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| Title | Li-ion Battery Specifications (Steel) | File No: HYB/QP-09-E167-NH | Version NO:B/0 |
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Presentation: 金辉源

Lithium-Ion Battery Cell Specification

Classification: Li-ion Cell

Cell Type: **ICR18650NH**

March 20, 2008

HYB BATTERY CO., LTD.

Technology Department

Battery Technical Service Department

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| Prepared | |
| Checked | |
| Approved | |

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| Customer Approval (Date) |
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1. Scope

This Specification is applied to rechargeable lithium ion battery cell of the following mentioned type for various applications in mobile communication devices and portable power systems.

2. Cell Classification and Type

2.1 Cell Classification : Lithium Ion Battery Cell

2.2 Cell Type : ICR18650NH

3. Standard

The specification is based on the technical specification of GB/T18287-2000 、UL1642 and IEC61960.

4. Nominal Specification

| Item | | Specification | Remarks |
|---|------------------|-------------------------------|--|
| 4.1 | Typical capacity | 2200mAh | 0.2 C ₅ A discharge |
| 4.2 | Minimum Capacity | 2150mAh | |
| 4.2 Nominal Voltage | | 3.7V | |
| 4.3 Discharging Voltage (Min) | | 2.75V | |
| 4.4 Charging Voltage (Max.) | | 4.2 ± 0.03V | |
| 4.5 Charging Current (Std.) | | 0.5 C ₅ A | |
| 4.6 Discharging Current (Std.) | | 0.2 C ₅ A | |
| 4.7 Charging Current (Fast) | | 1 C ₅ A | 0 ~ 40°C, ≤95%RH |
| 4.8 Discharging Current (Fast) | | 1 C ₅ A | |
| 4.9 Discharging Current (Max.) | | 2 C ₅ A | |
| 4.10 Internal Impedance | | 70mΩ | AC impedance 1kHz Difference among cells should be less than 10mΩ in a shipment. |
| 4.11 Weight | | 45.0 ± 2.0g | |
| 4.12 Outline dimension (see figure) | Diameter | 18.2±0.2mm (Including PVC) | |
| | Length | 64.8±0.5mm | |
| 4.13 Battery cell storage and transportation environment and temperature ranges | Min 1 Month | -20 ~ +60°C, <75%RH* | Initial status of cell 3.80V and 50% of charge, the capacity lost during shipment < 20%. Capacity recover rate > 80%. |
| | Min 3 Months | -20 ~ +45°C, <75%RH* | |
| | Min 12 Months | -20 ~ +25°C, <75%RH* | |

| Title | Li-ion Battery Specifications (Steel) | | Page | 3/11 |
|---|---|----------------|--|------|
| 6. Temperature Adaptability | | | | |
| Item | Test Method | | Performances | |
| 6.1 Capacity at different temperature | Measure capacity with constant discharge current of 0.2 C to 2.75V cut-off at each temperature after complete charge at 20 . | | Minimum capacity: 60% at -20 80% at 0 95% at 55 | |
| 6.2 Discharge at constant temperature /humidity | Percentage as an index of the capacity compared with 100% at 20 .Keep the battery at 40 and 90%RH, goal is 95%, for 48 hrs and then discharge at 1C to 2.75V Cut-off Voltage. | | The battery cell shall not rupture, smoke, catch fire, vent or leak. The time of discharge is no less than 36 min. | |
| 6.3 Vibration | The battery cell will be vibrated 10 sine sweeps in three mutually perpendicular directions with amplitude of 0.19-0.38mm and changing frequency between 10 and 55Hz. The rate of scanning frequency is from 10Hz to 55 Hz with the rate of 1 Hz per min. | | The battery cell shall not rupture, smoke, catch fire, vent or leak. The voltage is no less than 3.6V. | |
| 6.4 Shock | The battery cell shall be accelerated 1000 times at 100m/s ² for durations of 16mS. | | The battery cell shall not rupture, smoke, catch fire, vent or leak. | |
| 6.5 Free fall | The battery cell will be dropped free one time in three mutually perpendicular directions from the height of 1.0m onto a hard board with the thickness of 20mm. | | The battery cell shall not rupture, smoke, catch fire, vent or leak. | |
| 7. Safety Characteristics | | | | |
| Item | Test Method | | Performances | |
| 7.1 Short Circuit | The battery cell is to be short-circuited by connecting the positive and negative terminals of the battery with an external load of less than 100 m until the surface temperature decrease 10 degree from the highest point. | | The battery cell shall be no fire, somke or explosion. | |
| 7.2 Over charge | The battery cell charged completely will be charged continuously for 8hrs with the external power supply of the limit voltage of 4.6V and the current of 3A. | | The battery cell shall be no fire, smoke or explosion. | |
| File No: HYB/QP-09-E167-NH | ICR18650NH | Version No:B/0 | Engineering Center | |

