# Lithium Battery UN38.3 Test Report

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|---|---|
| **Prepared For :** | SHENZHEN MOTTCELL BATTERY TECHNOLOGY CO., LTD.<br>Mottcell Industrial Park, No 22nd WuShi Road, Kengzi Town, Pingshan District, Shenzhen |
| **Samples Name:** | Li-ion Battery |
| **Model :** | SmartScoot |
| **Prepared By :** | Shenzhen TCT Testing Technology Co., Ltd.<br>1F, Building 1, Yibaolai Industrial Park, Qiaotou Village, Fuyong Town, Baoan District, Shenzhen, Guangdong |
| **Report No.:** | TCT141204B008 |
| **Issued Date:** | Jan. 01, 2015 |
| **Conclusion:** | Shown in the results of test report |



Tested by: 张雨裙 Liz Zhang  Inspected by:

Approved by:  Approval Date: 2015. 01. 02

## Ⅰ、SAMPLE DESCRIPTION

| | | | | | |
|---|---|---|---|---|---|
| Product Name | Li-ion Battery | | Battery Type | SmartScoot | |
| Manufacturer | SHENZHEN MOTTCELL BATTERY TECHNOLOGY CO., LTD. | | | | |
| Address | Mottcell Industrial Park, No 22nd WuShi Road, Kengzi Town, Pingshan District, Shenzhen | | | | |
| Trade Mark | ---- | Shape | Prismatic | Size (L×W×T) | (200.0×108.5×81.5)mm |
| Nominal Voltage | 36V | Rated Capacity | 8000mAh 288Wh | Limited Charge Voltage | 42V |
| Charge Current | 1600mA | Maximum Continuous Charge Current | 4000mA | End Charge Current | 240mA |
| Cut-off Voltage | 30V | Standard Discharge Current | 15000mA | Maximum Discharge Current | 20000mA |
| Cell Number | 40PCS | | Cell Model | 18650 | |
| Date of Receipt | Dec. 04, 2014 | | Date of Test | Dec. 24, 2014 | |

## Ⅱ、STANDARD

Recommendations on the Transport of Dangerous Goods, Manual of Test and Criteria (ST/SG/AC.10/11/Rev.5/Amend.1+ Amend.2 Section 38.3)

## Ⅲ、TEST ITEM

1. ☒Altitude simulation
2. ☒Thermal test
3. ☒Vibration
4. ☒Shock
5. ☒External short circuit
6. ☐Impact / ☒Crush
7. ☒Overcharge
8. ☒Forced discharge

## Ⅳ、TEST METHOD

Tests T.1 to T.5 shall be conducted in sequence on the same cell or battery. Tests T.6 and T.8 shall be conducted using not otherwise tested cells or batteries. Test T.7 may be conducted using undamaged batteries previously used in tests T.1 to T.5 for purposes of testing on cycled batteries.

Batteries of 1#~8# are full charged after one cycle;

Batteries of 9#~16# are full charged after fifty cycles;

Component cells of 17#~21# are 50% charged after one cycle;

Component cells of 22#~31# are full discharged after one cycle;

Component cells of 32#~41# are full discharged after fifty cycle;

In order to quantify the mass loss, the following procedure is provided:

Mass loss (%) = (M1-M2)/M1 x 100

where M1 is the mass before the test and M2 is the mass after the test. When mass loss does not exceed the values in Table below, it shall be considered as "no mass loss".

| Mass M of cell or battery | Mass loss limit |
|---|---|
| M＜1g | 0.5% |
| 1g≤M≤75g | 0.2% |
| M＞75g | 0.1% |

Leakage means the visible escape of electrolyte or other material from a cell or battery or the loss of material (except battery casing, handling devices or labels) from a cell or battery such that the loss of mass exceeds the values in Table above.

In test 1 to 4, cells and batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.

## 1. Altitude simulation

Test cells and batteries shall be stored at a pressure of 11.6 kPa or less for at least six hours at ambient temperature (20 ± 5 °C).

