

LiFePO₄

Upower
ecoline

Specification of Product for Lithium-ion Rechargeable Cell

Product	LiFePO ₄ battery
Model	32700-6000mAh
Standards	GB/T18287-2013

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1. Scope

This product specification describes Upower, Ltd. production of lithium-ion rechargeable battery main performance index, please according to the specification of testing and the use of methods were used, if unknown, please and supplier negotiation.

2. Model

Model: **32700-6000mAh**

3. Specification

Items	Specification	Remarks	
3.1 Nominal Capacity	6000mAh	0.5C Discharge	
3.2 Nominal Voltage	3.2V		
3.3 Discharge Cut-off Voltage	2.0V	0.5C Discharge	
3.4 Charge Limited Voltage	3.65V	0°C ~ 60°C	
3.5 Standard Charge Current	0.5C	0°C ~ 60°C	
3.6 Standard Discharge Current	0.5C	0°C ~ 60°C	
3.7 Rapid Charge Current	1C	0°C ~ 45°C	
3.8 Rapid Discharge Current	1C	0°C ~ 45°C	
3.9 Max. Discharge Current	3C	Limited Voltage 2.0V	
3.10 Max. Pulse Discharge Current	5C	10ms	
3.11 Internal Impedance	≤10 mΩ	AC internal resistance	
3.12 Weight	About 141g	± 2g	
3.13 Storage Temperature Range	≤ one month	0°C ~ 35°C	2.8V ~ 3.2V
	≤ three months	0°C ~ 35°C	3.0V ~ 3.2V
	≤ a year	0°C ~ 35°C	3.1V ~ 3.2V

4. Electrical Characteristics

Items	Test Conditions	Specification
4.1 Standard Charge	The "Standard Charge" means charging with constant current 0.5C ₅ to 3.65V, then charging with constant voltage 3.65V to 0.01C ₅ under 25 ± 2°C charging time will not more than 3h.) (Use Lithium-ion battery charger, which with an accuracy ± 0.05V.	
4.2 Nominal Capacity	The capacity means the discharge capacity of the cell, which is measured with discharge current 0.5C to cut-off voltage at 2.0V at 25 ± 2°C rest for 30 minutes after the Standard Charge.	Nominal Capacity ≥ 6000mAh
4.3 Cycle Life	At 25 ± 2°C, 1C charge to 3.45V and discharge to 2.5V with 1C discharge current, after 2000 cycles the discharge capacity is measured with 1C discharge current and 2.5V cut-off voltage.	≥ 80% Nominal Capacity
4.4 Storage Characteristic	1. Test the cell initial capacity using 0.5C ₅ current at 25 ± 2°C and record, then charge the cells with 45% capacity, then storage for 3, 6,12 months respectively at 25 ± 2°C and relative humidity of 0%~75%, then the cell is cycled for 5 times with charge with 0.5C and discharge with 0.5C at 25 ± 2°C, The maximum discharge capacity (longest discharge capacity) is recorded.	0.5C discharge time: After 3 months storage ≥ 5.7Ah; After 6 months storage ≥ 5.6Ah; After 12 months storage ≥ 5.5Ah
	2. The cell is charged and discharged using 0.5C at 25 ± 2°C. The discharge capacity is C1. The cell is stored for 28 days in 20 ± 5°C after fully charged and then is discharged using 0.5C at 25 ± 2°C. The capacity is defined as C2.	Capacity Retention C2/C1 ≥ 93%
	3. After the test as C2, The cell is charged and discharged using 0.5C at 25 ± 2°C, The discharge capacity is C3.	Capacity recoverable ratio C3/C1 ≥ 95%
4.5 Rate Capacity	1. Under the temperature of 25 ± 2°C the discharge capacity is measured with 0.5C discharge current and 2.0V cut-off voltage after full charged.	≥ 100% Nominal Capacity
	2. Under the temperature of 25 ± 2°C the discharge capacity is measured with 1C discharge current and 2.0V cut-off voltage after full charged.	≥ 99% Nominal Capacity
	3. Under the temperature of 25 ± 2°C the discharge capacity is measured with 3C discharge current and 2.0V cut-off voltage after full charged.	≥ 98% Nominal Capacity