| Title | Li-ion Battery Specifications (Steel) | | Page | 4/11 |
|---|--|--|--------------------|------|
| 7.3 Over discharge | After complete charge, the battery cell will be discharged to end voltage. Then connect with external load of 30 discharge for 24hrs. | The battery cell shall not rupture, smoke, catch fire, vent or leak. | | |
| 7.4 Crush | A charged battery cell is to be crushed between two flat surfaces. The force for the crushing is to be applied by a hydraulic ram with a 1.25 inch (32mm) diameter piston. The crushing is to be continued until a pressure reading of 17.2Mpa is reached on the hydraulic ram, applied force of 13kN. Once the maximum pressure has been obtained it is to be released. | The battery cell shall not rupture or catch fire. | | |
| 7.5 Impact | Drop a 10kg hammer from a height of 1m onto the cell that is placed on a flat surface. (The largest surface of the battery cell shall be perpendicular to the flat surface.) | Deformation of the battery cell is allowed, but there shall be no fire or explosion. | | |
| 7.6 Heating | Place the battery cell in an oven. The temperature of the oven is to be raised at a rate of 5 ±2 /min to a temperature of 130 ±2 , and remain for 30min at that temperature. | The battery cell shall be no fire or explosion. | | |
| <p>8 . Standard Test Conditions</p> <p>8.1 Test Condition</p> <p>Unless otherwise specified, all tests stated in this Product Specifications shall be conducted under the following atmosphere condition:</p> <p>Temperature: 15 – 35 ; Relative Humidity: 45% – 75%;</p> <p>Atmospheric Pressure: 86kPa – 106kPa.</p> <p>8.2 Measuring meters & Instruments</p> <p>8.2.1 Voltmeter should have a precision of ±0.5% or higher. Its internal impedance should not be less than 10kΩ/V.</p> <p>8.2.2 Ammeter should have a precision of ±0.5% or higher.</p> <p>8.2.3 Hour-meter should have a precision of ±0.1% or higher.</p> <p>8.2.4 Thermometer should have a precision of ±0.5 or higher.</p> <p>8.2.5 The current of a constant-current supply should be stable and adjustable. Its variation shall be within ±1% during the charging and discharging process.</p> <p>8.2.6 The voltage of a constant- voltage supply should be stable and adjustable. Its variation shall be within ±0.5%.</p> | | | | |
| File No: HYB/QP-09-E167-NH | ICR18650NH | Version No:B/0 | Engineering Center | |

| Title | Li-ion Battery Specifications (Steel) | | Page | 5/11 |
|--|---------------------------------------|----------------|--------------------|------|
| <p>9. Design and Construction</p> <p>The design, structure and dimension of the battery cell are shown on the attached drawing (see figure) .</p> <p>10. Appearance</p> <p>There shall be no practical damage such as conspicuous liquid electrolyte leakage, flaw electrolyte leakage, rust, dirt, and deformation. The battery cell must have marketability.</p> <p>11. Packing and Shipping cells</p> <p>Inspection Before Shipment of the battery cells</p> <ul style="list-style-type: none"> • Inspect voltage, internal impedance and capacity and protection circuit function before shipment. <p>Minimum aging period should be more than 4 weeks from date of manufacturing. Outgoing Inspection Report should be come with Shipment.</p> <p>Packing and Shipping cells</p> <ul style="list-style-type: none"> • During transportation, must use appropriate package to protect the cell from damage. We recommend the original package method, whenever need during transportation. • The cells should be shipped with half-charged state and during transportation. Avoid mechanical shock, crush, sun radiation and shower. Should be shipped by truck, train, ship or airplane etc. <p>Date code on the cells and box:</p> <ul style="list-style-type: none"> - On the cell: Manufacturing date should be marked on the PVC sleeve, not on the can. - On the box: Manufacturing date and shipping date should be marked. Manufacturing date should be complied with cells. <p>Abnormal cell</p> <ul style="list-style-type: none"> • Don't use abnormal cells which have damages caused by stress, drop, short, or leakage of electrolyte. <p>12. Precautions on Charge use</p> <p>Charge</p> <ul style="list-style-type: none"> • A battery cell must be charged with constant current-constant voltage. • In case of ICR18650NH, charge current must be below 2C /cell. • Charge voltage must be less than 4.25V/cell. <p>Discharge</p> <ul style="list-style-type: none"> • Discharge current must be below 2C /cell. • Discharge temperature range should be -20~55°C. • Discharge end voltage must be over 2.75V/cell. <p>Required protection functions</p> <p>Have protection circuit functionality which is described below inside battery pack, to insure safety of battery cell in case of misuse.</p> | | | | |
| File No: HYB/QP-09-E167-NH | ICR18650NH | Version No:B/O | Engineering Center | |