## 2. Thermal test

Test cells and batteries are to be stored for at least six hours at a test temperature equal to72 ± 2 °C, followed by storage for at least six hours at a test temperature equal to - 40 ± 2 °C. The maximum time interval between test temperature extremes is 30 minutes. This procedure is to be repeated until 10 total cycles are complete, after which all test cells and batteries are to be stored for 24 hours at ambient temperature (20 ± 5 °C). For large cells and batteries the duration of exposure to the test temperature extremes should be at least 12 hours.

## 3. Vibration

Cells and batteries are firmly secured to the platform of the vibration machine without distorting the cells in such a manner as to faithfully transmit the vibration. The vibration shall be a sinusoidal waveform with a logarithmic sweep between 7 Hz and 200 Hz and back to 7 Hz traversed in 15 minutes. This cycle shall be repeated 12 times for a total of 3 hours for each of three mutually perpendicular mounting positions of the cell. One of the directions of vibration must be perpendicular to the terminal face.

The logarithmic frequency sweep shall differ for cells and batteries with a gross mass of not more than 12 kg (cells and small batteries), and for batteries with a gross mass of more than 12 kg (large batteries).

For cells and small batteries: from 7 Hz a peak acceleration of 1 $g_n$ is maintained until 18 Hz is reached. The amplitude is then maintained at 0.8 mm (1 6 mm total excursion) and the frequency increased until a peak acceleration of 8 $g_n$ occurs (approximately 50 Hz). A peak acceleration of 8 $g_n$ is then maintained until the frequency is increased to 200 Hz.

For large batteries: from 7 Hz to a peak acceleration of 1 $g_n$ is maintained until 18 Hz is reached. The amplitude is then maintained at 0.8 mm (1.6 mm total excursion) and the frequency increased until a peak acceleration of 2 $g_n$ occurs (approximately 25 Hz). A peak acceleration of 2 $g_n$ is then maintained until the frequency is increased to 200 Hz.

## 4. Shock

Test cells and batteries shall be secured to the testing machine by means of a rigid mount which will support all mounting surfaces of each test battery. Each cell or battery shall be subjected to a halfsine shock of peak acceleration of 150 $g_n$ and pulse duration of 6 milliseconds. Each cell or battery shall be subjected to three shocks in the positive direction followed by three shocks in the negative direction of three mutually perpendicular mounting positions of the cell or battery for a total of 18 shocks.

However, large cells and large batteries shall be subjected to a half-sine shock of peak acceleration of 50 $g_n$ and pulse duration of 11 milliseconds. Each cell or battery is subjected to three shocks in the positive direction followed by three shocks in the negative direction of each of three mutually perpendicular mounting positions of the cell for a total of 18 shocks.

## 5. External short circuit

The cell or battery to be tested shall be temperature stabilized so that its external case temperature reaches 55 ± 2 °C and then the cell or battery shall be subjected to a short circuit condition with a total external resistance of less than 0.1 ohm at 55 ± 2 °C. This short circuit condition is continued for at least one hour after the cell or battery external case temperature has returned to 55 ± 2 °C.

Cells and batteries meet this requirement if their external temperature does not exceed 170 °C and there is no disassembly, no rupture and no fire during the test and within six hours after the test.

## 6. Impact / Crush

Test procedure – Impact (applicable to cylindrical cells not less than 18.0 mm in diameter)

The sample cell or component cell is to be placed on a flat smooth surface. A 15.8 mm ± 0.1mm diameter, at least 6 cm long, or the longest dimension of the cell, whichever is greater, Type 316 stainless steel bar is to be placed across the centre of the sample. A 9.1 kg ± 0.1 kg mass is to be dropped from a height of 61 ± 2.5 cm at the intersection of the bar and sample in a controlled manner using a near frictionless, vertical sliding track or channel with minimal drag on the falling mass. The vertical track or channel used to guide the falling mass shall be oriented 90 degrees from the horizontal supporting surface.

The test sample is to be impacted with its longitudinal axis parallel to the flat surface and perpendicular to the longitudinal axis of the 15.8 mm ± 0.1mm diameter curved surface lying across the centre of the test sample. Each sample is to be subjected to only a single impact.

