Specification for Cylindrical Lithium-ion Cell

Model : IFR26650-4000mAh

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Customer Approval	
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Abstract

1.Scope of application

This specification specifies the technical requirements, test methods and precautions for the cylindrical lithium-ion cell manufactured by Shandong Tianhan New Energy Technology Co., LTD.

2.Model and description

2.1 Description： the cylindrical lithium-ion cell

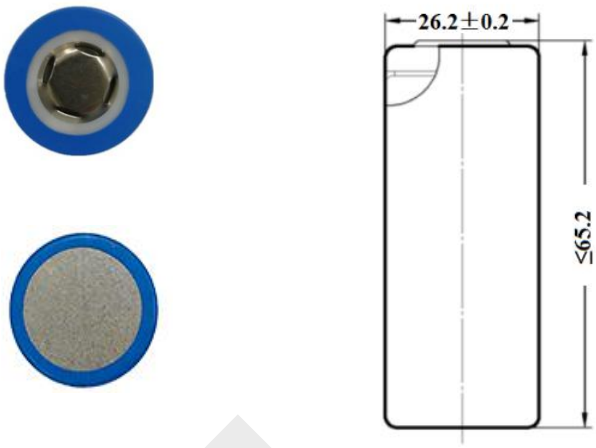
2.2 Model： IFR26650-4000mAh

3.Major Technical Parameters

NO	Item	Specifications		Note
1	Capacity	Nominal capacity	4000 mAh	0.5C
		Minimum Capacity	3900 mAh	0.5C
2	Alternating Internal Resistance	Max	23mΩ	AC 1 kHZ
3	Nominal Voltage		3.2 V	
4	Charging Voltage		3.65±0.05 V	
5	Standard Charge Conditions(Constant current charging and then constant voltage charging)	Current	0.5C (2000 mA)	
		Voltage	3.65V	25°C±2°C
		Cut-off Current	80±5mA	0.02C
6	Max Charging Current	0°C≤T≤5°C	0.2C (800 mA)	
		5°C≤T≤15°C	0.5C (2000mA)	
		15°C≤T≤55°C	1C (4000 mA)	
7	Standard Discharge Conditions （Constant Current Discharge）	Current	0.5C (2000 mA)	25°C±2°C
		Cut-off Voltage	2.5±0.05**V**	
8	Max Discharge Current	-20°C≤T≤5°C	0.5C (2000 mA)	
		5°C≤T≤45°C	3C（12000mA)	
		45°C≤T≤60°C	1C (4000 mA)	
9	Working Temperature	Charge	0～55°C	
		Discharge	-20~60°C	
10	Storage Temperature	1 month	-20~60°C	
		3 months	-20~40°C	
		12 months	-20~20°C	
11	Weight		≤91g	
12	Dimension	Height	≤65.2mm	Figure 1
		Diameter	26.2±0.2mm	

13	Appearance	No rupture, no scratch, no deformation, no stain, no electrolyte leakage, etc	

Figure 1: Schematic drawing of appearance and dimensions (unit: mm)



4. Test condition

4.1 Standard test condition

If there is no special requirement, the product test conditions in this specification book are temperature: 25℃±2℃, humidity: 65%±20% RH。