| NO | | Items | Requirements |
|----|--|-------------------------------------|---------------|
| 1 | Protection Functions (For reference) | Over Charge detection voltage. | 4.35 ± 0.025V |
| 2 | | Over Charge release voltage. | 4.15 ± 0.050V |
| 3 | | Excess discharge detection voltage. | 2.3 ± 0.08V |
| 4 | | Excess discharge release voltage | 3.0 ± 0.10V |
| 5 | | Over current protection(OCP) | 3.0 ~ 6.5A |

Precautions

Precautions on Battery Pack Design

- Fix cells with mold case by rib, tape, glue etc., but don't make damage cells (especially in sealing part) by rib or sharp part of mold case. In case the battery pack is struck by hard shock or vibration, the battery pack has possibility to cause leakage, smoke, or explosion.
- It is recommended that the protection device such as PTC (e.g. VTP210.VTP170) or thermal fuse (e.g. TA1 , TA2) should be used to protect the battery from the abnormality of equipment.

13. Storage Condition

Recommended Storage Temperature and Humidity

- Store the battery cell at temperature range -5 ~+35 , relative humidity of less than 75% and no corrosive gas atmosphere. Keep far away from fire or heat.

Long Period Storage

- In case of long period storage (more than 3 months), store the battery cell at temperature range -5~+25°C, less than 75% humidity, no corrosive gas atmosphere. And in this case, charge/discharge condition of one full cycle, and store the battery at 3.8V/cell.
- When storing the cell over one year, charge the cell at least once a year.
- No condensation on the cell.

| Title | Li-ion Battery Specifications (Steel) | | Page | 7/11 |
|---|---------------------------------------|----------------|--------------------|------|
| <p>14. Exemption from Warrantee</p> <ul style="list-style-type: none"> • HYB will not be responsible for trouble occurred by handling outside of the precautions in this specification. • HYB will not be responsible for trouble occurred by matching electric circuit, battery pack, terminal and charger. In case of any problem, an analysis must be conducted to determine the cause of failure. • HYB will not be responsible for any fault resulted from battery pack assembly such as welding <i>etc.</i> after acceptance of cells. <p>15. Safety Instruction</p> <p>Prohibition Points and Handle</p> <p>The battery cell includes the flammable objects such as the organic solvent. If the handling is missed there will be possibility that the battery cell ruptures, flames or hot, or it will cause the deterioration or damage of battery cell. Please observe the following prohibitive matters. And also, add the protection device the equipment for fear that the trouble would affect the battery cell by the abnormality of equipment. In addition, mention the following matters as “Prohibition Points on Handle” in the instruction manual of the equipment.</p> <p>16. Warranty Period of Battery</p> <p>The warranty period of a battery cell is for 12 months after shipment. However, even within the warranty period, HYB will only be responsible for defect of cells related to manufacturing process. Any other problem caused by malfunction of the equipment or unsuitable use of the cell will not be covered under this warranty.</p> | | | | |
| File No: HYB/QP-09-E167-NH | ICR18650NH | Version No:B/0 | Engineering Center | |

