



# Specification For Lithium-ion Rechargeable Cell

Cell Type :HDCF18650-2000mAh-3.2V





## 1 Preface

This specification describes the type and dimensions, performance, technical characteristics, warning and caution of the lithium ion rechargeable cell. The specification only applies to 18650 cell supplied by Tianke Power Technology Co.,Ltd.

## 2 Definition

### 2.1 Rated capacity and minimum capacity:

Rated capacity:  $Cap=2000mAh$ , minimum capacity:  $Cap=1950mAh$ . Under  $25\pm3^{\circ}C$ , It means the capacity value of being discharged by 2-hours rate to end voltage 2.0 V, which is signed Cap, the unit is mAh.

### 2.2 Standard charge method:

Under  $25\pm3^{\circ}C$ , it can be charged to 3.65V with constant current of 0.5C, and then, charged continuously with constant voltage of 3.65V until the charged current is 0.02C.

### 2.3 Standard discharge method:

Under  $25\pm3^{\circ}C$ , it can be discharged to the voltage of 2.0V with constant current of 0.5C.

## 3 Cell type and dimensions

### 3.1 Description and model

Description: Cylindrical Li-ion rechargeable cell  
Model: FRA EP H7

### 3.2 Cell bar code and explanation

HDCF 18650-2000mAh-3.2V

HD FRA EP H7 JFR 009758

Figure 1

Cell barcode includes six parts (Figure 1):

Company Abbreviations + Battery type + Cell type + Cell batch code + Cell ordinal code

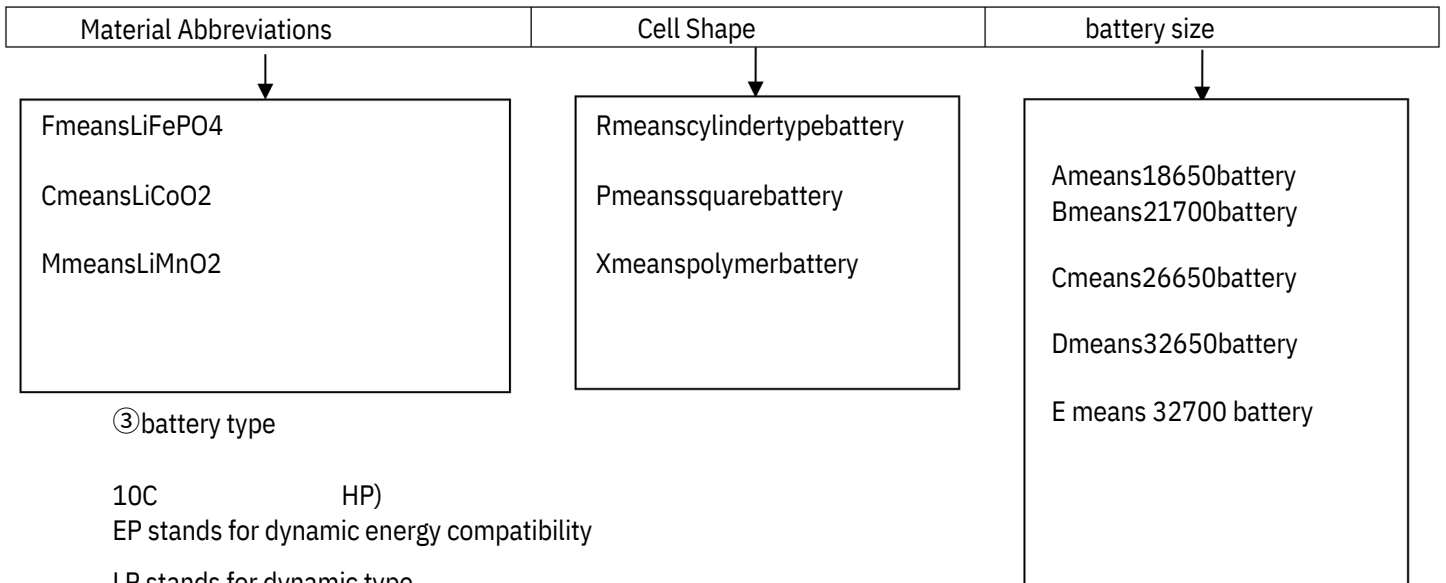
For example HD+FRA+EP+H7+JFR+009757

#### ① Company Abbreviations

The abbreviation of "HD"



