Specification for Lithium Iron Phosphate Cell

Cell Type：32650- 6.0Ah $LiFePO_4$ Cell

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Compilation/Date	Check/Date	Approval/Date

Content

1. General Information

1.1 Scope

This specification describes the technical requirements of Cylindrical Lithium Iron Phosphate Cell supplied by OPTIMUMNANO ENERGY CO., LTD. If any other technical information is needed, please contact OPTIMUMNANO ENERGY CO., LTD.

1.2 Product Classification

Cylindrical Rechargeable Lithium-ion Cell

1.3 Model Name

$LiFePO_4$-32650- 6.0Ah

1.4 Benefits

- Sturdy and pressure resistant steel envelope
- High capacity
- Excellent cycle life
- Excellent high and low temperature performance
- Steady output voltage
- Low self-discharge
- Double safety protection
- With outstanding high level of vibrations and shocks

1.5 Main Application

- EV/PHEV
- UPS/Telecom
- Storage energy
- Starting power supply

1.6 Battery Assembly

Individual cells should be integrated in specific battery pack according to customers' demands. The battery pack together with electronic system provides performance, thermal and safety management.

2. Nominal Specification

Item		Condition/ Note	Specification	Remarks
2.1 Norminal Capacity		1C discharge capacity	6.0Ah	
2.2 AC Impedance		At AC 1000 Hz	6.5 mΩ	
2.3 Nominal Voltage			3.2 V	
2.4 Cell Size		Cell Diameter	32.0±0.5 mm Max. 32.5 mm	For details, please prefer to Figure 1.
		Cell Height	70.0±0.5 mm Max. 70.5 mm	
2.5 Cell Weight		(Bare cell)	140± 5 g	
2.6 End-of-charge Voltage		CC Mode	3.65 V	
2.7 End-of-charge Current		CV Mode	0.3A	
2.8 Charging Method		Standard Charging	1 C at CC/CV	60 min
		Max Continuous Charging	6 C at CC/CV	10~15 min
2.9 End-of-discharge Voltage		CC Mode	2.0 V	
2.10 Max continuous Discharging Current			36A	
2.11 Max Pulse Discharging Current			60A	5 s
2.12 Cycle Life		1 C/ 70 % DOD	≥4000 cycles	
2.13 Operating Temperature Range	Charging Temperature		0~60 ℃	
	Discharging Temperature		-20~ 60℃	
	Storage Temperature	1 year	-20~ 45℃	
2.14 Appearance		Without break, scratch, distortion, contamination, leakage and so on		

3. Test Conditions

3.1 Standard Test Conditions

If no otherwise requirement, room temperature(RT) is 25 ℃ ±2 ℃, and all tests stated in this Specification are conducted at 25 ℃±5 ℃, 15~90 %RH and atmospheric pressure of 86 kPa~ 106 kPa.

3.2 Standard Charging Method

"Standard Charging" means that in standard test conditions, charge the cell at a constant current of 1 C until the voltage reaches 3.65 V, then charge it at a constant voltage of 3.65 V until the current decreases less than 0.05 C and placed for 1 h.

3.3 Standard Discharging Method

"Standard Discharging" means that in standard test conditions, discharge the cell at a constant current of 1 C until the voltage reaches 2.0 V.

4. Electrochemical Performance

Test Item	Test Method	Criteria
4.1 AC Impedance	Cell shall be measured at 1000 Hz after charged per 3.2.	≤ 8 mΩ
4.2 Initial Capacity (C_{ini})	Cell shall be charged per 3.2 and discharged per 3.3 within 1h after full charge.	C_{ini} ≥ 6.0 Ah
4.3 Cycle Life	Cell shall be charged at CC/CV mode(CC: 1 C, CV: 3.65 V, End-of-charge current: 0.05 C); After stored for 30 min, cell shall be discharged at CC mode(1 C, End-of-charge voltage: 2.0 V); After stored for 30 min, tests shall be continued for 2000 times.	Capacity retention ≥ 80 %
4.4 High-rated Discharging Performance	Cell shall be charged per 3.2, and discharged at 6C to ending voltage at RT.	Discharge Capacity: ≥ 90% C_{ini}
4.5 Low Temperature Performance	Cell shall be charged per 3.2 and stored in a temperature-controlled environment for 4h. Then discharged cell at 1C to ending voltage.	Discharge Capacity: ≥ 70%C_{ini}（-20℃）
4.4 Room Temperature Storage Test	Cell shall be charged per 3.2, then stored at 25 ℃ ±2 ℃ for 28 days. Finally discharged cell at 1 C to ending voltage.	Capacity retention ≥90%
4.5 High Temperature Storage Test	Cell shall be charged per 3.2, then stored at 55 ℃ ±2 ℃ for 7 days. After standing for 5h，discharged cell per 3.3.	Capacity retention ≥ 90 %

