



Lithium-Phosphite Battery

AML9113

1. Preface:

This document describes the Product Specification of the Lithium Phosphite rechargeable battery cell supplied by ENIX ENERGIES.

2. Rating:

No.	Items	Specifications
1	Charge voltage	14.8V
2	Nominal voltage	12.8V
3	Rated capacity	7500mAh MIN 7200MAH
4	Initial charge current	Standard charge : 0.5C Rapid charge : 1C
5	Standard charge	0.5C CC(constant current) charge to 3.7V/cell, then CV(constant voltage) 3.7V/cell charge 3.5hours
6	Rapid charge	1C CC(constant current) charge to 3.7V/cell, then CV(constant voltage) 3.7V/cell charge 3.0hours
7	Max. charge current	1C
8	Continuous discharge current	40000mA
9	Discharge cut-off voltage	10V
10	Operating temperature	Charging : 0 ~ 45°C Discharging : -20 ~ 60°C
11	Storage temperature	-20 ~ + 45°C
12	Battert Weight	Approx. 1.2 ± 0.5kg
13	Battery Dimension	Refer to the drawing below

3. Scope:

All data involves voltage and weight to stack-up battery are equal to the value of unit cell time the number of unit cell which consisted in the stack-up batteries

Example: Stack-up batteries consisting E unit cells series

Nominal voltage of unit cell=3.2V

Nominal voltage of stack-up batteries =3.2V x 4=12.8V

4. Battery Cell Performance Check and Test:

1) Visual inspection

There shall be no such defect as scratch, flaw, crack, and leakage, which may adversely affect commercial value of the cell.

2) Standard environmental test condition

Unless otherwise specified, all tests stated in this Product Specification are conducted at below condition:

Temperature : 23 ± 5°C

Humidity : 65 ± 20%

3) Electrical characteristics

Items	Test Method and Condition	Criteria
Standard Charge	Charging the cell initially with constant current at 0.5C, and then with constant voltage at 3.7V/cell (accuracy $3.7 \pm 0.05V$)/cell charge 3.5hours.	N.A.
Initial Capacity	The capacity means the discharge capacity of the cell, which is measured with discharge current of 0.2C with 2.5V/cell cut-off voltage after the standard charge.	7500 mAh
Cycle Life	The cycle life shall be conducted as the following procedures: Step 1:charge the cell with the standard charge Step 2:discharge the cell at 3600mA (0.5C) to 2.5V; Step 3:repeat Step 1 and Step 2 for 800 times. The capacity after 500 cycles is expected to be equal to or more than 80% of the rated capacity. The capacity after 800 cycles is expected to be equal to or more than 60% of the rated capacity.	≥ 800
Temperature Dependence Of Capacity (Discharge)	Capacity comparison at each temperature, measured with constant discharge current 0.5C with 2.5V/cell cut-off after Standard Charge shown below. If charge temperature and discharge temperature are not the same, the interval for temperature charge comes to 3 hours. Charge Temp: 20°C Discharge Temp. -20°C : 45% 0°C : 80% 20°C : 100% 60°C : 100%	
Storage Characteristics	Capacity after 30 days storage at 25°C, from Standard Charge, measured under the same conditions stated No. 2	Remaining capacity (after 25°C storage) $\geq 5760mAh$
Cell Voltage	As of shipment.	$\sim 3.25 V$

5. Mechanical Characteristics:

Items	Testing Method and Condition	Criteria
Vibration Test	Cell (as of shipment) vibrated for 90 minutes for each of the three mutually perpendicular planes with total excursion of 1.6mm and with frequency of 10 Hz to 55 Hz at the sweep rate of 1 Hz per minute.	No leakage, capacity recovery rate $\geq 90\%$ (Standby 3 hours).
Drop Test	The cell is to be dropped from a height of 1 meter 2 times onto concrete ground.	No explosion, no fire, no leakage.

6.Storage and Others

1) Storage for a long time

If the Cell is stored for a long time (beyond 3 months), the cell is to be placed at a dry environment and low temperature

2) Others

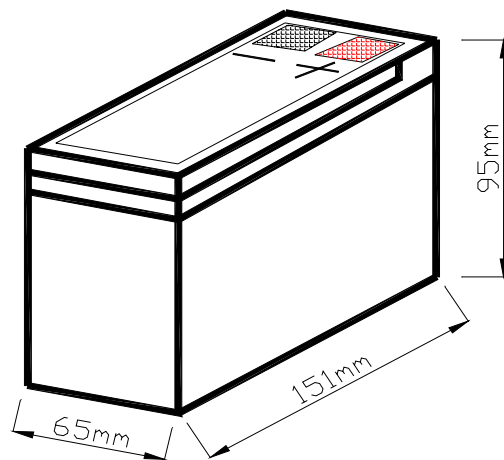
Any matters that this specification does not cover should be conferred between both parties.