## ② Battery Type



### ③ battery type

10C                      HP)

EP stands for dynamic energy compatibility

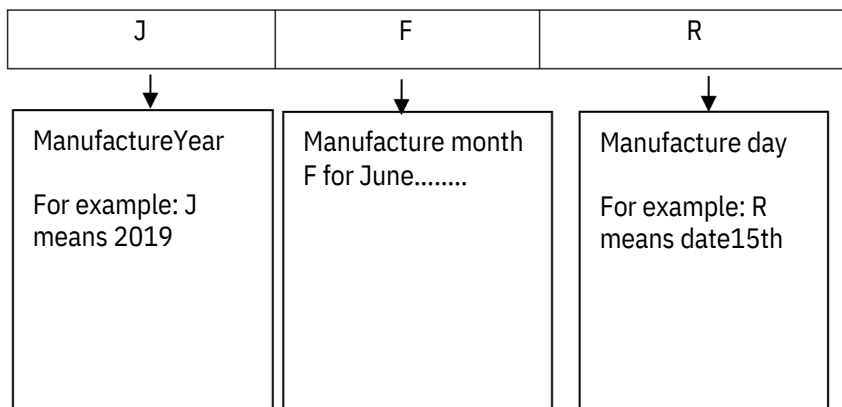
LP stands for dynamic type

HP represents the tool-start model

### ④ Cell Type

H7 means18650-2000mAh

### ⑤ Cell batch code definition as following B<sub>6</sub>(constituting by the ingredients of date) :



### ⑥ Cell ordinal code 生

009757 produces the 009757 th battery

### ⑦ Combination rules

Code spray-code content is; Company name + battery capacity + batch number+ water code