4.2. Charge method

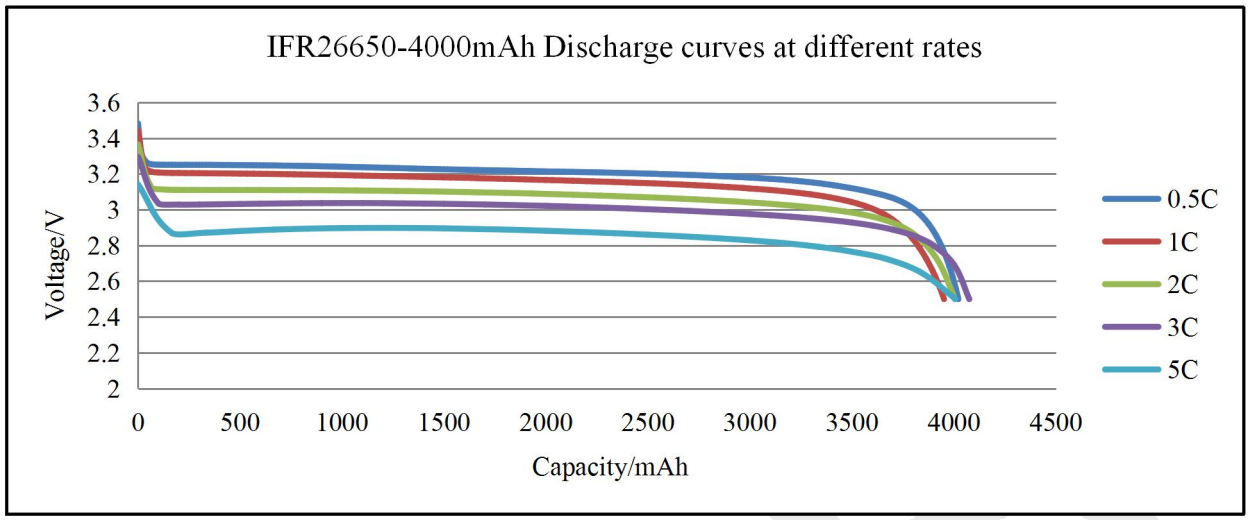
Standard charging means that under the condition that the ambient temperature is 25℃±2℃, charging is firstly done at a constant current of 0.5C to 3.65V, and then charging is stopped at a constant voltage of 3.65V until the current is less than 0.02C.