Test Procedure – Crush (applicable to prismatic, pouch, coin/button cells and cylindrical cells less than 18.0 mm in diameter)

A cell or component cell is to be crushed between two flat surfaces. The crushing is to be gradual with a speed of approximately 1.5 cm/s at the first point of contact. The crushing is to be continued until the first of the three options below is reached.

(a) The applied force reaches 13 kN ± 0.78 kN;

(b) The voltage of the cell drops by at least 100 mV; or

(c) The cell is deformed by 50% or more of its original thickness.

Once the maximum pressure has been obtained, the voltage drops by 100 mV or more, or the cell is deformed by at least 50% of its original thickness, the pressure shall be released.

A prismatic or pouch cell shall be crushed by applying the force to the widest side. A button/coin cell shall be crushed by applying the force on its flat surfaces. For cylindrical cells, the crush force shall be applied perpendicular to the longitudinal axis.

Each test cell or component cell is to be subjected to one crush only. The test sample shall be observed for a further 6 h. The test shall be conducted using test cells or component cells that have not previously been subjected to other tests.

Cells and component cells meet this requirement if their external temperature does not exceed 170 °C and there is no disassembly and no fire during the test and within six hours after this test.

## 7. Overcharge

The charge current shall be twice the manufacturer's recommended maximum continuous charge current. The minimum voltage of the test shall be as follows:

(a) when the manufacturer's recommended charge voltage is not more than 18V, the minimum voltage of the test shall be the lesser of two times the maximum charge voltage of the battery or 22V.

(b) when the manufacturer's recommended charge voltage is more than 18V, the minimum voltage of the test shall be 1.2 times the maximum charge voltage.

Tests are to be conducted at ambient temperature. The duration of the test shall be 24 hours.

Rechargeable batteries meet this requirement if there is no disassembly and no fire during the test and within seven days after the test.