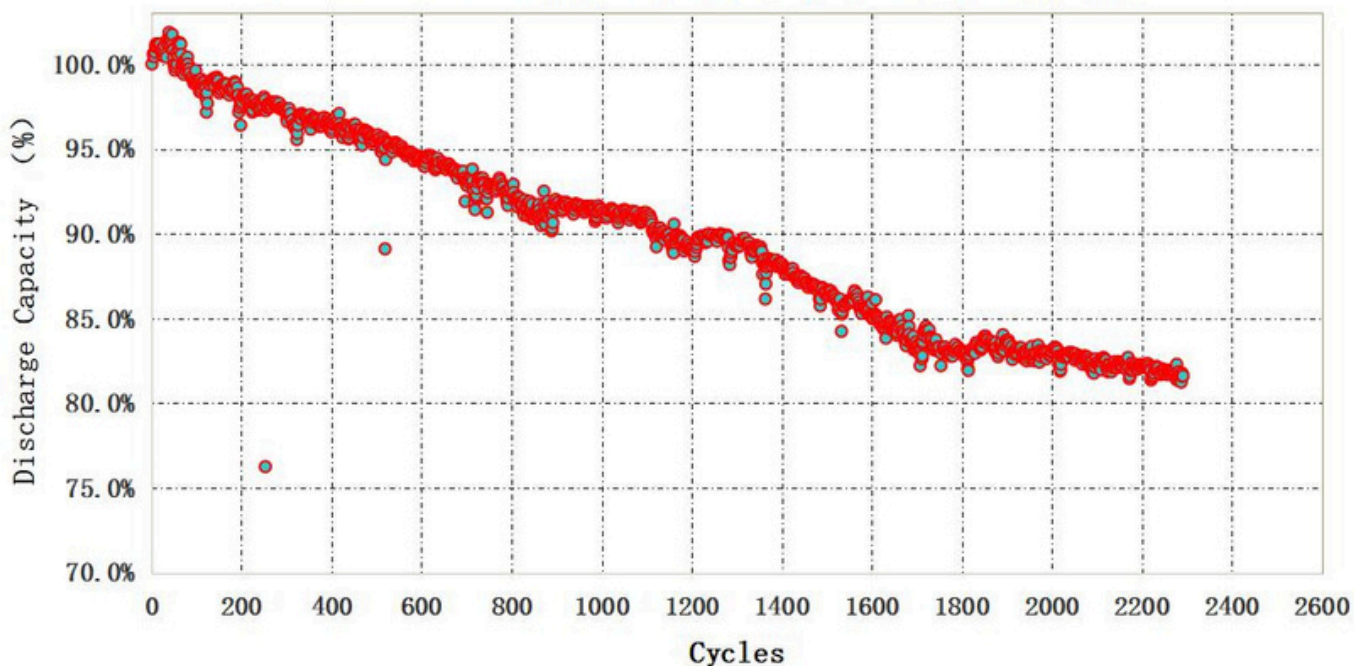
#### 4 Characteristics

##### 4.1 Cell specification

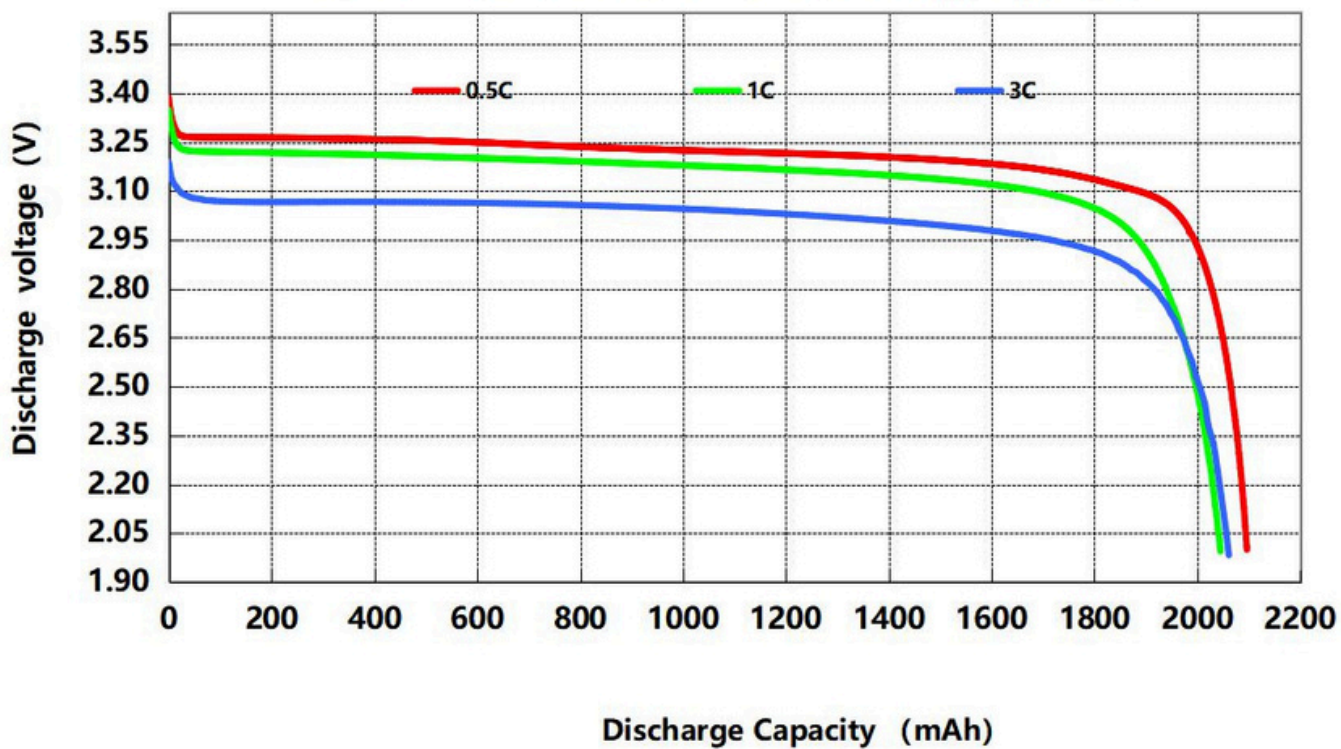
ITEM	SPECIFICATION
Normal capacity	2000 mAh@0.5C
Minimum capacity	1950 mAh@0.5C
Normal voltage	3.2V
Charging voltage	3.65 ±0.05 V
Discharge ending voltage	2.0 ±0.05 V
Standard charging current	0.5C(1000 mA)
Standard discharge current	0.5C(1000 mA)
Max charge current	1C (25±3°C ) (not for cycle life)
Max discharge current	3C (25±3°C) (not for cycle life)
Normal temperature cycle	100%DOD 2000@80% 80%DOD 3000@80% 50%DOD 5000@80%
recommended charge and discharge cell environment temperature	Charge: 0~45°C      Discharge: -10~60°C
Maximum short term allowable charge and discharge cell body temperature. Charging and discharging at these conditions will shorten cell cycle life.	Charge: 60°C Discharge: 70°C
Internal resistance	≤20 mΩ(AC Impedance, 1000 Hz)
Cell dimensions(with PET film) (	Height : 65.4± 0.3mm Diameter : 18.2± 0.2mm
Weight	≤45g