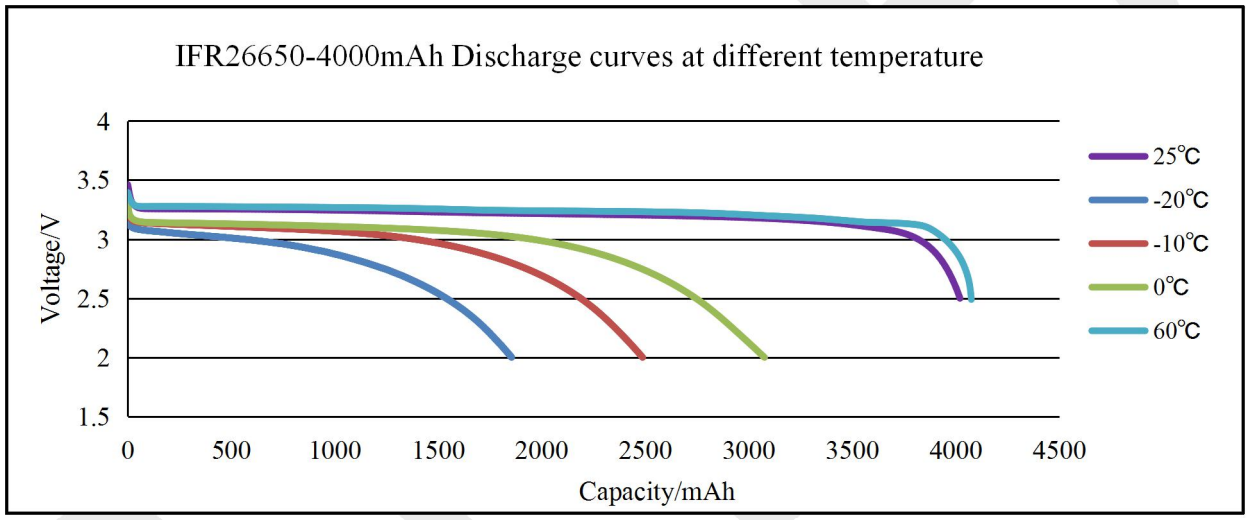
5. Electrical Characteristics

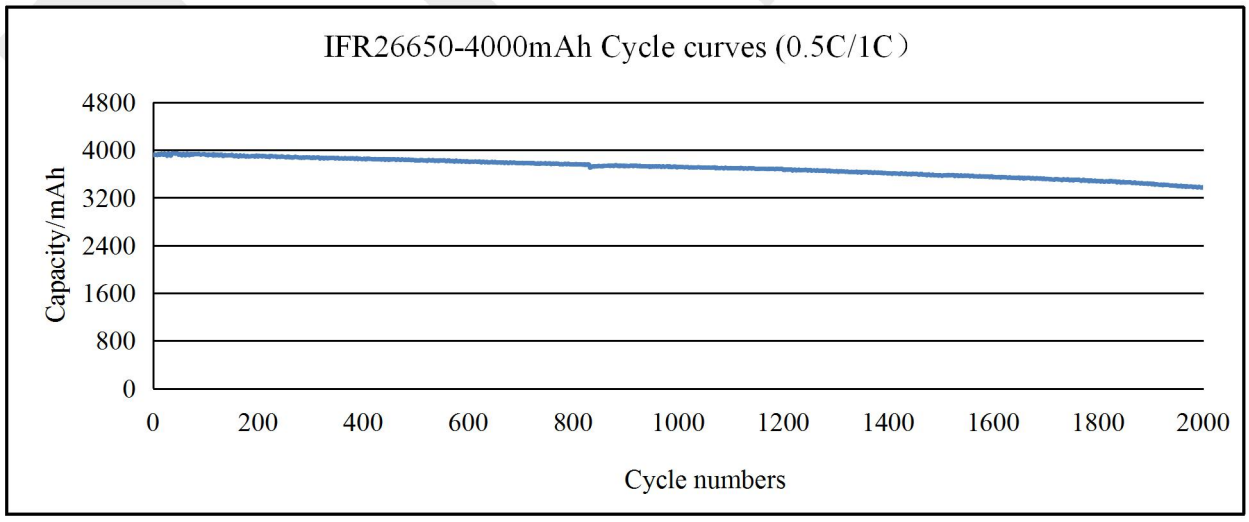
NO	Test item	Test method	Standard
1	Capacity	The cells is charged according to 4.2 method and discharged to 2.5V with 0.5C current, and record the discharge capacity;	≥3900mAh
2	Discharge performance at different rate	After the cells is charged according to 4.2 method, the cells is discharged to 2.5V with the current of 0.5C, 1C, 2C, 3C and 5C, and the percentage of discharge capacity is measured.(0.5C/0.5C, 1C/0.5C, 2C/0.5C, 3C/0.5C, 5C/ 0.5c)	0.5C=100% 1C≥95% 2C≥90% 3C≥88% 5C≥85%
3	Discharge performance at different	After the cells is charged according to the 4.2 method, the cells is stored at -20℃, -10℃ and 0℃ for 12h, and discharged to 2.0V at 0.1C,0.2C,0.5C current respectively.	25℃=100% -20℃≥40% -10℃≥60%

	temperatures	Stored at 25℃ and 60℃ for 5h and discharged to 2.5V with 0.5C current ; Measure the percentage of discharge capacity。(-20℃/25℃、-10℃/25℃、0℃/25℃、25℃/25℃、60℃/25℃)	0℃≥70% 60℃≥95%
4	Charge retention and capacity recovery capability at normal temperature	The initial capacity of the cells is measured. After charging according to 4.2 method, the cells is stored at room temperature for 28 days, and then discharged at 0.5C current to 2.5V to measure the capacity.After charging in accordance with 4.2., discharge to 2.5V with 0.5C current and measure the recovery capacity.	Storage capacity ≥92% recovery capacity ≥95%
5	Charge retention and capacity recovery capability at high temperature	The initial capacity of the cells was measured. After charging according to the 4.2 method, the cells was stored at 60℃±2℃for 7 days, and then set aside at room temperature for 5 hours. Then, the cells was discharged to 2.5V with a current of 0.5C, and the capacity was measured.After charging in accordance with 4.2 method, discharge at 0.5C current to 2.5V, and measure the recovery capacity.	Storage capacity ≥92% recovery capacity ≥95%
6	Storage performance	After the cells is charged according to the 4.2 method, after discharging with 1C current for 30min, the cells is stored at 45℃±2℃ for 28 days, and then stored at room temperature for 5 hours. After charging according to the 4.2. method, the cells is discharged with 0.5C current to 2.5V, and the discharge capacity is measured.	recovery capacity >90%
7	Cycle life	Stand for 10min after charging according to 4.2 method; Discharge with 1C current to 2.5V, complete a cycle, and stand for 10min;Repeat the steps above. When the discharge capacity is less than 80% of the initial capacity, the life is terminated.	0.5C charge /1C discharge cycle ≥1500次

