



## Howell Energy Co., Ltd

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VER:1.0

DATE:20.11.21

Customer number : 02037

# Cylindrical Li-ion Battery Specification

**MODEL: INR18650-2500 Li-ion 3.6V 2500mAh**

| Prepared By/Date | Checked By/Date | Approved By/Date |
|------------------|-----------------|------------------|
|                  |                 |                  |

|                   |                |
|-------------------|----------------|
| Customer Approval | Signature/Date |
|                   |                |
|                   | Company Name   |
|                   |                |
|                   | Company Stamp  |
|                   |                |



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### Amendment Records

| Edition | Description       | Prepared by | Approved by | Date       |
|---------|-------------------|-------------|-------------|------------|
| 1.0     | The first release | Harry       |             | 2020.11.21 |
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### 1 Scope

This specification is applied to the reference battery in this Specification that manufactured by Howell Energy Co., Ltd.

### 2 Product Specification

Table 1

| No. | Item                        | General Parameter                                                                              |         | Remark                                                                                                                                                                           |
|-----|-----------------------------|------------------------------------------------------------------------------------------------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Rated Capacity              | Typical                                                                                        | 2500mAh | Standard discharge (0.2C C <sub>5</sub> A)<br>after Standard charge                                                                                                              |
|     |                             | Minimum                                                                                        | 2450mAh |                                                                                                                                                                                  |
| 2   | Nominal Voltage             | 3.6V                                                                                           |         | Mean Operation Voltage                                                                                                                                                           |
| 3   | Voltage at end of Discharge | 3.0V                                                                                           |         | Discharge Cut-off Voltage                                                                                                                                                        |
| 4   | Charging Voltage            | 4.2±0.03V                                                                                      |         |                                                                                                                                                                                  |
| 5   | Internal Impedance          | ≤20mΩ                                                                                          |         | Internal resistance measured<br>at AC 1KHz after 50% charge<br>The measure must uses the<br>new batteries that within one<br>week after shipment and<br>cycles less than 5 times |
| 6   | Standard charge             | Constant Current 0.2C <sub>5</sub> A<br>Constant Voltage 4.2V<br>0.01 C <sub>5</sub> A cut-off |         | Charge time : Approx 4.0h                                                                                                                                                        |
| 7   | Standard discharge          | Constant current 0.2 C <sub>5</sub> A<br>end voltage 3.0V                                      |         |                                                                                                                                                                                  |



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Continuous the table 1

| No. | Item                                 | General Parameter                                                                              | Remark                    |
|-----|--------------------------------------|------------------------------------------------------------------------------------------------|---------------------------|
| 8   | Fast charge                          | Constant Current 1C <sub>5</sub> A<br>Constant Voltage 4.2V<br>0.01 C <sub>5</sub> A cut-off   | Charge time : Approx 2.5h |
| 9   | Maximum Continuous Charge Current    | Constant Current 1.0C <sub>5</sub> A<br>Constant Voltage 4.2V<br>0.01 C <sub>5</sub> A cut-off |                           |
| 10  | Maximum Continuous Discharge Current | 20A                                                                                            |                           |
| 11  | Maximum Pulse Discharge Current      | 30A(1s pulse)                                                                                  |                           |
| 12  | Operation Temperature Range          | Charge: 0~60℃                                                                                  | 60±25%R.H.<br>Bare Cell   |
|     |                                      | Discharge: -40~70℃                                                                             |                           |
|     |                                      | Storage: -20~60℃                                                                               | (Preferable-20~45℃)       |
| 13  | Weight                               | Approx: 49~50 g                                                                                | FYI                       |
| 14  | Pack Dimension                       | Height: 65±1 mm                                                                                | Initial Dimension         |
|     |                                      | Diameter: 18±0.5mm                                                                             |                           |



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### 3 Performance And Test Conditions

#### 3.1 Standard Test Conditions

Test should be conducted with new batteries within one week after shipment from our factory and the cells shall not be cycled more than five times before the test. Unless otherwise specified, test and measurement shall be done under temperature of  $20\pm5^{\circ}\text{C}$  and relative humidity of 45~85%. If it is judged that the test results are not affected by such conditions, the tests may be conducted at temperature  $15\sim30^{\circ}\text{C}$  and humidity 25~85%RH.

