Product Specification

Product Name: NCM Li-ion battery cell

Model: 18650-3.7V2600mAh

MINRUA POWER CO.,LIMITED

A407 ROOM,WANHUA CENTER, NO.113 ZHONGLING STREET, HULI DISTRICT XIAMEN,361000, CHINA
Website: www.modern-battery.com Email: sales@modern-battery.com

Contents

Note: MINRUA POWER CO.,LIMITED Hereinafter referred to as MINRUA.

1. Preface

This specification describes the type, dimensions, performance, technical characteristics, warning and caution of the lithium ion rechargeable cell. The specification only applies to 18650 cell supplied by MINRUA POWER CO.,LIMITED.

2. Definition

2.1 Rated capacity

Rated capacity: Cap=2600 mAh, under 25±2°C, it means the capacity value of being discharged by 5-hours rate to the end voltage 2.75 V, which is signed as Cap, the unit is mAh.

2.2 Charge method

Under 25±2°C, cell is charged to 4.20 V with constant current of 0.5C, and then charged continuously with constant voltage of 4.20 V until the current declines to 0.03C.

2.3 Discharge method

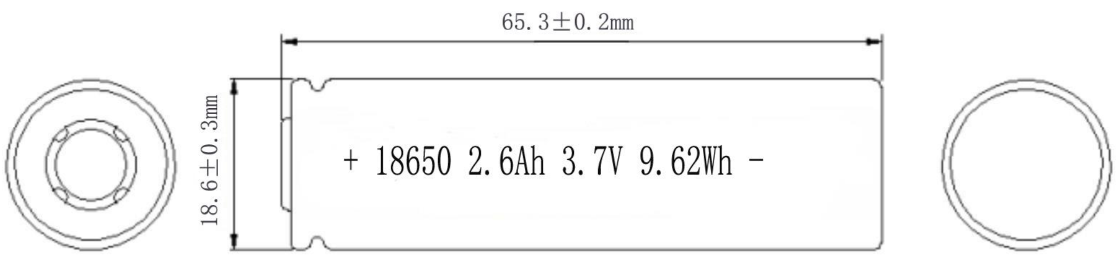
Under 25±2°C, cell is discharged to the voltage of 2.75 V with constant current of 1C.

3. Cell type, barcode, Color

3.1 Description and model

Description: Cylindrical Li-ion rechargeable cell.
Model: 18650-3.7V2600mAh

3.2 Cell barcode



3.3 Cell color explanation: Yellow

4. Characteristics

No.	Item	Specification	
1	Nominal Capacity	2600mAh	0.2C
2	Mininum Capacity	2500mAh	1C
3	Normal Voltage	3.7 V	
4	Energy Density	544Wh/L	
		195Wh/Kg	
5	Charging Voltage	4.2V±0.05V	
6	Discharge Ending Voltage	2.75V±0.05V	
7	Standard Charging Current	1300mA	
8	Standard Discharge Current	2600mA	
9	Max. Charging Current	45°C > T⩾10°C	1C
		10°C > T⩾0°C	0.5C
10	Quick Discharging	5C	
	Max Discharge current	8C（≤30s）	
11	Environment Temperature	Charge:0°C~45°C, Discharge:-20°C~60°C	
12	Internal resistance	≤ 18 m Ω(AC Impedance, 1000 Hz)	
13	Cell dimensions	Height : 65.3±0.2mm, Diameter : 18.6±0.3mm	
14	Battery Weight	45.45±1.5g	

5. Technical requirements

5.1 Cell storage conditions

Temperature: 3 months, -20～+40°C; more than 3 months, -20～+20°C
Relative humidity: 0～45%RH

5.2 Cell testing conditions

Unless otherwise specified, all tests stated according to following:
Temperature: 25±2°C; Humidity: 65±20%RH
Use standard charge current and standard discharge current
The cell used in the test is the cell sampled within one week of delivery.