| Title | Li-ion Battery Specifications (Steel) | Page | 8/11 |
|--|---------------------------------------|----------------|--------------------|
| <p>Danger !</p> <p>1. Disassemble and Reconstruction “Do not disassemble or reconstruct battery” The battery pack has safety function and protection circuit to avoid the danger. If they have serious damage, it will cause the generating heat, smoke, rupture or flame.</p> <p>2. Short-circuit “Don not short-circuit battery cell Do not connect + and – terminals with metals (such as wire). Do not carry or store the battery cell with metal objects (such as wire, or hairpins). If the battery cell is short-circuited excessive large current will flow and then the generating heat, smoke, rupture or flame will occur. And also, it causes generating heat at metals.</p> <p>3. Incineration and Heating “Do not incinerate or heat the battery cell” These occur the melting of insulator, damage of gas release vent or safety function, or ignition on electrolyte. Above mentioned matters cause the generating heat, smoke, rupture or flame.</p> <p>4. Use nearby Heated Place “Do not use or leave battery nearby fire, stove or heated place (more than 80°C)” In case that separator made of polymer is melted by high temperature, the internal short-circuit occurs in individual cells and then it causes the generating heat, smoke, rupture or flame. In addition, do not use the battery cell under the heated place (more than 80°C).</p> <p>5. Immersion “Do not immerse the battery in water or sea water, or get it wet” If the protection circuit included in the battery cell is broken, the battery cell will be charged at extreme current or voltage and the abnormal chemical reaction occurs in it. And then it causes the generating heat, smoke, rupture or flame.</p> <p>6. Charge nearby Heated Place “Do Not charge battery nearby the fire or under the blazing sun” If the protection circuit to avoid the danger works under high temperature or it is broken, the battery cell will be charged at abnormal current (or voltage) and abnormal chemical reaction will occur. It causes the generating heat, smoke, rupture or flame.</p> <p>7. Charger and Charge Condition “Do use the specified charger and observe charging requirement” If the battery cell is charged with unspecified condition (under high temperature over the regulated value, excessive high voltage or current over regulated value, or remodeled charger), there are cases that it will be overcharged or the abnormal chemical reaction will occur in cells. It causes the generating heat, smoke, rupture or flame.</p> | | | |
| File No: HYB/QP-09-E167-NH | ICR18650NH | Version No:B/0 | Engineering Center |

| Title | Li-ion Battery Specifications (Steel) | Page | 9/11 |
|---|---------------------------------------|----------------|--------------------|
| <p>8. Penetration “Don to drive a nail into the battery, stick it by hammer, or tread it” As the battery cell might be broken or deformed and then it will be short-circuited, it causes the generating heat, smoke, rupture or flame.</p> <p>9. Impact “Do Not give battery impact or throw it” The impact might cause leakage, heat, smoke, rupture, and/or fire of cell in the battery. And also if the protection circuit in the battery cell is broken, the battery will be charged abnormal voltage or current, and abnormal chemical reaction might occur. It might cause leakage, heat, smoke, rupture, and/or fire.</p> <p>10. Deformation “Do not use the battery cell with conspicuous damage or deformation” It causes the generating heat, smoke, rupture or flame.</p> <p>11. Soldering “Do not make the direct soldering on battery cell” As the insulator is melted by heat or the gas release vent (or safety function) is broken, it causes the generating heat, smoke, rupture or flame.</p> <p>12. Reverse Charge and Over-discharge “Do not reverse polarity (and terminals)” On charging, the battery cell is reverse-charged and abnormal chemical reaction occurs. And also, there may be case that unexpected large current flows on discharging. These cause the generating heat, smoke, rupture or flame.</p> <p>13. Reversed Polarity Use “Do not reverse-charge or reverse-connect” The battery cell has polarity. In case the battery cell is not connected with charger or equipment smoothly, do not force them and do check polarity of battery. If the battery cell is connected to opposite polarity with charger, it will be reverse-charged and abnormal chemical reaction will occur. It causes the generating heat, smoke, rupture or flame.</p> <p>14. Inappropriate Use For Other Equipment “Do not use battery cell for other equipment” If the battery cell is used for unspecified equipment, it will deteriorate its performance and cycle-life. At worst, abnormal current will flow or battery may generate heat, smoke, rupture or flame.</p> <p>15. Leakage “Do not touch leaked battery cell” Do not touch your eyes but wash them immediately, and then see a doctor if leaked electrotype is into your eyes. If pay no attention to your eyes, it will cause eye disease.</p> | | | |
| File No: HYB/QP-09-E167-NH | ICR18650NH | Version No:B/O | Engineering Center |

| | | | |
|-------|---------------------------------------|------|-------|
| Title | Li-ion Battery Specifications (Steel) | Page | 10/11 |
|-------|---------------------------------------|------|-------|

Warning !

1. Mixed Use

“Do not use lithium ion battery cell in mixture”

Do not use lithium ion battery cell with the primary batteries or secondary batteries whose capacity or kinds or maker is different. If do that, the battery cell will be discharged or charged excessively in use. And it may cause the generating heat, smoke, rupture or flame because of the abnormal chemical reaction in cells.

2. Ingestion

“Keep the battery cell away from babies”

Keep the little battery cell out of the reach of babies in order to avoid troubles by Swallowing. In case of swallowing the battery, see a doctor immediately.

3. Charging Time

“Do not continue to charge battery cell over specified time”

If the battery cell is not finished charging over regulated time, let it stop charging. There is possibility that the battery cell might generate heat, smoke, rupture or flame.

4. Storage

“Do not get into a microwave or a high pressure container”

It causes the generating heat, smoke, rupture or flame because of a sudden heat or damage of sealing condition of battery cell.