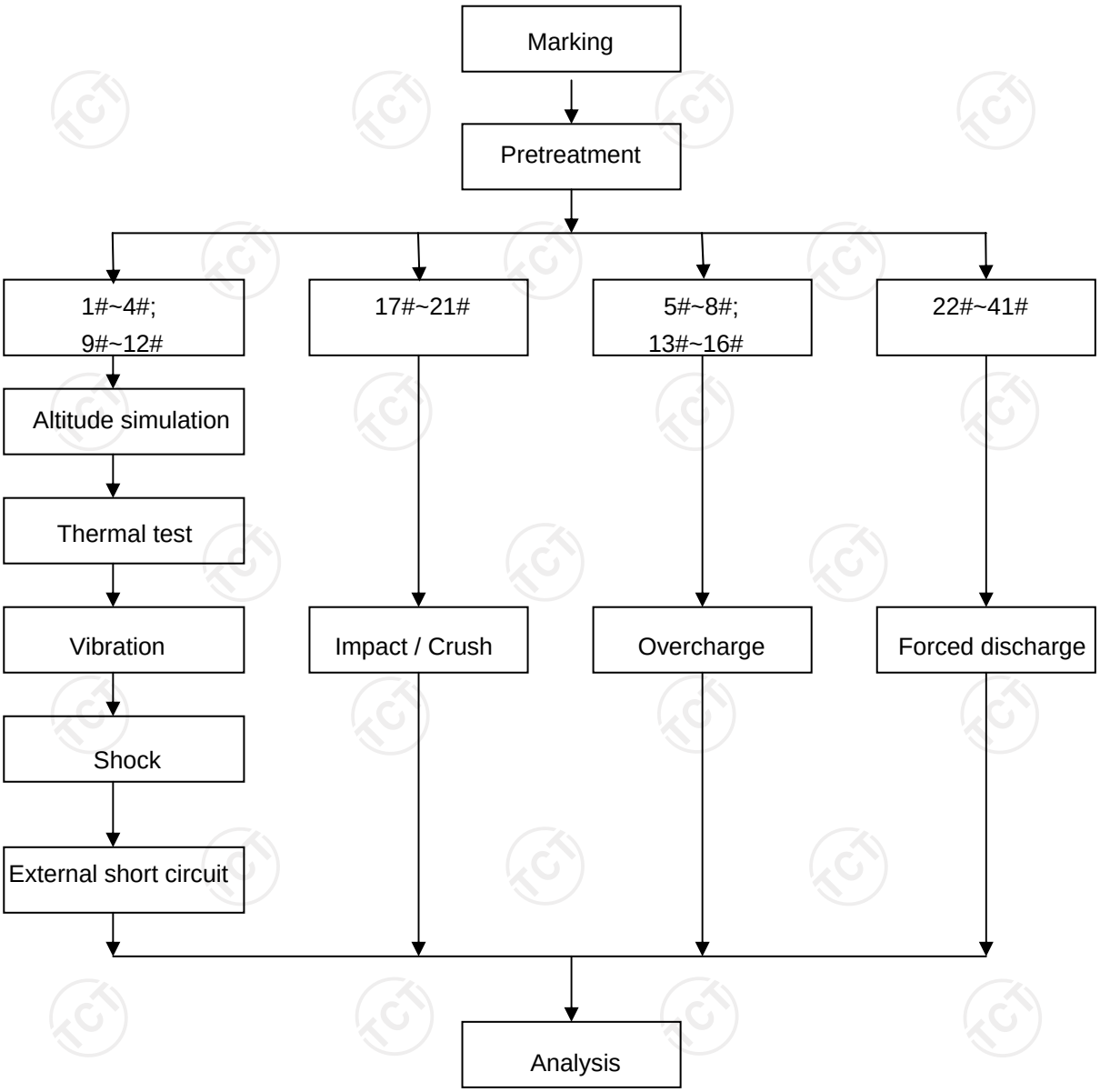
## 8. Forced discharge

Each cell shall be forced discharged at ambient temperature by connecting it in series with a 12V D.C. power supply at an initial current equal to the maximum discharge current specified by the manufacturer.

The specified discharge current is to be obtained by connecting a resistive load of the appropriate size and rating in series with the test cell. Each cell shall be forced discharged for a time interval (in hours) equal to its rated capacity divided by the initial test current (in ampere).

Primary or rechargeable cells meet this requirement if there is no disassembly and no fire during the test and within seven days after the test.

## Ⅴ、TEST PROCEDURE



## Ⅵ、MAIN TEST APPARATUS

| Serial No. | Name of Equipment | Model | Calibration Date /Due Date |
|---|---|---|---|
| TC-101 | Rechargeable battery test system | CTS-20V/10A-GGS | 2014. 03. 03 |
| | | | 2015. 03. 02 |
| TC-104 | Vacuum chamber (for battery test) | GX-3020-Z | 2014. 03. 03 |
| | | | 2015. 03. 02 |
| TC-109 | Temperature circulation chamber | BE-TH-150M8-4 | 2014. 03. 03 |
| | | | 2015. 03. 02 |
| TC-113 | Vibration test instrument | ES-3-150 | 2014. 03. 03 |
| | | | 2015. 03. 02 |
| TC-114 | Shock test instrument | SY10-2 | 2014. 03. 03 |
| | | | 2015. 03. 02 |
| TC-110 | Battery short circuit test instrument | BE-1000W | 2014. 03. 03 |
| | | | 2015. 03. 02 |
| TC-111 | Impact test instrument | BE-5066 | 2014. 03. 03 |
| | | | 2015. 03. 02 |
| TC-112 | Crush test instrument | BE-6045T | 2014. 03. 03 |
| | | | 2015. 03. 02 |
| TC-009 | DC regulated power supply | GPR-3060D | 2014. 03. 03 |
| | | | 2015. 03. 02 |
| TC-108 | Battery anti-explosion chamber | GX-100 | 2014. 03. 03 |
| | | | 2015. 03. 02 |
| TC-103 | Electronic Balance | PTT-A+300 | 2014. 03. 03 |
| | | | 2015. 03. 02 |
| TC-001 | Digital multimeter | 15B | 2014. 03. 03 |
| | | | 2015. 03. 02 |
| TC-026 | Data acquisition unit | 34970A | 2014. 03. 03 |
| | | | 2015. 03. 02 |