5.3 Requirement of the testing equipment

Voltage meter: The precision is higher than 0.5 grade
Temperature meter: The precision is higher than ±0.5°C

5.4 Characteristics

NO.	Item	Standard	Test
1	Discharge Characteristics (Room Temperature)	Discharge capacity/ 0.2C discharge capacity *100％ A） 0.2C =100％ B） 1C ⩾95％ C） 2C ⩾90％ D） 3C ⩾90％	After the battery is charged to 4.2V at 0.5C CCCV (cut off 0.02C), let it stand for 15 minutes and discharged to 2.75 V with currents of 0.2C, 1C, 2C and 3C respectively. Note: The relative capacity is divided by 0.2C discharge capacity.
2	Cycle Life	The 500th discharge capacity⩾The first discharge capacity *80％	Test the initial capacity of the battery (0.5C / 1C), perform 0.5C/1C cycle (4.2-2.75V) at room temperature, and test the final state of the battery after cycling. Note: The first 1C discharge capacity of the cycle test is the first discharge capacity;
3	Normal Storage	Residual capacity ⩾Initial capacity *85％ Recovery capacity ⩾ Initial capacity *90％	Test the initial state and initial capacity of the battery. After the battery is charged to 4.2V at 0.5C CCCV(cut off 0.02C), store it at room temperature for 28d,Then discharge to 2.75 V with 1C current, test the residual capacity of cell. Then conduct 0.5C/ 1C cycle for 3 times to test the recovery capacity of cell. Note: The initial capacity refers to the capacity detected when the battery is charged to 4.2V at 0.5C CCCV (cut off at 0.02C) and discharged to 2.75 V with 1C current after standing for 10 minutes.

4	High Temperature Storage(55°C)	Residual capacity ≥ Initial capacity *85% Recovery capacity ≥ Initial capacity *90%	Test the initial state and initial capacity of the battery. Charge the battery to 4.2V at 0.5C CCCV (cut off at 0.02C). Keep the cell in 55°C±2°C environment for 7d, then discharge at 1C to the discharge cut-off voltage 2.75 V, test the residual capacity of the cell. Then test the recovery capacity of the cell after cycling 3 times at 0.5C/ 1C. Note: The initial capacity refers to the capacity detected when the battery is charged to 4.2V at 0.5C CCCV (cut off at 0.02C) and discharged to 2.75 V with 1C current after standing for 10 minutes.
5	Discharge Characteristics under Different Temperature	Discharge capacity / 25 ℃ discharge capacity×100% A) 55 ℃≥100% B) -20 ℃≥70%	Test the initial state and initial capacity of the battery. After the battery is charged to 4.2V at 0.5C CCCV (cut off 0.02C), let the cell stand for 5h under 25°C and 55°C respectively before discharging at 1C to the cut-off voltage 2.75V. Let the battery stand under -20°C±2°C for 24h before discharging at 1C to 2.5V. Record the discharge capacity at different temperature. Note: The relative capacity is divided by 1C constant current discharge at 25 ° C to 2.75V capacity.

5.5 Safety Performance

NO.	Item	Standard	Test Method
1	Overcharge	No explosion、No fire	Charge the battery to 4.2V at 0.5C CCCV (cut off at0.02C) and then charge it to 6.3V with 1C current, observe for 1h before ending the test.
2	Over Discharge	No explosion、No fire、No leakage	Charge the battery to 4.2V at 0.5C CCCV (cut off at 0.02C) and then charge it to 6.3V with 1C current for 90 minutes, observe for 1h before ending the test.
3	Short Circuit	No explosion、No fire	Charge the battery to 4.2V at 0.5C CCCV (cut off at 0.02C). Place the battery in the explosion-proof box and short its positive and negative electrode (the total resistance of the circuit is less than 5mΩ). Keep the battery in short-circuit state for 10 minutes, observe for 1h before ending the test.