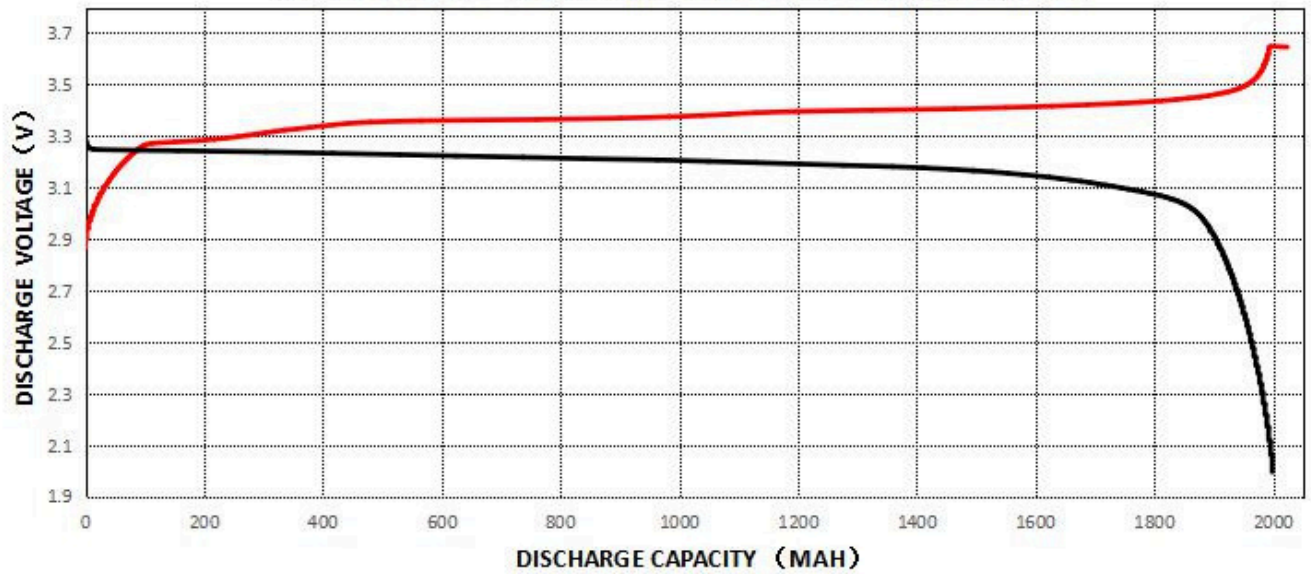
HDCF18650-2000mAh-3.2V (3C) 0.5C/1C循环曲线图