5. Environment Characteristic

Test Item	Test Method	Criteria
5.1 Constant Temperature and Humidity Test	Cell shall be charged per 3.2, and stored in 45 ℃ ±2 ℃ (90~95% RH) for 48 h. Then be placed in RT for 2h and checked for 1h.	No distortion, no rust, no fume and no explosion.
5.2 Thermal Shock Test	Cell shall be charged per 3.2, and put into an oven. Temperature inside the oven will drop to -40 ℃ in 60 min and remain for 90 min. Then it will rise to 25 ℃ in 60 min and keep rising to 85 ℃ in 90 min, following by remaining for 110 min. And it will drop to 25 ℃ in 70 min. Repeat this process for 5 times, then check it for 1h.	No explosion, no fire, no leakage.
5.3 Low-pressure Test	Cell shall be charged per 3.2, then stored it for 6h at an absolute pressure of 11.6 kPa (RT). Check it for 1h.	No explosion, no fire, no leakage.
5.4 Drop Test	Cell shall be charged per 3.2, then dropped from a height of 1.5 m onto the concrete ground. Positive and negative terminals of cells shall be towards the ground. Check it for 1h.	No explosion, no fire.
5.5 Soaking Test	Cell shall be charged per 3.2, then completely soaking into NaCl solution (3.5 wt %) for 2h. Check it for 1h.	No explosion, no fire.

6. Safety Characteristic

Test Item	Test Method	Criteria
6.1 External Short-Circuiting Test	Cell shall be charged per 3.2, then short-circuited by connecting the positive and negative terminals with a resistance of <5 mΩ for 10 min. Check it for 1h.	No explosion, no fire.
6.2 Over-charge Test	Cell shall be charged per 3.2, then charged at 1C to ending voltage of 5.5 V or charged at 1C for 1h. Check it for 1h.	No explosion, no fire.
6.3 Over-discharge Test	Cell shall be charged per 3.2, then discharged at 1C for 90 min. Check it for 1h.	No explosion, no fire, no leakage.
6.4 Crush Test	Cell shall be charged per 3.2,then crush the cell perpendicularly to the cell plate at a rate of (5±1) mm/s with a semi-cylinder (radius of 75 mm). When met any of the following criteria, stopping crushing and check it for 1h. 1. Voltage reaches 0 V; 2. Deformation reaches 30%; 3. Pressure reaches 200 kN.	No explosion, no fire.

6.5 Acupuncture Test	Cell shall be charged per 3.2, then acupuncture the cell perpendicularly to the cell plate at a rate of (25±5)mm/s with a ϕ5 mm~ϕ8 mm steel needle and remain it inside. The acupuncturing location shall be near the geometric center of plane. Check it for 1h.	No explosion, no fire.
6.6 Heating Test（130 ℃）	Cell shall be charged per 3.2, then heated in an oven. Temperature will rise to 130 ℃±2 ℃ at a rate of 5 ℃/min and remain for 30 min. Check it for 1h.	No explosion, no fire.

7. Storage and Transportation

7.1 Based on the character of cell, proper environment for transportation of pack need to be created to protect the battery.

7.2 During transportation, 50% SOC must be kept to ensure that short circuit, appearance of liquid in the battery or immersion of battery in liquid never occur.

7.3 Cell should be kept at -20℃-45℃ in warehouse where it's dry, clean and well-ventilated.

7.4 During loading of battery, attention must be paid against dropping, turning over and serious stacking.

8. Precautions and Safety Instructions

In order to prevent the battery leakage, getting hot and explosion, please pay attention to preventing measures as following:

Warning!