4	Drop	No explosion、No fire、No leakage	Charge the battery to 4.2V at 0.5C CCCV (cut off at 0.02C). Free drop the positive and negative terminals of the battery from a height (the lowest point) of 1.0m to the concrete floor, observe for 1h before ending the test.
5	Crush	No explosion、No fire	Charge the battery to 4.2V at 0.5C CCCV (cut off at 0.02C). Test the battery's initial state, crush the battery perpendicularly at a speed of 5±1mm/s until the voltage becomes 0V or the deformation is 30% or the pressure reaches 200 kN. Observe for 1h before ending the test.
6	Heating test	No explosion、No fire	Charge the battery to 4.2V at 0.5C CCCV (cut off at 0.02C). Put the battery cell in the thermal box, and heat the box to 130°C at a rate of 5°C/ min. Keep the battery in the box at 130°C for 30 minutes then stop heating. End the test after observing for 1h.
7	Seawater Immersion	No explosion、No fire	Charge the battery to 4.2V at 0.5C CCCV (cut off at 0.02C). Immerse the battery completely in 3.5% NaCl solution for 2h, observe for 1h before stopping the test.
8	Low Pressure	No explosion、No fire、No leakage	Charge the battery to 4.2V at 0.5C CCCV (cut off at 0.02C). Put the cell under a pressure of 11.6 kPa for 6h at room temperature, observe for 1h before ending the test.
9	Heat Cycle Properties	No explosion、No fire、No leakage	Charge the battery to 4.2V at 0.5C CCCV (cut off at 0.02C). Put the cell into a temperature controlled tank, then conduct the test according to the parameter and test for five times.

Comments: the definitions of some nomenclatures of this specification

(1) Initial State: The initial appearance, open-circuit voltage and internal resistance of cell.
(2) Final State: The final appearance, open-circuit voltage and internal resistance of cell.
(3) Residual Capacity: After a specific testing program, the first discharge capacity of cell.
(4) Recovery capacity: After a specific testing program, and through the repeatedly charging and discharging to the recovery state, then the discharge capacity of cell.
(5) The short-term maximum temperature on the surface of the battery cell during charging should be ≤ 60 ℃, and the short-term maximum temperature on the surface of the battery cell during discharging should be ≤75 ℃. (In these cases, the charge and discharge will cause the battery cycle life to decay quickly).

6 Cell safety code

6.1 Design and usage of chargers and battery packs

6.1.1 Charge

6.1.1.1 The cell should be charged by constant current charge - constant voltage charge. The charging voltage of a single cell should not exceed 4.20 V, and the cut-off current of charging should be greater than or equal to 1/50C. Considering the control deviation of the charger, the charging voltage of the cell must be lower than 4.20 V. Even in exceptional circumstances, the charging voltage shall not exceed 4.25 V to avoid overcharging. Charging voltage higher than 4.20 V will shorten the cell cycle life.

6.1.1.2 The charger should have a pre-charging system and the pre-charging function should be used to prevent abnormal high power charging after deep discharge. After long-term storage, When the cell voltage is lower than 2.75V (0%SOC), the cell must be pre-charged with a current lower than 0.1C until the cell voltage is higher than 2.75V, then charge in standard mode. If the cell voltage cannot be charged to 2.75V within 30 minutes, the charger shall stop charging;

6.1.1.3 Chargers should be equipped with a complete charge detection device. The charging detection device can be checked by timer, current detection or open circuit voltage detection to detect the charging state. When the charging detection device detects that the cell is fully charged, the charging circuit should be completely cut off to avoid trickling charge. The cell charge should be carried out at the temperature of 0°C ~ +45°C. When the cell temperature exceeds this range, it should be placed until the cell temperature reaches the above range.

6.1.2 Discharge

6.1.2.1 Single cell discharge current should be less than maximum discharge current.

6.1.2.2 The discharge cutoff voltage of the cell shall be higher than 2.75 V;

6.1.2.3 The discharge temperature of the cell range from -20°C to +60°C. During the discharge process, if the surface temperature of the cell exceeds 70 °C, the discharge must be terminated.

6.1.3 Over-discharge

If the voltage of a single cell is lower than 2.75 V, the cell is considered to be over discharged and cannot be used anymore.

6.1.4 Storage

The cell should be stored in a dry (0-45%RH) and non-corrosive gas environment, do not allow the cell to bear any pressure, and there should be no condensed liquid attached to the surface of the cell, the best storage temperature is -20~+25°C.
Long-term storage, the cell must be in charge of 10%~35%SOC state, and need to carry out voltage detection before use.
Storage life less than 3 months: -20°C ~ +40°C.
Storage life longer than 3 months to 12 months: -20°C to +20°C.

6.1.5 Considerations for battery pack design

6.1.5.1 The shape, mechanism and material of the battery pack

The battery pack should be designed so that it cannot be charged by an unauthorized charger. The battery pack design should ensure that it does not connect to unauthorized equipment and equipment.
The positive and negative ends of the battery pack should be designed to avoid short circuit or reverse connection.
In addition, the battery pack should have an overcurrent protection device to avoid the occurrence of external short circuit.
There should be no overlap between the positive and negative connection wires of the battery pack.
The battery pack should be designed to prevent static electricity and dust, liquids, etc.