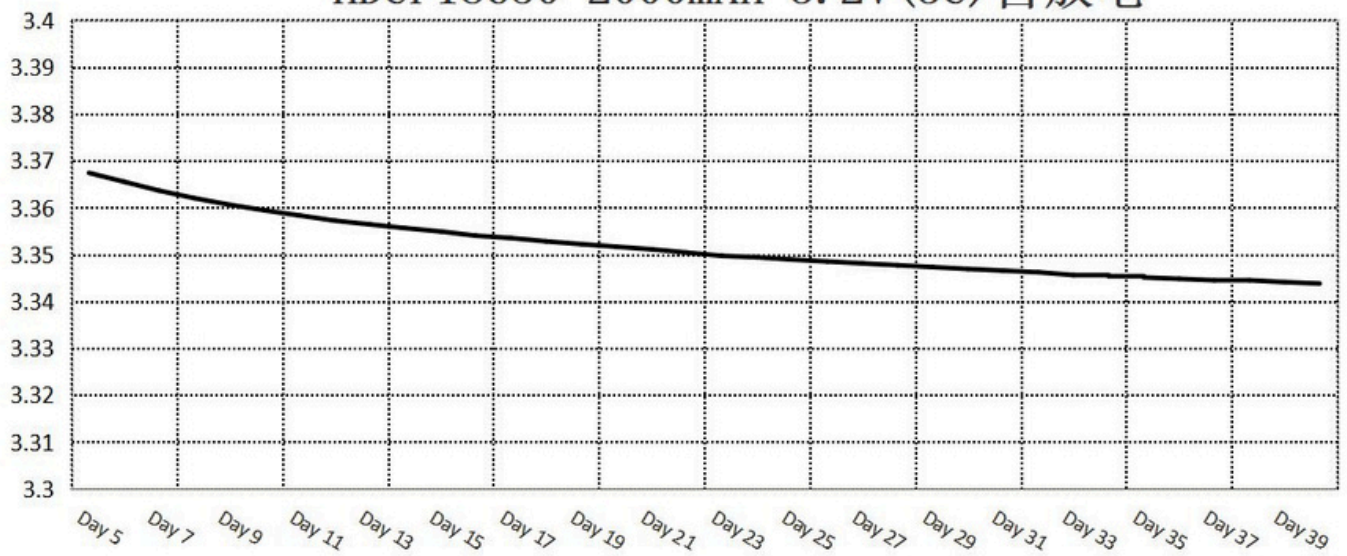
HDCF18650-2000mAh-3.2V (3C) 倍率温升图



HDCF18650-2000mAh-3.2V (3C) 充放电曲线



HDCF18650-2000mAh-3.2V (3C) 自放电





#### 4.2 Cell dimensions

Cell physical dimensions listed in Figure 2(unit: mm)

Height :  $65.4 \pm 0.3 \text{ mm}$

Diameter :  $18.2 \pm 0.2 \text{ mm}$

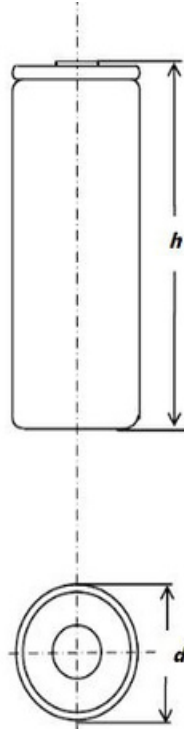


Figure 2

### 5 Technical requirements

#### 5.1 Cell storage conditions

Temperature: 1months  $20 \sim 35^{\circ}\text{C}$  3months  $25 \sim 45^{\circ}\text{C}$  1years  $-10 \sim$  Relative humidity  $25^{\circ}\text{C}$

#### 5.2 Cell testing conditions

Unless otherwise specified, all tests stated according to following:

Temperature :  $25 \pm 3^{\circ}\text{C}$  Use standard charge and standard discharge method

#### 5.3 Requirement of the testing equipment

Voltage meter: The voltage tester internal resistance is  $\geq 10 \text{ K}\Omega/\text{V}$

Temperature meter: The precision is  $\leq 0.5^{\circ}\text{C}$



#### 5.4 Characteristics

NO.	Item	Standard	Test Method
1	Discharge Characteristics (Room Temperature)	Discharge capacity / Nominal capacity *100% A) 0.5C ≥100 % B) 1C ≥97 % C) 3C ≥95 %	In 1 standard atmospheric pressure, ambient temperature of 25 °C ± 3 °C, relative humidity is 15% ~ 90%, 0.5 C standard battery charge (if no specific instructions, below are placed under the condition, is by the way), suspended 10 min, respectively by 0.5 C and 1 C, 3 C discharge to the threshold voltage of 2.0 V, cycle for three to five times, when there is a meet the requirements, which meet the standard requirements (the same below).