Figure 2: Main discharge curve (for reference only)


IFR26650-4000mAh Discharge curves at different rates
Voltage/V
3.6
3.4
3.2
3
2.8
2.6
2.4
2.2
2
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Capacity/mAh
0.5C
1C
2C
3C
5C


IFR26650-4000mAh Discharge curves at different temperature
Voltage/V
4
3.5
3
2.5
2
1.5
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Capacity/mAh
25℃
-20℃
-10℃
0℃
60℃


IFR26650-4000mAh Cycle curves (0.5C/1C）
Capacity/mAh
4800
4000
3200
2400
1600
800
0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Cycle numbers

6. Safety performance

The following tests shall be carried out under forced exhaust conditions and explosion-proof measures. Before the test, all batteries shall be charged according to 4.2 method, and the following tests shall be carried out after 24h of use：

NO	Test item	Test method	Standard
1	Forced discharge	Reverse charge the cells with 1C current for 90min.	No explosion, No fire.
2	Overcharge	After the cells was discharged as standard (discharge to 2.5V with 0.5C), 1C and 12V were used for constant current and constant voltage charging for 90min。	No explosion, No fire.
3	Short circuit	The cells positive and negative electrode short circuit, with the external circuit the total resistance is less than 80±20mΩ.When the cells voltage drops to 0.1V, the test is over.	No explosion, No fire.
4	Thermal Abuse	Put the cells into the electric blast drying oven for heating, and the temperature rose to 130±2℃ at a rate of 5℃/min, and kept for 30 minutes.	No explosion, No fire.
5	Extrusion Test	The cells is squeezed between two planes with a pressure force of 13KN±1KN.Discharge pressure when the extrusion pressure reaches the maximum or the cells voltage drops sharply to 1/3 of the cells voltage.	No explosion, No fire.
6	Heavy Impact	The cells was placed on a flat surface and a rod with a diameter of 15.8mm was placed in the center of the cells, with a weight of 9.1kg falling on the sample from a height of 610±25mm。	No explosion, No fire.
7	Low atmospheric pressure	The cells was placed in a low-pressure box, and the air pressure in the test box was adjusted to 11.6kPa. The temperature was room temperature, and the cells was allowed to stand for 6H	No explosion, No fire. No leakage.
8	Free fall	The cells dropped freely from a height of 1.5m onto the concrete floor.The positive and negative end faces of the cells fell once each, and the cylinder fell twice, for a total of four times. After the experiment, the cells was placed for 24h, and then the appearance was observed.	No explosion, No fire. No leakage.
9	Vibration	The cells vibrates with a sinusoidal vibration amplitude of 0.8mm, the vibration frequency range is 10Hz ~ 55Hz, and the frequency change rate is 1Hz/min.Vibration along X, Y, Z three directions, each direction vibration 90±5 min.	No explosion, No fire. No leakage.
10	Seawater immersion	When the cells is immersed in 3.5%NaCl solution for 2h, the water depth should not exceed the cells。	No explosion, No fire

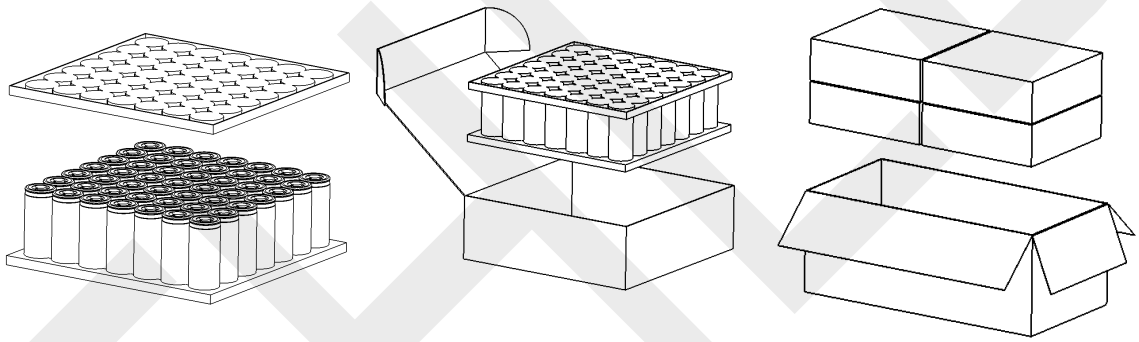
11	Temperature cycle	The cells was used at 75±2° C for 6h;The temperature was set at -40±2° C for 6h, and the maximum interval between the two extremes was 30min.After 10 cycles, the cells shall be tested after being put aside for 24h.	No explosion, No fire. No leakage.
12	Prick	Use Φ5 mm to Φ8 mm high-temperature steel needle (pinpoint the conical Angle of 45 ~ 60）, to (25±5) mm/S of speed, from the perpendicular to the direction of the cells plate, through the appropriate location near by the geometric center, steel needle to stay in the cell;Observation of 1 h.	No explosion, No fire