- Never throw the battery into water. Store it under dry, shady circumstance when not use.
- Never misidentify the positive and negative terminals.
- Never connect the positive and negative terminals of battery with metal to prevent short-circuiting.
- Never ship or store the battery together with metal.
- Never knock, throw or trample the battery.
- Never cut through the battery with nail or other edge tool.

Tips!

- Never use or store the battery under the over-high temperature. Otherwise it will lead to battery over-heating, which might lose some function and reduce life, even getting fire. The proposed temperature for long-term storage is 10~45℃.
- Never throw the battery into fire or heating machine to avoid fire, explosion and environment pollution; scrap battery should be returned to the supplier and handled by the recycle station.
- Never use the battery under strong static electronic and magnetic field, otherwise it will destroy the protecting device.
- Never knead eyes if leakage electrolyte gets into eyes. Wash eyes by water and seek medical advice ASAP.
- If battery emit peculiar smell, over-heating, distortion or appear any unconventionality during using, storage or

charging process, please stop using and take it out of the device.

- Never cut the battery in socket directly, please use the stated charger when charging.
- Check the voltage of battery and relevant connectors before using. Do not use until everything turns out to be normal.
- Prior to charging, fully check the insulativity, physical condition and ageing status. The pack voltage must not be less than the cut-off voltage, if not, it needs to be labeled. The user should contact our Customer Service Department. It can't be charged until repaired by our staff.
- The battery should be stored in 50% SOC. It needs to be charged once again if out of use for as long as half a year.
- Clean the dirty electrode with a clean dry cloth if any contamination appears, otherwise poor contact or operation failure may occur.

9. Consultation

As to obscurity, contact us as followings:

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Annex

Figure 1

Cell's appearance and dimension

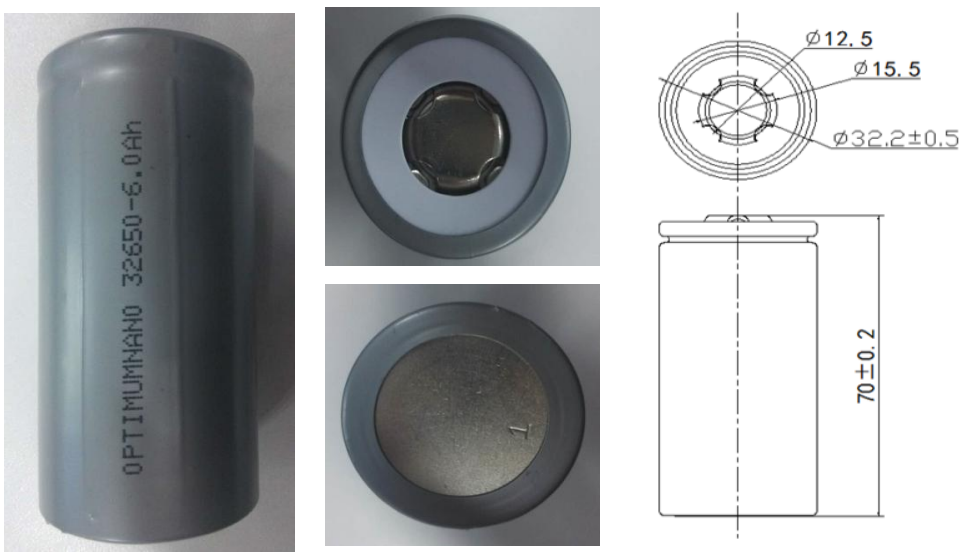

Figure 2

Different rate charge curve of 6.0Ah $LiFePO_4$ Cell

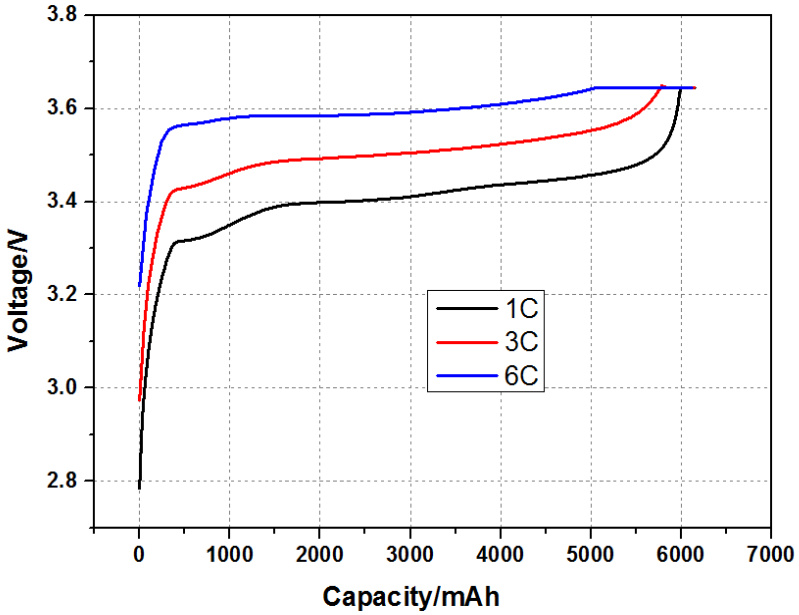

Figure 3

Different rate discharge curve of 6.0Ah $LiFePO_4$ cell

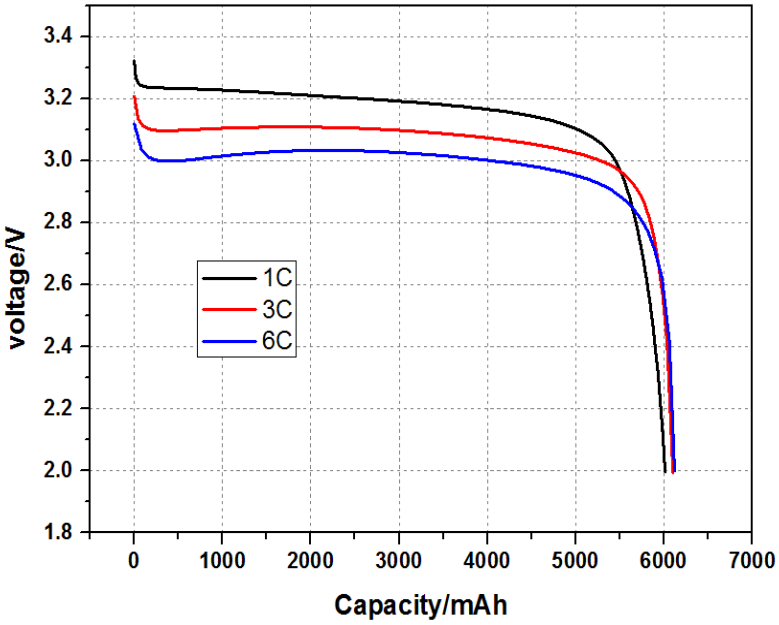

Figure 4

Discharge curve of 6.0 Ah $LiFePO_4$ cell at different temperatures (1C)

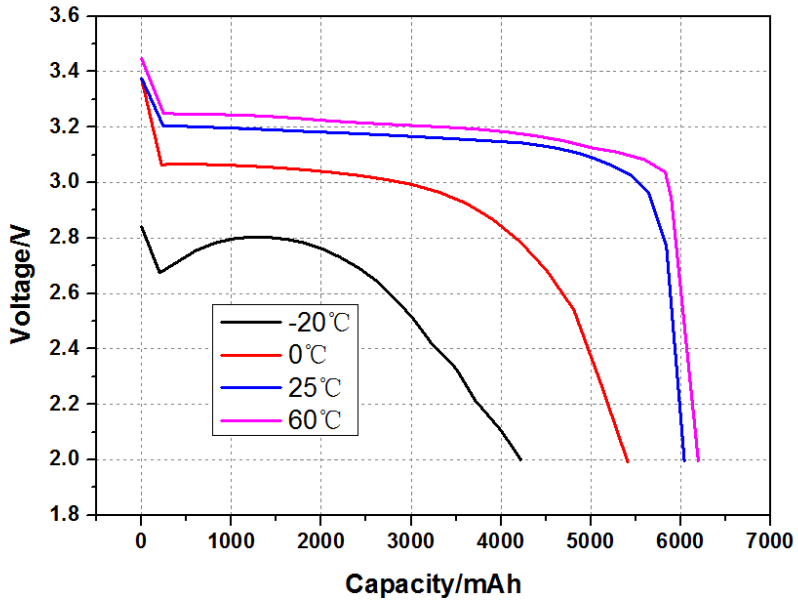

Figure 5

Circular curve of 6.0 Ah $LiFePO_4$ cell