2	Normal Storage	Residual capacity $\geq$ Nominal capacity *90 %    Recovery capacity $\geq$ Nominal capacity *95%	Tested the initial condition and initial capacity of battery. Store for 28 days after standard charged, tested the final condition of battery. Then discharge at 0.5C to the discharge cut-off voltage 2.0V, tested the residual capacity of battery. 0.5C /0.5 C tested the recovery capacity of battery. Charge/discharge cycle can be conducted for 3-5 times before meeting the Standards.
3	Cycle Life	Residual capacity $\geq$ Nominal capacity *80%	1、Measured the initial condition and initial capacity of battery. Then conduct 0.5C/1C 2000th cycle measured the final condition of battery.



4	Long Time Storage	Residual capacity $\geq$ Nominal capacity *95%	Charged to the voltage of $3.65 \pm 0.05V$ , Capacity after storage for 90dat $25 \pm 3^{\circ}C$ after the standard charged and then discharge for 2h at 0.5C, measured with charge and discharge current 0.5C to cut-off voltage. Cycle three to five times, when one meets the standard, that is the standard requirements.
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#### 5.5 Safety Performance

NO.	Item	Standard	Test Method
1	Overcharge	No fire, No explosion	

2	Over Discharge	No fire, No explosion, No leakage	Standard charge. Discharge at 1C to 90 min and watch for 1h.
3	Short Circuit at Room Temperature	No fire, No explosion,	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 5mΩ). Stop the test when the time is 10 minutes . Observe the variation of the battery's appearance and temperature.
4	Crush	No fire, No explosion,	Standard charge. Use the half cylinder radius 75 mm (half the size of the cylinder are greater than the length of the squeezed battery), with (5±1mm/s speed in vertical direction extrusion batteries, battery plate until the voltage reaches 0 v or deformation after reaching 30% or extrusion of 200 kN stop pressing, observation of 1 h.

5	Hot Oven	No fire, No explosion	Standard charge. Keep the battery connected with a thermocouple and put it into a gravity convection or circulating air oven. Temperature is raised at a rate of 5 °C±2 °C per minute to a temperature of 130 °C±2 °C and remained for 30 min at this temperature. observation of 1 h.Observe the variation of the battery's appearance.
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#### 5.6 Environmental characteristics

NO.	Item	Standard	Test Method
1	Thermal cycling Properties	No leakage \ fire \ explosion	Standard charge. Put battery into rapid temperature change box, starting from 25 °C with 60 min cooled to -40 °C, and held to -40 °C environment after 90 min, with 60 min to 25 °C, with another 90 min at 85 °C and 85 °C under the environment of 110 min, with another 70 min to 25 °C.As a cycle, a total of 5 loop, observation of 1 h.
2	Seawater immersion	No fire, No explosion	Standard charge. Battery in 2 h in 3.5% NaCl solution, the depth of the water completely after a battery, observation of 1h.

3	Drop	No leakage \ fire \ explosion	Standard charge. Make a battery positive and negative terminals from 1.2 m to the cement floor height in free fall, the observation of 1 h.
4	Discharge Characteristics under Different Temperature	Discharge capacity / Nominal capacity *100% A) 25 °C ≥ 100% B) 55 °C ≥ 98% C) 0°C≥60% D) -10 °C ≥50% No fire \ explosion	Tested the initial condition and initial capacity of battery. Standard charge. Put the battery into a 55 °C±3 °C for 5h, discharge at 0.2C to the cut-off voltage 2.0V , then standard charge at room temperature. In turn put the battery into 25°C±3°C to -10°C±3°C for 2h、5h、10h、10h, discharge at 0.2C to the cut-off voltage, then test the final capacity of the battery, and then store it for 2h at room temperature. Observe the variation of the battery's appearance.
5	Depression	No leakage \ fire \ explosion	Standard charge. Put the battery in low pressure box, regulate pressure of 11.6 kPa in test chamber temperature to room temperature, let stand for 6 h, the observation of 1 h.