#### 3.2 Measuring Instrument or Apparatus

##### 3.2.1 Dimension Measuring Instrument

The dimension measurement shall be implemented by instruments with equal or more precision scale of 0.01mm.

##### 3.2.2 Voltmeter

Standard class specified in the national standard or more sensitive class having inner impedance more than  $10\text{k}\Omega/\text{V}$

##### 3.2.3 Ammeter

Standard class specified in the national standard or more sensitive class. Total external resistance including ammeter and wire is less than  $0.01\Omega$ .

##### 3.2.4 Impedance Meter

Impedance shall be measured by a sinusoidal alternating current method(1kHz LCR meter).

#### 3.3 Standard Charge\Discharge

##### 3.3.1 Standard Charge : Test procedure and its criteria are referred as follows:

$0.5C_5A = 1300\text{mA}$

Charging shall consist of charging at a  $0.5C_5A$  constant current rate until the cell reaches 4.2V. The cell shall then be charged at constant voltage of 4.2 volts while tapering the charge current. Charging shall be terminated when the charging current has tapered to  $0.01 C_5A$ . Charge time : Approx 4.0h, The cell shall demonstrate no permanent degradation when charged between  $0^{\circ}\text{C}$  and  $45^{\circ}\text{C}$ .

##### 3.3.2 Standard Discharge

$0.2C_5A = 520\text{mA}$

Cells shall be discharged at a constant current of  $0.2 C_5A$  to 3.0 volts @  $20^{\circ} \pm 5^{\circ}\text{C}$



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### 3.6 Cycle Life and Leakage-Proof

Table 4

| No. | Item          | Criteria                          | Test Conditions                                                                                                                                                            |
|-----|---------------|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Cycle Life    | $10A \geq 500$ cycles             | With standard charge and 10A continuous discharge, rest for 60mins. Then repeat above steps, when capacity is less than 60% of initial capacity, the battery life is over. |
| 2   | Leakage-Proof | No leakage<br>(visual inspection) | After full charge with standard charge, store at $60 \pm 3^{\circ}\text{C}$ , $60 \pm 10\%\text{RH}$ for 1 month.                                                          |

## 4. Mechanical characteristics and Safety Test

Table 5

(Mechanical characteristics)

| No. | Items          | Test Method and Condition                                                                                                                                                                                                                                                                      | Criteria                              |
|-----|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| 1   | Vibration Test | After standard charging, fixed the cell to vibration table and subjected to vibration cycling that the frequency is to be varied at the rate of 1Hz per minute between 10Hz and 55Hz, the excursion of the vibration is 1.6mm. The cell shall be vibrated for 30 minutes per axis of XYZ axes. | No leakage<br>No fire                 |
| 2   | Drop Test      | The cell is to be dropped from a height of 1 meter twice onto concrete ground.                                                                                                                                                                                                                 | No explosion,<br>No fire, no leakage. |



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Table 6 (Safety Test)

| Item             | Battery Condition       | Test Method                                                                                                                                                                                                                        | Requirements                                                                                |
|------------------|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| Crush            | Fresh,<br>Fully charged | Crush between two flat plates. Applied force is about 13kN(1.72Mpa) for 30min.                                                                                                                                                     | No explosion,<br>No fire                                                                    |
| Short Circuit    | Fresh,<br>Fully charged | Each test sample battery, in turn, is to be short-circuited by connecting the (+) and (-) terminals of the battery with a Cu wire having a maximum resistance load of 0.1Ω. Tests are to be conducted at room temperature(20±2℃ ). | No explosion,<br>No fire<br>The Temperature of the surface of the Cells are lower than 150℃ |
| Short Circuit    | Fresh,<br>Fully charged | Each test sample battery, in turn, is to be short-circuited by connecting the (+) and (-) terminals of the battery with a Cu wire having a maximum resistance load of 0.1Ω. Tests are to be conducted at temperature(60±2℃ ).      | No explosion,<br>No fire<br>The Temperature of the surface of the Cells are lower than 150℃ |
| Impact           | Fresh,<br>Fully charged | A 56mm diameter bar is inlayed into the bottom of a 10kg weight. And the weight is to be dropped from a height of 1m onto a sample battery and then the bar will be across the center of the sample.                               | No explosion,<br>No fire                                                                    |
| Forced Discharge | Fresh,<br>Fully charged | Discharge at a current of 1 C <sub>5</sub> A for 2.5h.                                                                                                                                                                             | No explosion,<br>No fire                                                                    |
| Nail Pricking    | Fresh,<br>Fully charged | Prick through the sample battery with a nail having a diameter of 3mm and remain 2h.                                                                                                                                               | No explosion,<br>No fire                                                                    |



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### 5. CAUTIONS IN USE

To ensure proper use of the battery please read the manual carefully before using it.

