



VAPCELL TECHNOLOGY CO., LTD

Add: 617, Fengtian Bldg., Donghuan 1st Road Longhua New Dist., Shenzhen, Guangdong, China

Specification for Lithium-ion Rechargeable Cell

Cell Type: 32700- 6.5Ah LiFePO₄ Cell

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1. General Information

1.1 Scope

This specification describes the technical requirements of Cylindrical Lithium-ion 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

LiFePO₄-32700- 6.5 Ah

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/ Notes	Specification	Remarks
2.1 Norminal Capacity		1 C discharge capacity	≥ 6.5 Ah	
2.2 AC Impedance		At AC 1000 Hz	≤ 8 m Ω	
2.3 Nominal Voltage			3.2 V	
2.4 Cell Size		Cell Diameter	32.2 \pm 0.3 mm Max. 32.5 mm	For details, please prefer to Figure 1. Excluding plastic parts outside.
		Cell Height	70.5 \pm 0.3 mm Max. 70.8 mm	
2.5 Cell Weight		(Bare cell)	140 \pm 5 g	Excluding plastic parts outside.
2.6 End-of-charge Voltage		CC Mode	3.65 V	
2.7 End-of-charge Current		CV Mode	0.275 A	
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			33 A	
2.11 Max Pulse Discharging Current			55 A	5s
2.13 Cycle Life		1 C/ 70 % DOD	≥ 3000 cycles	
2.14 Storage performance		60°C 10 -day capacity retention	$\geq 90\%$	
		60°C 10 -day capacity recovery	$\geq 92\%$	
2.15 Operating Temperature Range	Charging Temperature		0~45 °C	
	Discharging Temperature		-20~ 65°C	

3. Test Conditions

3.1 Standard Test Conditions

If no otherwise requirement, room temperature(RT) is $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$, and all tests stated in this Specification are conducted at $25\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$, 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 1h.

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 Items	Test Method	Criteria
4.1 AC Impedance	Cell shall be measured at 1000 Hz after charged per 3.2.	$\leq 8\text{ m}\Omega$
4.2 Initial Capacity (C_{ini})	Cell shall be charged per 3.2 and discharged per 3.3 within 1h after full charge.	$C_{ini} \geq 6.5\text{ Ah}$
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 $\geq 80\%$
4.4 High-rated Discharging Performance	Cell shall be charged per 3.2, and discharged at 6C to ending voltage at RT.	Discharge Capacity: $\geq 90\% C_{ini}$
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: $\geq 70\% C_{ini}$ (-20°C)
4.4 Room Temperature Storage Test	Cell shall be charged per 3.2, then stored at $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 28 days. Finally discharged cell at 1 C to ending voltage.	Capacity retention $\geq 90\%$
4.5 High Temperature Storage Test	Cell shall be charged per 3.2, then stored at $60\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 10 days. After standing for 5h, discharged cell per 3.3.	Capacity retention $\geq 90\%$

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 °C \pm 2 °C (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 °C in 60 min and remain for 90 min. Then it will rise to 25 °C in 60 min and keep rising to 85 °C in 90 min, following by remaining for 110 min. And it will drop to 25 °C 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 Items	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 m Ω 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 \pm 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 0V; 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 $\phi 5$ mm~ $\phi 8$ 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 °C)	Cell shall be charged per 3.2, then heated in an oven. Temperature will rise to 130 °C±2 °C at a rate of 5 °C/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 10°C -45°C 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°C.
- 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.

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- 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.