The battery pack should be designed so that even if the cell leaks, the electrolyte will not reach the protective circuit board.
The design of the battery pack should ensure that the cells are fixed in the battery pack and not arbitrarily movable.
The battery pack shall be structurally designed to prevent the occurrence of dents, deformations or other mechanical stresses on the cells in the event of a predictable fall.
The flammability of materials used in the battery pack, such as double-sided tape and rubber, should be verified.

6.1.5.2 Battery pack structure (Cell number limitation)

The number of parallel connections is unlimited, but the battery pack must pass the overcharge test (the charging current of the overcharge test is the product of the maximum charging current of the charger and the number of parallel connections).
The number of serial connections is unlimited, and series fuses are required.
The cell should be kept away from heating electronic components to avoid deterioration of cell performance.
Insulation should be provided between the PCB'A and the battery pack (e.g. plastic barrier for air isolation or non-thermal conductive insulation).

6.1.5.3 Protection circuit

The following protection circuit should be installed in the battery pack.
Over charge protection.
For safety reasons and in order not to shorten cycle life, the maximum overcharge protection voltage of the single cell in each module should be less than 4.2V.
Over discharge protection.
If the single cell voltage reaches 2.5 V, MINRUA recommends that the discharge current should be cut off by over discharge protection circuit, and the consumption current of the protection circuit should be no more than 100μA
Over current protection
If the discharge current of a single cell exceeds about maximum discharge current, the overcurrent protection should cut off the discharge current.
Protection circuit power consumption
In order to avoid over discharge mode in long-term storage, the current consumption of the battery pack protection circuit should be set as small as possible. When it is not in use for a long time, it is necessary to check the residual state of the cell regularly and ensure that each single cell in the battery pack cannot reach the over-discharge state.

6.1.5.4 Cell connection

The cells cannot be connected using soldering process. In order to avoid any damage, resistance welding or laser welding is recommended for cell connection.
Cells in battery pack should be temperature balanced. When the battery pack is discharging, the internal temperature difference of the battery pack should be less than or equal to 5°C.

6.1.6 Use mode of cell

6.1.6.1 When the cell is used in tandem, the same grade, the same batch and the same charging state are necessary. This information can be obtained from the label of the inner and outer box. Before the cell is used, the voltage, internal resistance should be detected and assembled according to its purpose. MINRUA suggests that the cell voltage within 20 mV and the internal resistance difference within 6 mΩ should be guaranteed at least.

6.1.6.2 Check voltage, internal resistance, protection circuit function, thermistor, thermal fuse of battery pack before shipment.

6.1.6.3 Special attention should be paid to the transfer of the cell to the assembly plant. External damage caused by the transport process is forbidden. MINRUA recommends using the same transport packaging, even if the packaging is opened during the process.

6.1.6.4 Do not use damaged or leaking cells caused by transportation damage, drop, short circuit or other reasons.

6.1.7 Quality assurance immunity

6.1.7.1 Within one year of normal use, any quality problem caused by any manufacturing process, other than abuse, shall be solved by the manufacturer. Outside this period, the reason is not the manufacturing process but the cell quality problem caused by customer misuse. MINRUA does not promise free replacement.

6.1.7.2 When conducting resistance welding and laser welding of cells, it is necessary to conduct DOE process experiment and confirm welding parameters. MINRUA is not responsible for the safety problems related to internal damage of the cell caused by improper welding.

6.1.7.3 MINRUA shall not be liable for any loss caused by violation of the specifications;

6.1.7.4 MINRUA will not be responsible for any problems caused by design defects of battery packs and chargers;

6.1.7.5 MINRUA does not accept abnormal cells due to improper assembly.

6.1.7.6 MINRUA is not responsible for spot welders；

6.2 Safety regulations

The cell contains organic solvent and other flammable substances, improper use may lead to cell self-heating or catch fire, causing damage to the cell or personal injury. Please pay attention to the prohibited matters, and should add protective devices to avoid cell accident caused by appliance failure. Before using a lithium ion rechargeable cell, read the following safety guidelines carefully. In addition, it is strongly recommended that these instructions be incorporated into the user manual.