5. Leakage

“Do not use a leaked battery cell narby fire”

If the liquid leaks from the battery cell (or the battery gives out bad smell), let the battery cell leave from flammable objects immediately. Unless do that, the electrolyte leaked from battery cell will catch fire and it will cause the smoke, flame or rupture of it.

6. Rust, Charging color and Deformation

“Do not use an abnormal battery cell”

In case the battery cell has bad smell or is generated its changing color or deformation or causes something wrong in using (includes charging and storage). Let it take out from equipment or charger and do not use it. If an abnormal battery cell is used, it will generate heat, smoke, rupture or flame.

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|-------------------------------|------------|----------------|--------------------|
| File No: HYB/QP-09-E167-NH | ICR18650NH | Version No:B/0 | Engineering Center |
|-------------------------------|------------|----------------|--------------------|

| | | | |
|-------|---------------------------------------|------|-------|
| Title | Li-ion Battery Specifications (Steel) | Page | 11/11 |
|-------|---------------------------------------|------|-------|

Caution !

1. Use under strong sunshine

Do not use or leave the battery cell under the blazing sun (or in heated car by sunshine). The battery cell may generate heat, smoke or flame. And also, it might cause the deterioration of battery cell's characteristics or cycle life.

2. Static Electricity

The battery pack has the protection circuit to avoid the danger. Do not use nearby the place where generates static electricity (more than 100V) which gives damage to the protection circuit. If the protection circuit were broken, the battery cell would hide danger.

3. Charging Temperature Range

Charging temperature range is regulated between 0°C and 40°C. Do not charge the battery cell out of recommended temperature range. Charging out of recommended range might cause the generating heat or serous damage of battery cell. And also, if might cause the deterioration of battery cell's characteristics and cycle life.

4. Manual

Please read the manual before using the battery cell and keep it after reading.

5. Charging method

Please read the manual of specified charger about charging method.

6. First time use

When the battery cell has rust, bad smell or something abnormal at first-time using, do not use the equipment and go to bring the battery cell to the shop which it was bought.

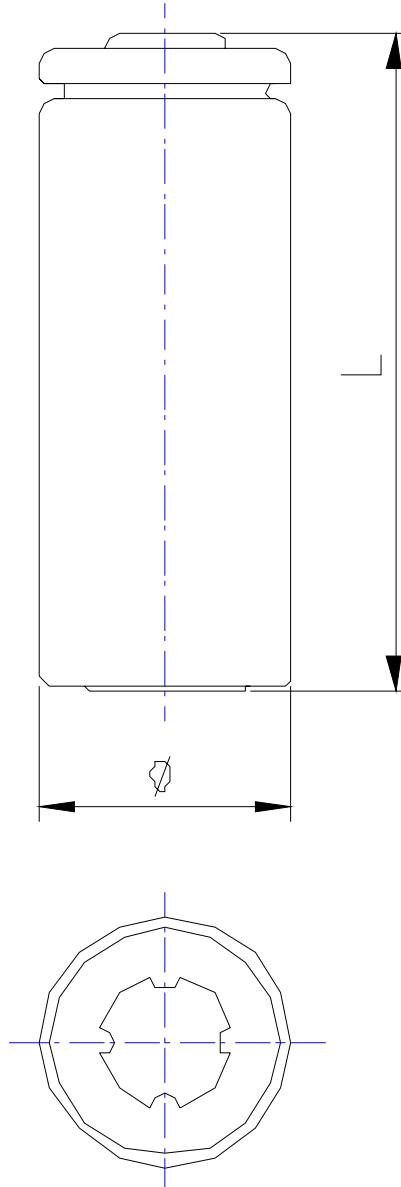
7. Leakage

If the skin or cloth is smeared with liquid form the battery cell, wash with fresh water. It may cause the skin inflammation.

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|-------------------------------|------------|----------------|--------------------|
| File No: HYB/QP-09-E167-NH | ICR18650NH | Version No:B/0 | Engineering Center |
|-------------------------------|------------|----------------|--------------------|

| | | | |
|-------|---------------------------------------|------|--------|
| Title | Li-ion Battery Specifications (Steel) | Page | Figure |
|-------|---------------------------------------|------|--------|

Battery sketch map



| NO. | Name | Remarks |
|-------------------------------|------------|----------------------------|
| 1 | Diameter | 18.2±0.2mm (Including PVC) |
| 2 | Length | 64.8±0.5mm |
| 3 | Case | Steel |
| File No: HYB/QP-09-E167-NH | ICR18650NH | |