Comments: the definitions of some nomenclatures of this specification

- (1) Standard Charge: Charge with current 0.5C to limit charge voltage 3.65V under the condition of  $25^{\circ}\text{C}\pm 3^{\circ}\text{C}$  surrounding temperature, then change to charge with constant voltage till the current less than or equal to 0.02 C.
- (2) Initial State: The initial appearance, open-circuit voltage and internal resistance of battery.
- (3) Final State: The final appearance, open-circuit voltage and internal resistance of battery.
- (4) Residual Capacity: After a specific testing program, the first discharge capacity of battery.
- (5) Recovery capacity: After a specific testing program, and through the repeatedly charging and discharging to the recovery state, then the discharge capacity of battery.

## 6 The restriction of the use of hazardous substances

This model of lithium-ion cell is in accordance with our company's request of "environmental substances control standard".



# HANDLING INSTRUCTIONS FOR LITHIUM ION RECHARGEABLE CELL

## 1 CAUTION AND PRECAUTION

### 1.1 Charging

- a) Charging voltage must be set 3.65V/cell. Concerning charge voltage tolerance of charger, charging voltage must be set below 3.70V/cell. Even if the charge could be out of order, charge voltage of charger should not be above 3.70V/cell to avoid over-charging. Cell life will be shorten by charging voltage above 3.70V.
- b) Charger should start charging at temperature range 0 ~ +45°C.
- c) Charge the cell at a constant current of 0.5C until 3.65V is attained. Charge rates greater than 1C are NOT recommended. (C: Rated Capacity of cell)
- d) Maintain charge voltage at 3.65V for 2.0 hours (recommended for maximum capacity).
- e) Cell must be charged with constant current-constant voltage method. Do not use the continuous charging method..
- f) Do not continue to charge cell over specified time.
- g) No reverse charging
- h) In case of cell voltage is below 2.0V, cell should be charged with pre-charge that current is below 0.20A (0.1C). Then cell voltage reach over 2.0V, standard charge starts. And if cell voltage never reaches to 2.0V in specified period (timer), charger will stop charging.



- i) By timer, current detection and open circuit voltage detection, charger detects full charge. When charger detect cell is full charged, charger stop charging.

## 1.2 Discharging

- a) Discharge current must be below 3C (6000mA)
- b) Discharge end voltage must be over 2.0V.
- c) Do not over-discharge cell below 2.0V
- d) Discharge temperature range should be -10 °C ~ +60°C

## 1.3 Environmental using conditions

When the cell is charged. : 0°C ~ +45°C

When the cell is discharged. : -10°C ~ +60°C

Charge or discharge out of recommended range might cause the generating heat or serious damage of cell. And also, it might cause the deterioration of cell's characteristics and cycle life.

## 1.4 Storage

Any storage, cell should be in low humidity, no corrosive gas atmosphere area. And there is no press and condensation on the cell. Best temperature range 20~30°C.

## 1.5 Precautions on Handling Lithium Ion Cells

- a) When the cells are connected in series, use same rank cells, use same lot number cells and use same charging date cells. These date show label for carton on the master carton. Further, the cell's voltage and impedance have to be checked and matched as uses of cells. Tianke recommend match cells keep voltage within 3mV difference and impedance within 3mΩ difference at least.