5. Environment Characteristics

Items	Test Conditions	Specification
5.1 Temperature Performance	Cells shall be charged according to 5.1 and discharged at 0.5C to 2.0V after full charged. Cells shall be stored for 4 hours at the test temperature prior to discharging and then shall be discharged at the test temperature, The percentage shall be calculated using discharging capacity compared to the minimum capacity.	No leakage, No Appearance defect -10°C/25°C ≥ 50% (to 1.8V) 0°C/25°C ≥ 75% 25°C/25°C ≥ 100% 60°C/25°C ≥ 98%
5.2 Constant Temperature and Humidity	Under the temperature of 25 ± 2°C, after charging the cell with 0.5C, then put the cell into the constant temperature and humidity oven with 40 ± 2°C and 90 ~ 95% for 48h, then store the cells at RT for 2hrs, and discharge the cells with 0.5C to 2.0 volts.	The cell should be no deformation, no rust, no leakage, no fire, no smoking and no explosion Discharge ≥ 98% Nominal Capacity
5.3 Free Fall Test	The fully charged cell is dropped three times from a height of 1200 mm (the lowest point of the cell) onto a concrete floor. The cells or batteries are dropped so as to obtain impacts in random orientations. After the test, the cell shall be put on rest for a minimum of one hour and then a visual inspection shall be performed.	No explosion, No fire, No smoke. The OCV after the test no less than 90% before free-fall test
5.4 Vibration Test	A full-charged cell is to be subjected to simple harmonic motion with amplitude of 0.8mm total maximum excursion. The frequency is to be varied at the rate of 1 hertz per minute between 10 and 55 hertz. After the test is completed, And the cell returned to the starting position. The cell shall be vibrated for 90 ~ 100 minutes per axis of XYZ axes. The samples should be observed for 6 hours after the test, and also check the weight loss of cells before and after the test.	Not explosion, No fire, No leakage, Mass loss ≤ 0.1%
5.5 Crush Test	A full charged cell is to be crushed between two flat surfaces. The force for the crushing is applied by a hydraulic ram exerting a force of 13 ± 1KN. Once the maximum force has been applied, or an abrupt voltage drop of 0 voltage, or 30% of deformation has occurred compared to the initial dimension, the force is released.	No explosion, No fire.
5.6 Shock Test	The full charged cell has only two axes of symmetry in which case only two directions shall be tested. Each shock is to be applied in a direction normal to the face of the cell. For each shock the cell is to be accelerated in such a manner that during the initial 3 milliseconds the minimum average acceleration is 735m/s ² . The peak acceleration shall be between 1225m/s ² and 1715m/s ² . The samples should be observed for 6 hours after the test, and also check the weight loss of cells before and after the test. Cells shall be tested at a temperature of 25 ± 2°C.	No explosion, No fire, No leakage.
5.7 Altitude Simulation Test	The full-charged cells are to be stored for 6 hours at an absolute pressure of 11.6 KPa and a temperature of 20 ± 3.	No explosion, No fire, No leakage.

6. Safety Characteristics

Items	Test Conditions	Specification
6.1 Short Circuit	Each test sample cell is to be short-circuited by connecting the positive and negative terminals of the cell with a Cu wire having a maximum resistance load of $80 \pm 20\text{m}\Omega$. The sample is to discharge until a fire or exposition is obtained, or until it has reached a completely discharge state of less than 0.2V and the sample case temperature has returned to ± 10 of the ambient temperature. Tests are to °C be conducted at $25 \pm 2^\circ\text{C}$ and $55 \pm 5^\circ\text{C}$. Cell Condition: Fresh, Fully charged cell.	No fire, No explosion; Max. Temp. of battery surface should not exceed 150°C
6.2 Over-charge Characteristics	The battery is charged at a 3C constant current with a voltage limit of 4.8V for 8 hours after fully charged.	No fire, No explosion; Max.Temp.of battery surface should not exceed 150°C.
6.3 Over Discharge	After standard charge. Cells are discharged at constant Current of 0.2C to 2.0V, and the positive and negative terminal is connected by a 30Ω wire for 24 hours. Cell Condition: Fresh, Fully charged cell.	No explosion, No fire
6.4 Hot oven Characteristics	The fully charged battery is placed the battery in the hot box then rose to $130^\circ\text{C} \pm 2^\circ\text{C}$ in the temperature to $5^\circ\text{C} \pm 2^\circ\text{C}/\text{min}$ rate, insulation 30min.	No fire, No explosion
6.5 High Temperature Storage Test	Put cell into the 80°C box and keep the cell in the box for 7 hours after it be charged according to 6.1, and then take it out. Cell Condition: Fresh, Fully charged cell.	No explosion, No fire
6.6 Thermal-cold Cycling Performance Test	The full-charged cell is placed in $75 \pm 2^\circ\text{C}$ for 6h, and then put the Cell in -40°C for 6h; change temperature time $< 30\text{min}$, then repeat it for 10 cycles. Finally the cell is placed in room temperature for 24h. Watch the appearance of cell.	No explosion, No fire, No smoke, Open circuit voltage changed not less than 90%, mass loss limit: $\leq 0.1\%$
6.7 Impact Test	A test sample cell is to be placed on a flat surface. A $15.8 \pm 0.1\text{mm}$ diameter bar is to be placed across the center of the sample. A $9.1\text{Kg} \pm 0.46\text{Kg}$ mass is to be dropped from the height of $610 \pm 25\text{mm}$ to the center of the cell vertically. Cell Condition: Fresh, Fully charged cell.	No explosion, No fire

7. Standard Testing Conditions and Requirements

7.1 Standard Testing Conditions and Requirements

Test should be conducted with new cells within three months after shipment from our factory and cells shall not be cycled more than five times and Storage at 0-35°C and 5-10% charge before test. Unless there is special requirement, test shall be done under temperature of 25 ± 2°C.

