



Product Specification

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Product Specification

Product Name: Lithium-ion battery

Model: APL18650-1500mAh-3.3V

Make By: _____ Liu Tian _____

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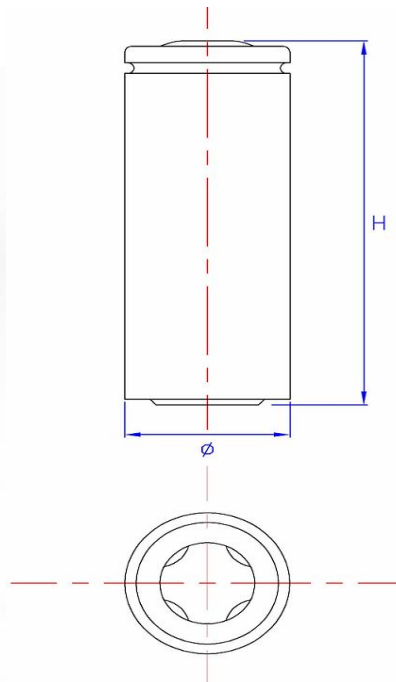
1. Application Scope

This product specification specifies characteristics of cylindrical lithium rechargeable battery manufactured by Shenzhen Apollo Battery Tech. Development Co., Ltd.

2. Model

APL18650-1500mAh-3.3V

3. Dimension



Item	Description	Dimension (mm)
Φ	Diameter	18.2±0.1
H	Height	≤65.5



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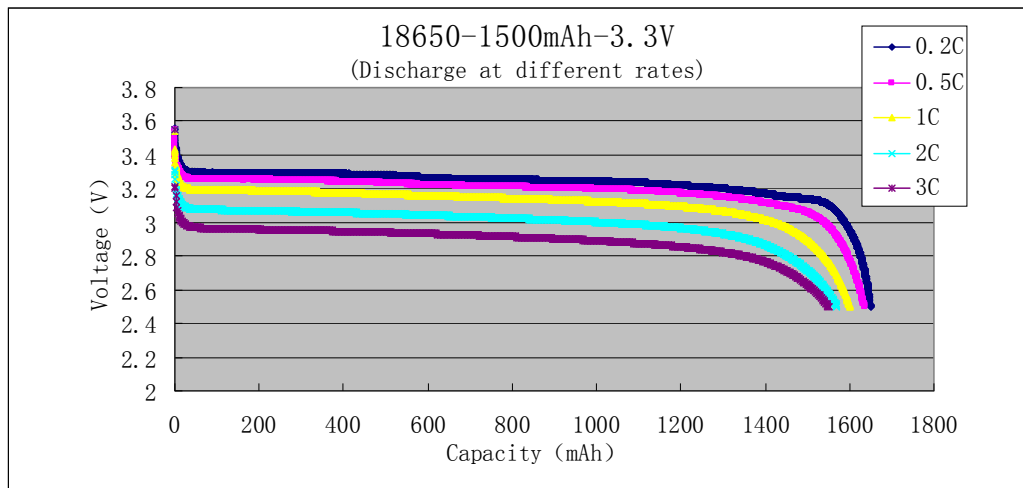
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4. Specifications

NO	Item	Parameters
1	Rated Capacity	1600mAh (0.5C,25°C)
2	Minimal Capacity	1550mAh (0.5C,25°C)
3	Rated Voltage	3.3 V
4	Internal Resistance	$\leq 60\text{m}\Omega$
5	Charge Voltage	3.65V
6	Charge Mode	CC/CV
7	Charge Time	Standard Charge Method: 6.0h (for ref.) Quick Charge Method: 2.5h (for ref.)
8	Max. Continuous Discharge Current	3C
9	Discharge Cut-off Voltage	2.5V
10	Working Temperature	Charge: 0°C ~ 55°C Discharge: -20°C ~ 60°C
11	Storage Temperature	-20°C ~ 45°C
12	Storage Humidity	<85%
13	Battery Weight	42g (Approx.)