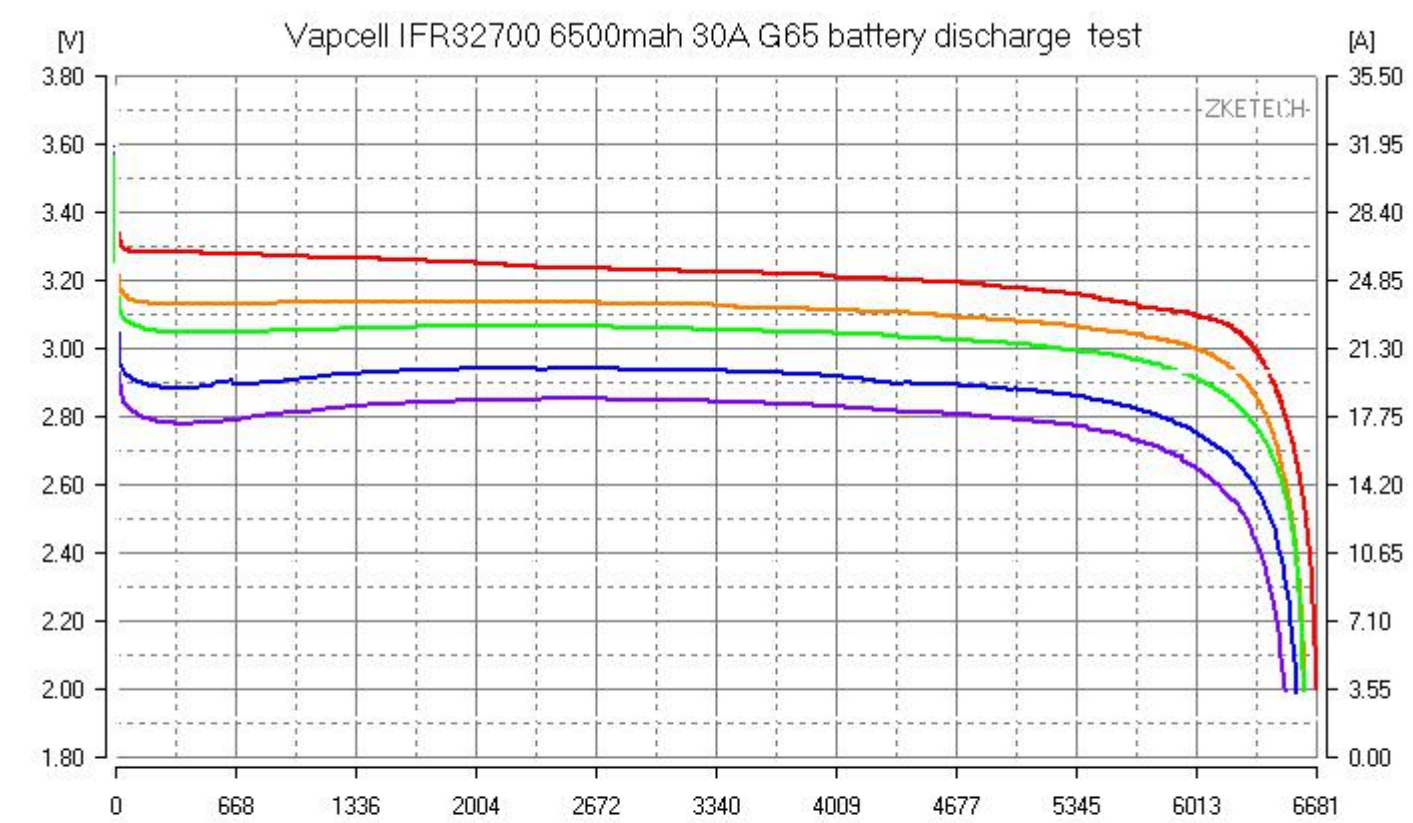
Annex

Figure 1

Cell's appearance and dimension



Discharge Graph :



Device	Mode	Begin Volt	Cutoff Volt	Capacity	Energy	Avg Volt	Title
EBD-A40L	D-CC 2.00A 2.00V	3.567V	1.999V	6680mAh	21.31Wh	3.19V	red
EBD-A40L	D-CC 10.00A 2.00V	3.575V	1.997V	6619mAh	20.41Wh	3.08V	orange
EBD-A40L	D-CC 20.00A 2.00V	3.574V	1.995V	6608mAh	19.91Wh	3.01V	green
EBD-A40L	D-CC 30.00A 2.00V	3.596V	1.987V	6569mAh	18.92Wh	2.88V	blue
EBD-A40L	D-CC 35.00A 2.00V	3.574V	1.993V	6506mAh	18.17Wh	2.79V	purple