7. Warranty Time

Warranty time is six (6) months from the date when the LiFePO₄ battery ship out from our factory. But If the LiFePO₄ battery is found to have a problem due to use outside of recommended specification, we will have no responsibility for the battery.

8. Battery drawing:

With plastic case



Handling Precautions and Guideline
For LiFePO₄ (Lithium Phosphite) Rechargeable Batteries
Subject to change without notice

Preface

This document of 'Handling Precautions and Guideline LIFE Rechargeable Batteries' shall be applied to the battery cells manufactured.

Note (1):

The customer is requested to contact in advance, if and when the customer needs other applications or operating conditions than those described in this document. Additional experimentation may be required to verify performance and safety under such conditions.

Note (2):

We will take no responsibility for any accident when the cell is used under other conditions than those described in this Document.

Note (3):

We will inform, in a written form, the customer of improvement(s) regarding proper use and handling of the cell, if it is deemed necessary.

1. Charging

1) Charging current:

Charging current should be less than maximum charge current specified in the Product Specification. Charging with higher current than recommended value may cause damage to cell electrical, mechanical, and safety performance and could lead to heat generation or leakage.

2) Charging voltage:

Charging shall be done by voltage less than that specified in the Product Specification (3.7V/cell). Charging beyond 3.7V, which is the absolute maximum voltage, must be strictly prohibited. The charger shall be designed to comply to this condition. It is very dangerous that charging with higher voltage than specified value may cause damage to the cell electrical, mechanical safety performance and could lead to heat generation or leakage.

3) Charging temperature:

The cell shall be charged within the specified temperature range in the Product Specification.

4) Prohibition of reverse charging:

Reverse charging is prohibited. The cell shall be connected correctly. The polarity has to be confirmed before wiring. In case of the cell is connected improperly, the cell cannot be charged. Simultaneously, the reverse charging may cause damaging to the cell which may lead to degradation of cell performance and damage the cell safety, and could cause heat generation or leakage.

2. Discharging

1) Discharging current

The cell shall be discharged at less than the maximum discharge current specified in the Product Specification. High discharging current may reduce the discharging capacity significantly or cause over-heat.

2) Discharging temperature

The cell shall be discharged within the temperature range specified in the Product Specification.

3) Over-discharging:

It should be noted that the cell would be at an over-discharged state by its self-discharge characteristics in case the cell is not used for long time. In order to prevent over-discharging, the cell shall be charged periodically to maintain between 3.25V and 3.3V. Over-discharging may causes loss of cell performance, characteristics, or battery functions.

The charger shall be equipped with a device to prevent further discharging exceeding a cut-off voltage specified in the Product Specification. Also the charger shall be equipped with a device to control the recharging.

Procedures as follows:

The cell battery pack shall start with a low current (0.01C) for 15 - 30 minutes, i.e. pre-charging, before rapid charging starts. The rapid charging shall be started after the individual cell voltage has been reached above 2.6V within 15 - 30 minutes which can be determined with the use of an appropriate timer for pre-charging. In case the individual cell voltage does not rise to 2.6V within the pre-charging time, then the charger shall have functions to stop further charging and display the cell/pack is at abnormal state.

3. Protection Circuit Module (PCM)

1) The cell/battery pack shall be with a PCM which can protect cell/battery pack properly.

PCM shall have functions of (i) overcharging prevention, (ii) over-discharging prevention, (iii) over current prevention to maintain safety and prevent significant deterioration of cell performance. The over current can occur by external short circuit.

2) Overcharging prohibition:

Overcharging prevention function shall stop charging if any one of the cells of the battery pack reaches 3.7V.

3) Over-discharge prohibition:

Over-discharging prevention function shall work to minimize a dissipation current to avoid further drop in cell voltage of 2.5V or less per cell in any cell of the battery pack. It is recommended that the dissipation current of PCM shall be minimized to 0.5uA or less with the over-discharge prevention. The protection function shall monitor each bank of the battery pack and control the current all the time.