5. Characteristics Curves



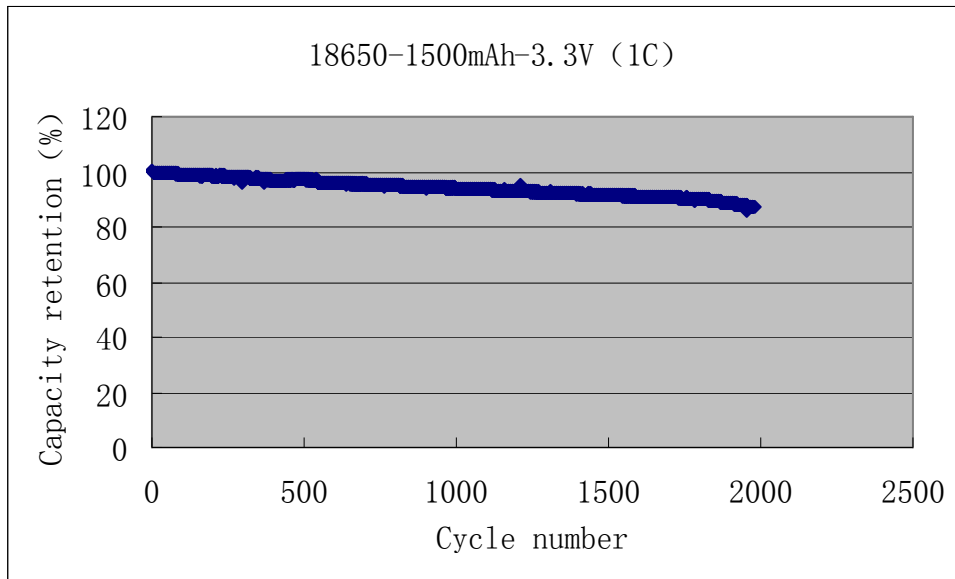


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6. Battery Characteristics

6.1 Electric Characteristics

No	Item	Standard	Test Method
1	Standard Discharge Performance	A) Discharge Performance $(0.2C_5mA) \geq 100\%$ Rated Capacity B) Discharge Performance $(0.5C_5mA) \geq 95\%$ Rated Capacity C) Discharge Performance $(1C_5mA) \geq 90\%$ Rated Capacity	Store the battery for 0.5-1h after standard charged, then discharged to cut-off voltage at a constant current of 0.2C ₅ mA、0.5C ₅ mA and 1C ₅ mA, Three cycles are permitted for this test , If the capacity of one of the three cycles can reach the standard, it represents the battery has reached the standard.



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2	Normal Storage	Residual Capacity $\geq 90\%$ Rated Capacity Recovery Capacity $\geq 95\%$ Rated Capacity Internal resistance increase rate $\leq 30\%$	Test the batteries' initial state and capacity; store the battery for 30 days after standard charge, test the final state; Discharge at $0.2 C_5$ mA to 2.5V, then test batteries' residual capacity. Then after normal charge, discharge the battery at $0.2 C_5$ mA to 2.5V, then test the batteries' recovery capacity, Three cycles are permitted for this test, If one of the three cycles can reach the standard, it represents the battery has reached the standard.
3	Cycle life	3000 Times	100%DOD recycle it continuously at 1C rate. The residual capacity is 70% of rated capacity.
4	Storage performance	0.2C ₅ mA discharge time battery stored for 3 months ≥ 4.5 h; battery stored for 6 months ≥ 4.0 h; battery stored for 12 months ≥ 3.5 h.	Test the batteries' initial state and capacity. After battery is charged to storage voltage, test the initial state of battery. After store 3 months, 6 months, 12 months at room temperature respectively, test final state of battery. After normal charge, discharge at $0.2 C_5$ mA to 2.5V, then test battery residual capacity. Three cycles are permitted for this test, If one of the three cycles can reach the standard, it represents the battery has reached the standard.

