard label on outer case:	
Special instructions:	A88, A99, A154, A164, A182, A183, A185, A201, A206, A331

The transport with passenger aircrafts is for bidden. Batteries must not be damaged. The battery terminals must be protected against short circuit. The state of charge must not exeed 30% of each battery. The energy content (Wh) must be specified on the type plate. Note that the different airline companies request different terms for transportation (refer to Addendum 1 of IATA-DGR 58 edition 2017).

Shipping by sea IMDG/GGVSee:

IMDG/GGVSee Class:	9
UN No.:	3480
Proper shipping name:	Lithium Ion Batteries
Hazard label for posting*:	Class 9 (also after 31 Dec. 2018)
Hazard label (for packages):	Class 9 Miscellaneous (permitted until 31 Dec. 2018)
Hazard label (for packages):	Class 9A Lithium Ion Batteries (of 01 Jan. 2019 obligatory)
IMDG-Code:	38 - 16
EMS:	F-A, S-I
Packaging group:	II
Packing instruction:	PI 910
Max. gross weight per package:	30 kg
Marine Pollutant:	No

The special instructions SV 310 und SV 376 for transport of batteries with damaged housing and the special instructions SV 310 und SV 377 for the transport of batteries for disaposal are to be complied with.

SECTION 15: Regulatory Information

15.1 There are no safety reports according to 1907/2006/EC (REACH) available.

15.2 *Substances of very high concern (SVHC):*

This product does not contain substances of very high concern according to directive 1907/2006/EC, article 57.

All other relevant regulations are mentioned elsewhere in this Safety Data Sheet.

15.3 National Regulations, Germany:

15.3.1	*StörfallV:*	Annex I, lower threshold: 10 t; upper threshold: 50 t (applies only to dimethyl carbonate)
15.3.2	*TA-Luft:*	Clause 5.2.1 Total dust including fine dusts: max. mass concentration: 20 mg/m^3 or max. mass flow: 0,20 kg/h (at a max. mass concentration of 150 mg/m^3). Clause 5.2.5: Organic substances apart from particulate matter: max. mass concentration: 50 mg/m^3 or max. mass flow: 0.50 kg/h (calculated as total carbon)
15.3.3	*VCI Storage Class:*	11 (combustible solids, TRGS 510)
15.4.4	*AwSV:*	Batteries with damaged housing are WGK 3 (highly water polluting, German Water Pollution Category 3), batteries in good order are WGK 0 (not water polluting, German Water Pollution Category 0), as long as damaging can be excluded, e. g. by traffic of staplers.

15.3.5	*Volatile components:*	Water, dimethyl carbonate (boiling point: 90°C, VOC: < 8,5%, only relevant, if the housing is untight)
15.4	*Further regulations and restrictions:*	Occupational restrictions: Take note of Directive 94/33/EC on the protection of young people at work.

SECTION 16: Other Information

Abbreviations:

ACGIH: American Conference of Governmental Industrial Hygienists
AwSV: Verordnung über Anlagen zum Umgang mit wassergefährdenden Stoffen vom 18 April 2017 (ordinance about facilities for handling with substances hazardous to water of 18 April 2017)
BAnz. AT: Liste der wassergefährdenden Stoffe, veröffentlicht im Bundesanzeiger AT vom 10.08.2017 (list of water polluting substances, published in Bundesanzeiger AT of 8 Aug. 2017)
BOD: Biochemical oxygen demand
ChemIDplus: Database of the United States National Library of Medicine
COD: Chemical oxygen demand
DNEL Derived No-Effect Level
DIN; DIN/ISO: German standard
DOC: Dissolved organic carbon
EN: European standard
EINECS: European Inventory of Existing Commercial Substances
GESTIS: Data base of Berufsgenossenschaftliches Institut für Arbeitsschutz, Germany
IARC: International Agency for Research on Cancer (World Health Organisation)
IRT: Inhalation risk test
IUCLID: International Uniform ChemicaL Information Database
LOEC: Lowest Observed Effect Concentration
MAK: Maximale Arbeitsplatzkonzentration (maximum concentration in the workplace, out of date)
Merck, Sigma-Aldrich, etc.: Actual MSDS of Merck, Darmstadt, Germany, Sigma-Aldrich, Germany, etc.
MITI: Ministry of International Trade and Industry, Japan
MSDS: Material Safety Data Sheet
NIOSH: National Institute for Occupational Safety and Health (USA)
NOAEL: No Observed Adverse Effect Level
NOEC: No Observed Effect Concentration
NOEL: No Observed Effect Level
OECD: Organisation for Economic Co-operation and Development
OSHA: Occupational Safety and Health Adminstration (USA)
PNEC: Predicted No-Effect Concentration
RTECS: Register of Toxic Effects of Chemical Substances
TG: Test-Guideline
TOC: Total organic carbon
TOD: Theoretical oxygen demand
TRGS: Technische Regel für Gefahrstoffe (Technical rules for hazardous substances, Germany)
TRK: Technische Richtkonzentration (technical concentration in the workplace to comply with [for cancerogenic substances], out of date)
TTC: 2,3,5-Triphenyl, tetrazoliumchloride
VCI: Verband der Chemischen Industrie e.V. (Chemical Industry Association, Germany)
VwVwS: Ordinance on water polluting substances, Germany
VOC: Volatile organic carbons
WGK: Wassergefährdungsklasse (Water Pollution Category, Germany)

As of the date of issuance, we are providing available information relevant to the handling of this material in the workplace. All information contained herein is offered in good faith in the belief that it is accurate. This material safety data sheet shall not be deemed to constitute or imply any warranty of

81209

SAFETY DATA SHEET

CARBEST
INNOVATIONS FOR MOBILE LIFE

Safety Data Sheet according to Directive 1907/2006/EC, Article 31, Annex II, and TRGS 220 (Germany)
Product name: **LiFePO4 Battery 12V/100Ah**
Date of issue: 31 January 2018
Date of last revision:

any kind. In the event of an adverse incident associated with this material, this safety data sheet is not intended as a substitute for consultation with appropriately trained personnel (refer to SECTION 1). Nor is this safety data sheet intended to be a substitute for any product literature which may accompany the finished product.

REIMO REISEMOBIL-CENTER GMBH
63329 EGELSBACH · BOSCHRING 10
GERMANY · WWW.REIMO.COM
MADE IN CHINA