6.2.1 Dangerous items

6.2.1.1 Do not use or place the cell in a high temperature environment (above 70°C). Do not throw cells into fire, water or exposed to moisture. Do not repair or disassemble the cell. There is a risk of ignition, overheating, leakage, or explosion.

6.2.1.2 Do not put the cell disorderly, at the same time away from metal and other conductive materials, to avoid positive (+) negative (-) short circuit, do not reverse the cell positive (+) negative (-) pole use.

6.2.1.3 Do not use unauthorized charging equipment or violate charging requirements. Unauthorized charger can lead to overcharging of the cell or abnormal chemical reactions, heating, smoke, rupture or fire.

6.2.1.4 Do not connect the cell to the AC plug (outlet) or the facilities plug. Cells need to have a specific charger. If the cell is connected directly to the plug, it may catch fire, smoke, explode or emit heat.

6.2.1.5 Do not overcharge, over discharge, needling or hammer the cell.

6.2.1.6 Do not strike or throw the cell. If the cell falls, please treat it as waste products and do not continue to be used.

6.2.1.7 Do not dissect the cell. If the protective circuit is damaged, the cell will no longer be protected. Then, the cell may catch fire, smoke, explode or emit heat.

6.2.1.8 Do not charge in high temperatures environment. Because of the protective circuit action, cell cannot be recharged in high temperatures environment. In this situation, the protection line may be interrupted, and the cell may catch fire, smoke, explode, or emit heat.

6.2.1.9 Do not use damaged or deformed cells, these cells may catch fire, smoke, explode, or emit heat.

6.2.1.10 Do not solder the cell directly. Overheating can cause deformation of cell components such as insulation washers, causing deformation of the cell, leakage, explosion or fire.

6.2.1.11 Do not reverse charge. Abnormal chemical reactions occur when the cell is recharged in reverse. In addition, the discharge will have unpredictable large current. These can emit heat, smoke, cracking or burning.

6.2.2 Cautions

6.2.2.1 Cells should be stored away from infants and toddlers. If cell swallowing occurs, seek medical attention immediately.

6.2.2.2 Do not put cells in microwave ovens or other cooking utensils. Cells can catch fire due to microwave heating and electrical shock, to emit smoke, explosion, or emit heat.

6.2.2.3 Don't mix it with other cells. Cells should not be mixed with other cells of different capacities, chemical systems or manufacturers. Don't Connect to other cells or mix other cells. Cells can catch fire, smoke, explode or emit.

6.2.2.4 Do not use abnormal cells. Discontinue use if there are obvious abnormalities, such as odor, fever, deformity, or Discoloration.

6.2.2.5 If the charging process does not end, stop charging. the cell cannot be charged within the specified time, please stop charging.

6.2.2.6 Do not use drain cells near flame. If the cell or cell with liquid running out produces a pungent odor, keep cells away from flame, it can cause fire or explosion.

6.2.2.7 Do not touch the leaky cell. If fluid from the cell leaks into the eye, it can cause serious damage, flush immediately with fresh water and seek medical advice.

6.2.2.8 In order to avoid short circuit or damage, please tightly pack the cell into a box or carton.

6.2.3 Matters Requiring attention

6.2.3.1 Do not use or place cells in hot environments, such as facilities in direct sunlight. Cells may catch fire, smoke, explode or emit heat. At the same time, it may cause deterioration of cell performance and life.

6.2.3.2 The battery pack has protective wiring. Do not use cells where static electricity (over 100V) is generated, as it may damage the protective circuit. If the protective circuit of the battery is damaged, the battery may catch fire, smoke, explode or cause heat.

6.2.3.3 The charging temperature range is between 0°C and 45°C. Do not charge the cell outside the specified temperature range. Otherwise, it may emit heat, fluid leakage, or serious damage. In addition, it may cause deterioration of cell performance and life.

6.2.3.4 If the cell has abnormal odor, heat or rust during the first use, please contact the supplier.

6.2.3.5 Keep away from flammable materials during charging and discharging. It can cause fire, smoke, explosion or heat up.

6.2.3.6 If the electrolyte leaks from the cell and gets on clothes or skin, rinse immediately with water. Otherwise, it may irritate the skin.