#### . Handling

- Do not expose to, dispose of the battery in fire.
- Do not put the battery in a charger or equipment with wrong terminals connected.
- Avoid shorting the battery
- Avoid excessive physical shock or vibration.
- Do not disassemble or deform the battery.
- Do not immerse in water.
- Do not use the battery mixed with other different make, type, or model batteries.
- Keep out of the reach of children.

#### . charge and discharge

- Battery must be charged in appropriate charger only.
- Never use a modified or damaged charger.
- Do not leave battery in charger over 24 hours.

#### . storage

- Store the battery in a cool, dry and well-ventilated area.

#### . disposal

- Regulations vary for different countries. Dispose of in accordance with local regulations.

### 6 Battery operation instruction

#### 6.1 Charging

Charging current: Cannot surpass the biggest charging current which in this specification book stipulated.

Charging voltage: Does not have to surpass the highest amount which in this specification book stipulated to decide the voltage.

Charge temperature: The battery must carry on the charge in the ambient temperature scope which this specification book stipulated.

Uses the constant electric current and the constant voltage way charge, the prohibition reverse charges. If the battery positive electrode and the cathode meet instead, can damage the battery.



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### 6.2 Discharging current

The discharging current does not have to surpass this specification book stipulation the biggest discharging current, the oversized electric current electric discharge can cause the battery capacity play to reduce and to cause the battery heat.

### 6.3 Electric discharge temperature

The battery discharge must carry on in the ambient temperature scope which this specification book stipulated.

### 6.4 Over-discharges

After the short time excessively discharges charges immediately cannot affect the use, but the long time excessively discharges can cause the battery the performance, battery function losing. The battery long-term has not used, has the possibility to be able to be at because of its automatic flashover characteristic certain excessively discharges the condition, for prevented excessively discharges the occurrence, the battery should maintain the certain electric quantity.

### 6.5 Storing the Batteries

The battery should store in the product specification book stipulation temperature range. If has surpasses above for six months the long time storage, suggested you should carry on additional charge to the battery.

### 7. Period of Warranty

The period of warranty is a year from the date of shipment. Howell guarantees to give a replacement in case of cells with defects proven due to manufacturing process instead of the customers abuse and misuse.

### 8. Other The Chemical Reaction

Because batteries utilize a chemical reaction, battery performance will deteriorate over time even if stored for a long period of time without being used. In addition, if the various usage conditions such as charge, discharge, ambient temperature, etc. are not maintained within the specified ranges the life expectancy of the battery may be shortened or the device in which the battery is used may be damaged by electrolyte leakage. If the batteries cannot maintain a charge for long periods of time, even when they are charged correctly, this may indicate it is time to change the battery.

9.Note: Any other items which are not covered in this specification shall be agreed by both parties.



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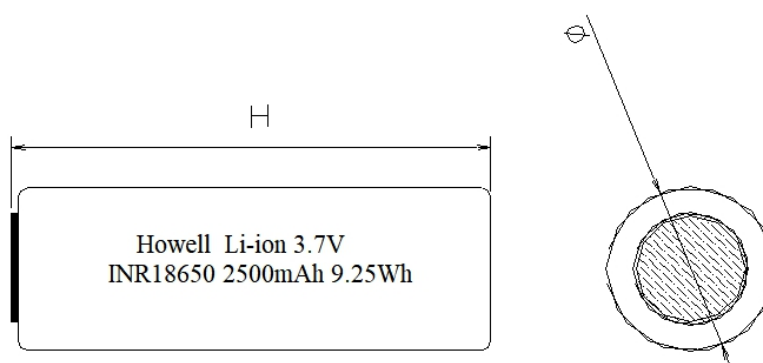
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### 10. Configuration



| No. | Items           | Value      |
|-----|-----------------|------------|
| 1   | Diameter $\Phi$ | 18.5±0.2mm |
| 2   | Height H        | 65.5±0.2mm |

### 11. Mainly capability graph (For Reference Only)