- b) Inspect voltage and internal impedance before using.
- c) When cells are re-shipped to assembling factory, make enough attention the packing to avoid stress by shipping. Tianke recommends the same package shipped from Tiankewhen re-shipping. Even if after open package, when re-shipping, use the same parts and materials from Tianke for re-packing.
- d) Do not use abnormal cell which has damages by shipping stress, drop, short or something else, and which gives off electrolyte odor.
- e) Do not use or leave the cell under the blazing sun (or in heated car by sunshine). The cell may generate heat, , it might cause the deterioration of cell's characteristics or cycle life.
- f) Do not use cell nearby the place where generates static electricity (more than 100V).
- g) Please read the manual before using the cell and please reread if necessary.
- h) Please read the manual of specified charger about charging method.
- i) When the cell has rust, bad smell or something abnormal at first-time-using, do not use the equipment and go to bring the cell to the place which it was bought.
- j) In case younger children use the cell, their parents teach how to use cells according to the manual with care.
- k) Keep the cell out of the reach of younger children. And also, pay attention to cell be taken out it from the charger or equipment by little children.
- l) If the skin or cloth is smeared with liquid from the cell, wash with fresh water. It may cause the skin inflammation, see a doctor immediately.



#### 1.6 Cell position in equipment and charger.

To avoid degradation of cell performance by heat, a cell should set the place apart from heat generating electronic parts inside equipment and charger.

#### 1.7 Precautions on Battery Pack Design.

##### a) Battery pack Shape, Mechanism and Material

- Do not make the shape and mechanism which easy connect to other equipment and charger.
- Do not make the terminal shape which easy cause short circuit by metal object such as necklaces, hairpins, etc. And further, have over current protection function to prevent outer short circuit.
- Do not make the terminal shape and mechanism which connect reverse to equipment.
- Do not make the shape and mechanism which static electricity and water easy go through the battery pack inside.
- Make the shape and mechanism which can inspect protection circuit function before the battery pack makes completely.
- Fix cells with mold case by rib, tape, glue etc., but do not make damage cells (especially sealing part) by rib or sharp part of mold case. In case of the battery pack is struck by hard shock or vibration, the battery pack has possibility to cause leakage, smoke, explosion.
- Weld mold case by glue. Not weld mold case by ultra sonic welding.

##### b) Protection Circuit insure safety of battery

- Overcharge protection should work below 3.7V/cell by charge. Then charge current shall be shut down.
- At the voltage range 2.0V/cell, over-discharge protection should work. Then discharge current shall be shut down and consumption current is below 1 $\mu$ A.

##### c) Electric circuit

- To avoid to discharge during storage, design the low consumption current electronic circuit(e.g. Protection circuit, fuel gauge, etc) inside battery pack.
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d) Cell connection

- Do not solder onto a cell in order to avoid a damage on the cell. Weld spot welding lead plate onto cell, and solder lead wire or lead plate.

## 2 PRECAUTIONS AND SAFETY INSTRUCTIONS

The cell includes the flammable objects such as the organic solvent. If the handling is missed there will be possibility that the cell rupture flames or hot, or it will cause the damage to the cell and/or personal injury. Please observe the following prohibitive matters. And also, add the protection device the equipment for fear that the trouble would affect the cell by the abnormality of equipment. Please read and observe the standard cell precautions below before using utilization.

2.1 Don't use or expose the cell to extreme heat, flame, disposed in fire or water or get it wet. Don't modify or disassemble the cell. It will be dangerous, and may cause ignition, heating, leakage or explosion.

2.2 Don't short-circuit cell positive(+) and negative(-) terminals. Keep away from metal or other conductive materials. Jumbling the cells of direct contact with positive(+) and negative(-) terminals or other conductive materials may cause short-circuit. Don't reverse the positive (+) and negative (-) terminals for any reason.

2.3 Don't use the unspecified charger and breach charging requirement. Cell charged with unspecified condition maybe lead cell to be overcharged or abnormal chemical reaction. It causes the generating heat, smoke, rupture .

2.4 Don't overcharge, over-discharge, drive nail into the cell, strike it by hammer or tread it.

2.5 Don't give cell impact or drop, and not use the cell with conspicuous damage or deformation.

2.6 Don't connect cell to the plug socket or car-cigarette-plug. Don't use lithium-ion cell in mixture of different batch or use cell for other equipment.

2.7 Do not use or leave the cell under the blazing sun (or in heated car by sunshine), and keep cell away from little children in order to avoid troubles by Swallowing. In case of swallowing the cell, see a doctor immediately.