4. Storage

The cell should be stored within the proper temperature range specified in the Product Specification.

5. Handling of Cells

1) Consideration of strength of film package

(i)Aluminium laminated film. (ii) Easily damaged by sharp edge parts such as pins and needles, comparing with metal-can-cased LIB. (iii)Sealed edge May be damaged by heat above 100°C.

2) Prohibition short circuit

Never make short circuit cell. It generates very high current which causes heating of the cells and may cause electrolyte leakage, gassing or explosion that are very dangerous. The LIFE tabs may be easily short-circuited by putting them on conductive surface. (Such outer short circuit may lead to heat generation and damage of the cell.) An appropriate circuitry with PCM shall be employed to protect accidental short circuit of the battery pack.

3) Mechanical shock

LIFE cells have less mechanical endurance than metal-can-cased LIB.

Falling, hitting, bending, etc. may cause degradation of LIFE characteristics.

4) Handling of tabs

The LIFE tabs are not exceedingly sturdy, especially the aluminium tabs for the terminal. Do not put much force on LIFE tabs. (Aluminium tab may easily be torn off by shear force.) Do not bend tabs unnecessarily.

6. Notice for Designing Battery Pack

1) Pack toughness

Battery pack should have sufficient strength and the LIFE cell inside should be protected from mechanical shocks.

2) Cell fixing

The LIFE cell should be fixed to the battery pack by its large surface area.

No cell movement in the battery pack should be allowed.

3) Inside design

No sharp edge components should be inside the pack containing the LIFE cell.

4) Tab connection

Ultrasonic welding is recommended for LIFE tab connection method.

Battery pack should be designed that shear force are not applied to the LIFE tabs.

5) For mishaps

Battery pack should be designed not to generate heat even when leakage occurs due to mishaps.

- i) Isolate PCM (Protection Circuit Module) from leaked electrolyte as perfectly as possible.
- ii) Avoid narrow spacing between bare circuit patterns with different voltage. (Including around connector).
- iii) LIFE battery should not have liquid from electrolyte, but in case If leaked electrolyte touches bare circuit patterns, higher potential terminal material may dissolve and precipitate at the lower potential terminal, and may cause short circuit. The design of the PCM must have this covered.

7. Notice for Assembling Battery Pack

Shocks, high temperature, or contacts of sharp edge components should not be allowed in battery pack assembling process.

- 1) Do not solder directly to LIFE tabs. Do not bring heated tools such as soldering Iron close to LIFE cells. Temperature above 80°C may cause damage to the LIFE cell and degrade its performances.
- 2) In case that the battery pack is fixed by ultrasonic welding, it is necessary not to apply too much ultrasonic welding power to LIFE cell and electronic circuits such as PCM. Otherwise it may cause serious damage to the cells and electronic circuit.

8. Others

1) Cell connection

- i) Direct soldering of wire leads or devices to the cell is strictly prohibited.
- ii) Lead tabs with pre-soldered wiring shall be spot welded to the cells. Direct soldering may cause damage of components, such as separator and insulator, by heat generation.

2) Prevention of short circuit within a battery pack

Enough insulation layers between wiring and the cells shall be used to maintain extra safety protection. The battery pack shall be structured with no short circuit within the battery pack, which may cause generation of smoke or firing.

3) Prohibition of disassembly

i) Never disassemble the cells

The disassembling may generate internal short circuit in the cell, which may cause gassing, fining, explosion, or other problems.

ii) Electrolyte is harmful

LIFE battery should not have liquid from electrolyte flowing, but in case the electrolyte come into contact with the skin, or eyes, physicians shall flush the electrolyte immediately with fresh water and medical advice is to be sought.

4) Prohibition of dumping of cells into fire

Never incinerate nor dispose the cells in fire. These may cause explosion of the cells, which is very dangerous and is prohibited.

5) Prohibition of cells immersion into liquid such as water

The cells shall never be soaked with liquids such as water, seawater, drinks such as soft drinks, juices, coffee or others.

6) Battery cells replacement

The battery replacement shall be done only by either cells supplier or device supplier and never be done by the user.

7) Prohibition of use of damaged cells

The cells might be damaged during shipping by shock. If any abnormal features of the cells are found such as damages in a plastic envelop of the cell, deformation of the cell package, smelling of an electrolyte, an electrolyte leakage and others, the cells shall never be used any more.

The Cells with a smell of the electrolyte or a leakage shall be placed away from fire to avoid firing or explosion.