7. Packaging

7.1 Cells packing: 49 cells per box, 4 boxes per box, 196 cells in total, Outer box size : 455*232*172mm.

7.2 The cells packing case shall be marked with the product name, model, nominal voltage, quantity, gross weight, date of manufacture and the corresponding grade of internal resistance and capacity.

Figure 3: cells packaging structure diagram



8.Transportation

The outgoing cells is in the state of 40-50% SOC. Due to the self-consumption of the cell, the cell delivered to the client cannot fully guarantee 40-50%SOC. The transportation process should prevent violent vibration, impact, sun and rain.。

9. Quality guarantee

In 12 months from the date of shipment, any quality problem that is confirmed to be caused by process and not by misuse shall be resolved by the manufacturer. Beyond this deadline, the cells quality problem caused by misuse by customers is not the reason of production process. Tianhan company does not promise to replace the cells for free.

9.1 Tianhan shall not assume any responsibility for the problems caused by violation of the safety rules.

9.2 Tianhan shall not take any responsibility for the problems caused by the combination of the circuit, cells pack and charger.

9.3 Defective batteries produced by customers in the cells assembly process after shipment shall not be included in the scope of quality assurance.

10.Cells use warning and Precautions

To prevent possible leakage, heating and explosion of the cells, please pay attention to the following precautions:

→Before using the new cells or using the cells for the first time after long-term storage, please use a special charger to fully charge the cells before using；

→Do not disassemble, open, crush, bend, deform, Pierce or break;

→Do not modify, do not insert external objects into batteries, do not immerse or expose in water or other liquids, and stay away from fires, explosives and other hazards;

→Do not short-circuit the cells and do not allow metal or other conductors to contact the cells terminal；

→Do not drop the host or cells, if the host or cells dropped accidentally, users suspect that the cells is damaged, should find the service center for inspection；

→ Changing cell shall be completed by the cells supplier or equipment supplier, and the user cannot replace the cells by himself.

→The cells can be replaced with a cells that has been certified as standard. Uncertified batteries may cause fire, explosion, or other hazards；

→Avoid cells storage for a long time， because safety issues may arise when batteries that have been left unused for a long time are recharged

→If the cells leaks, do not allow the cells to come into contact with the skin or eyes. If contact occurs, flush the contact area with plenty of water or seek medical attention.

→Children using batteries should be monitored and seek medical attention if they are swallowed.

→Under no circumstances shall the cell be removed;Removing the cell can cause an internal short circuit that can cause fire and other problems；

→Under no circumstances shall the cells be burned or put in the fire, otherwise it will cause the cells to burn;

→Do not remove the sleeve of the cells;

→Do not mix our batteries with other brands of batteries or different types of batteries.

→Do not mix old and new batteries, which may cause overdischarge;

→Dispose of discarded batteries according to local regulations.

11. Disclaimer

Shandong Tianhan New Energy Technology Co., Ltd. shall not be responsible for any accident caused by failure to operate in accordance with the provisions of this manual.Improper use of the product, improper circuit connection, or the use of input power supply, load function parameters inconsistent with the performance parameters specified in the product manual and other phenomena are improper use. The Company shall not be liable for damage (personal safety) to the product, load and peripheral connectors caused by improper use.

Shandong Tianhan New Energy Technology Co., Ltd. reserves the right to change the contents of this manual.The company reserves the right of final interpretation of the materials.