7.2 Measurement Equipment and Instrumentation

7.2.1 Measurement Tool

With a precision of 0.01 mm caliper or higher precision instruments for measuring size, range 0 ~ 100mm.

7.2.2 Measurement Voltage

With a precision of 0.1 mV voltage meter measuring voltage, range 0 ~ 20V.

7.2.3 Measurement Current

With a precision of ± 0.1% current Ammeter to measure the current, range 0 ~ 10A.

7.2.4 Measurement Impedance

The impedance is measured with 1KHz sinusoidal alternating current resistance instrument.

8. Outside Appearance

There should not be any appearance defect such as leakage, rust, deformation, severe blow fire effect on cell performance.

9. Packing/Storage/Shipment

9.1 Pre shipment inspection

The battery should be checked the voltage, resistance and the function of protective circuit before shipment.

9.2 Packing and Shipping

9.2.1 The battery should be transported to the factory assembly, to pay special attention to the packing, in order to avoid transport stress. We suggest to use the same packaging when the battery be transported. Even the package is opened, please pack with the components and materials as same as Upower.

9.2.2 The battery should be in a 5- 30% state of charge packaging boxes for transport, in the transport process, prevent severe vibration, shock, extrusion, prevent the sun and rain, should be in automobile, train, ship, airplane and other forms.

9.3 Abnormal Condition

Do not use the battery when it's smell like abnormal cell electrolyte because of transport stress, sag, short circuit or any other.

10. Safety precaution and prohibitions

In order to prevent battery leakage, heating, fire, reduced performance or life drops, explosion and other accidents, please do the following provisions of the normal use of battery, and compliance with preventive matters.

10.1 Charging

10.1.1 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.

10.1.2 Charging Voltage

Charging shall be done by voltage less than that specified in the Product Specification (3.65V/cell).

Charging beyond 3.65V, which is the absolute maximum voltage, must be strictly prohibited. The charger shall be designed to comply with this condition. It is very dangerous that charging with higher voltage than maximum voltage may cause damage to the cell electrical, mechanical safety performance and could lead to heat generation, leakage or explosion.

10.1.3 Charging Temperature

The cell shall be charged within 0°C ~ 60°C range in the Product Specification.

10.1.4 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, leakage or explosion.

10.2 Discharging

10.2.1 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.

10.2.2 Discharging Temperature

The cell shall be discharged within -10°C ~ 60°C range specified in the Product Specification.

10.2.3 Over-Discharging

It should be noted that the cell would be at 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 3.0V and 3.2V. 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.

10.3 Exception Handling

Do not use the cell if you find it in unusual conditions such as distortion, leakage (or odors). The cell should be kept away from fire and drilling and immersion to avoid an explosion.

11. Storage

11.1 Storage temperature and humidity

The cell shall be stored at temperature range of 0°C ~ +35°C relative humidity of 0~75%, clearing, drying, ventilated, and kept away from corrosive substances and fire.

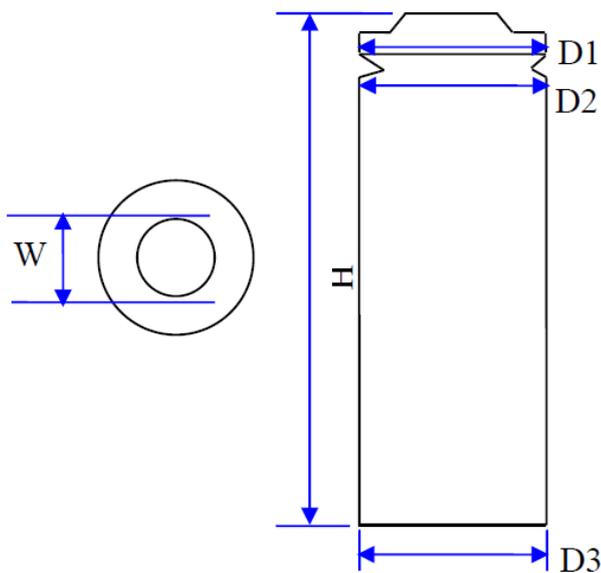
11.2 Long Time Storage

If the battery is stored for a long time, the battery should be conducted a cycle of charge and discharge, and the voltage should be about 3.0-3.2V and the battery is to be stored at temperature range of 0°C ~ 35°C and RH0% ~75%, low moisture and corrosive gases environment.

12. Guarantee Period of Quality

The guarantee period of quality extend for one years after code. Upower would replace battery which due to the manufacturing problems and it is not abnormal use, if the battery appears during the abnormal situation.

13. Appearance structure and Size of The Battery



Items	Size(mm)	Tolerance(mm)
Width	15.92	±0.1
Height	70.5	+0.4
		-0.2
Diameter 1	32.15	±0.05
Diameter 2	32.5	±0.3
Diameter 3	32.4	±0.1