6.2 Safety Characteristics

No	Item	Standard	Test method
1	Overcharge	No explosion, No fire. Surface maximum temperature is not higher than 150°C	After normal charge, test the batteries' initial state and capacity. Charge at $3 C_5$ mA to 5.0V, then at CV mode to $0.01 C_5$ mA, stop charge. Observe battery's variation of appearance.
2	Over Discharge	No explosion , No fire	After normal charge, test the batteries initial state and capacity. Discharge at $1 C_5$ mA to 2.5V, then connect positive and negative pole with resistor less than 10Ω. Store it for 14 days. Observe battery's variation of appearance.



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3	Short Circuit At Room Temperature	No explosion, No fire Surface maximum temperature is not higher than 150°C	Standard charge. Keep the battery into a ventilation cabinet and short-circuit the positive and negative terminals directly (general resistance shall be less than or equal to 50mΩ). Stop the test when the temperature falls to 10 °C lower than the peak value. Observe the variation of the batteries' appearance and temperature.
4	Thermal Shock	No explosion , No fire	Test the batteries' initial state and capacity. Standard charge. Put battery into oven, increase the temperature to 130±2°C at rate of (5±2°C) /min, and keep it for 30min. Observe variation of batteries' appearance.
5	Drop	No explosion, No fire	Test the initial capacity. Standard charge. Then let it fall from a height of 1m (the lowest height) to a smooth cement floor, twice.

6.3 Environmental Adaptability

No	Item	Standard	Test Method
1	Temperature shock	No leakage, No smoke, No fire, No explosion.	Store the battery for 48 hours at 75±2°C after standard charge, then store the battery at -20°C for 6 hours, and at room temperature for 24 hours. Observe the batteries' appearance.
2	Static Humidity	Discharge capacity after storage/rated capacity×100 %>60% rated capacity No obvious outside damage, No leakage, No smoke, No explosion	Put the battery at 40°C±5°C and 95% RH chamber for 48h, then get it out and store it for 2h at room temperature. Observe the appearance and discharge at 0.2C ₅ mA till 2.5V, and then test the final capacity.
3	Discharge performance at different temperature	Discharge capacity/ rated capacity×100% A)60°C ≥95%rated capacity B)0°C ≥85%rated capacity C)-10°C ≥70% rated capacity D)-20°C ≥40% rated capacity No obvious outside damage, No leakage, No smoke, No explosion	Test the batteries' initial state and capacity , standard charge, then store it at 60±2°C for 12 hours, discharge at 0.2C ₅ mA to 2.5V, then standard charge at room temperature. Store it at corresponding temperature according to the 0±2°C/-10±2°C/-20±2°C order for 12 hours. Test the final capacity at 0.2C ₅ mA, at last, store it at room temperature for 2 hours, and test the final state and appearance.



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4	Vibration	Residual Capacity $\geq 95\%$ Rated Capacity Voltage Decrease Rate $\leq 0.5\%$ Internal Resistance Increase Rate $\leq 20\%$ No obvious outside damage, No leakage, No smoke, No explosion.	Standard charge. Equip it to the vibration platform, prepare the test equipment according to following vibration frequency and relevant swing, doing frequency sweeping from X, Y, Z three directions, each from 10Hz to 55Hz for 30 minutes of recycling, rating of which is 1oct/min: A)vibration frequency:10Hz~30Hz Displacement breadth (single swing): 0.38mm B)vibration frequency:30Hz~55Hz Displacement breadth (single swing): 0.19mm. Observe the final state after scanning.
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Note: The definitions of some nomenclatures of this specification:

- (1) Standard charge: $0.2C_5$ mA charge at $25^\circ\text{C}\pm 2^\circ\text{C}$ to 3.65V, then change to charge with constant voltage till the current less than or equal to $0.01C_5$ mA.
- (2) Rapid charge: $1C_5$ mA, charge at $25^\circ\text{C}\pm 2^\circ\text{C}$ to 3.65V, then change to charge with constant voltage till the current less than or equal to $0.01C_5$ mA.
- (3) Initial state: battery initial voltage, internal resistance and appearance.
- (4) Final state: battery final voltage, internal resistance and appearance.
- (5) Residual Capacity: The first discharge capacity after being tested by the specific procedure.
- (6) Standard cycle: charge at $1C_5$ mA, then store for 30min, discharge at $1C_5$ mA to the 2.5V.
- (7) Recovery Capacity: The discharge capacity by specifically charge-discharge cycle repeatedly after being tested by the specific procedure.
- (8) All batteries tested above are within 30 days unless there are other regulations. Otherwise, part of the electrical properties may be inconsistent with the above parameters, while other properties must meet the requirements

7. Outlook Inspection

There should be no such defects as leakage, crack etc, which influence the batteries' characteristics.

8. Standard Test Environment

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

Temperature: $25\pm 2^\circ\text{C}$

Humidity: $(65\pm 20)\%$ RH

9. Storage and Others

9.1 Long Time Storage

If the battery is stored for a long time (more than three months), the battery should be stored in dry and cool place. The battery should be charged and discharged every three months. The batteries' storage voltage should be 3.3~3.4V and the battery should be stored in a condition as NO.8.

9.2 Others

Any matters that this specification does not cover should be consulted between the customer and Apollo.

10. Warranty and Responsibility

Warranty period is six months which begins from the delivery date. Apollo is not responsible for the incident caused by not obeying the specifications. Apollo is not responsible for problem due to used that is not specified by this spec. Apollo is not responsible for the problem due to improper charge or assembly. When the specification is modified, Apollo will don't inform the customer.

11. Notice In Using Battery

11.1 Mechanical Crack

- No drop or crack.

11.2 Short Circuit

- Short circuit is prohibited anytime. It will cause serious damage of battery.

12. Signs On The Battery Package

- Use specified charger



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- Do not heat or throw the battery into fire.
- Do not short-circuit the two electrodes.
- Do not disassemble and break up the battery.

13. Warning and matters need attention In Using Battery

Please pay attention to followings in case of battery will have leakage, heat or explosion.

Warning!

- Do not immerse the battery in water or seawater, and keep the battery in a cool dry surrounding if it stands by.
- Do not use or leave the battery near a heat source as fire or heater
- Use the battery charger specifically when recharging.
- Do not reverse the position and negative terminals.
- Do not connect the battery electrodes to an electrical outlet.
- Do not discard the battery in fire or a heater.
- Do not short-circuit the battery by directly connecting the positive and negative terminals with metal objects.
- Do not transport or store the battery together with metal objects such as hairpins, necklaces, etc.
- Do not strike, trample or throw the battery.
- Do not directly solder the battery and pierce the battery with a nail or other sharp objects.

Be careful!

- Do not use or leave the battery at high temperature (for example at strong direct sunlight). Otherwise, it can overheat or fire or its performance will be degenerate and its service life will be decreased
- Do not use the battery in a location where static electricity and magnetic field is great, otherwise, the safety devices may be damaged, causing hidden trouble of safety.
- If the battery leaks and the electrolyte gets into the eyes, do not rub the eyes, instead, rinse the eyes with clean water, and immediately seek medical attention. Otherwise, it may injure eyes.
- If the battery gives off strange odor, generates heat, becomes discolored or deformed, or in any way appear abnormal during use, recharging or storage, immediately remove it from the device or battery charger and stop using it.
- In case the battery terminals are dirty, clean the terminals with a dry cloth before use. Otherwise poor performance may occur due to the poor connection with the instrument.
- Be aware of discarded batteries may cause fire or explosion; tape the battery terminals to insulate them.