## Ⅶ、DATA

1) Altitude simulation

| The state of cells | No. | Pre-test | | After test | | Mass loss (%) | Voltage after test/Voltage pre-test (%) | Status |
|---|---|---|---|---|---|---|---|---|
| | | Mass (g) | Voltage (V) | Mass (g) | Voltage (V) | | | |
| Full charged after one cycle | 1# | 2320.175 | 41.98 | 2320.155 | 41.96 | 0.00 | 100.0 | Pass |
| | 2# | 2320.493 | 41.98 | 2320.466 | 41.96 | 0.00 | 100.0 | Pass |
| | 3# | 2320.178 | 41.99 | 2320.152 | 41.95 | 0.00 | 99.9 | Pass |
| | 4# | 2320.334 | 41.99 | 2320.317 | 41.96 | 0.00 | 99.9 | Pass |
| Full charged after fifty cycles | 9# | 2320.581 | 41.98 | 2320.545 | 41.96 | 0.00 | 100.0 | Pass |
| | 10# | 2320.365 | 41.98 | 2320.328 | 41.96 | 0.00 | 100.0 | Pass |
| | 11# | 2320.314 | 41.99 | 2320.225 | 41.96 | 0.00 | 99.9 | Pass |
| | 12# | 2320.199 | 41.98 | 2320.132 | 41.96 | 0.00 | 100.0 | Pass |

2) Thermal test

| The state of cells | No. | Pre-test | | After test | | Mass loss (%) | Voltage after test/Voltage pre-test (%) | Status |
|---|---|---|---|---|---|---|---|---|
| | | Mass (g) | Voltage (V) | Mass (g) | Voltage (V) | | | |
| Full charged after one cycle | 1# | 2320.155 | 41.96 | 2319.336 | 41.50 | 0.04 | 98.9 | Pass |
| | 2# | 2320.466 | 41.96 | 2319.873 | 41.48 | 0.03 | 98.9 | Pass |
| | 3# | 2320.152 | 41.95 | 2319.418 | 41.48 | 0.03 | 98.9 | Pass |
| | 4# | 2320.317 | 41.96 | 2319.462 | 41.56 | 0.04 | 99.0 | Pass |
| Full charged after fifty cycles | 9# | 2320.545 | 41.96 | 2319.772 | 41.56 | 0.03 | 99.0 | Pass |
| | 10# | 2320.328 | 41.96 | 2319.373 | 41.48 | 0.04 | 98.9 | Pass |
| | 11# | 2320.225 | 41.96 | 2319.581 | 41.48 | 0.03 | 98.9 | Pass |
| | 12# | 2320.132 | 41.96 | 2319.385 | 41.56 | 0.03 | 99.0 | Pass |

3) Vibration

| The state of cells | No. | Pre-test | | After test | | Mass loss (%) | Voltage after test/Voltage pre-test (%) | Status |
|---|---|---|---|---|---|---|---|---|
| | | Mass (g) | Voltage (V) | Mass (g) | Voltage (V) | | | |
| Full charged after one cycle | 1# | 2319.336 | 41.50 | 2319.328 | 41.48 | 0.00 | 100.0 | Pass |
| | 2# | 2319.873 | 41.48 | 2319.775 | 41.48 | 0.00 | 100.0 | Pass |
| | 3# | 2319.418 | 41.48 | 2319.382 | 41.48 | 0.00 | 100.0 | Pass |
| | 4# | 2319.462 | 41.56 | 2319.375 | 41.50 | 0.00 | 99.9 | Pass |
| Full charged after fifty cycles | 9# | 2319.772 | 41.56 | 2319.722 | 41.50 | 0.00 | 99.9 | Pass |
| | 10# | 2319.373 | 41.48 | 2319.281 | 41.48 | 0.00 | 100.0 | Pass |
| | 11# | 2319.581 | 41.48 | 2319.533 | 41.48 | 0.00 | 100.0 | Pass |
| | 12# | 2319.385 | 41.56 | 2319.322 | 41.50 | 0.00 | 99.9 | Pass |

4) Shock

| The state of cells | No. | Pre-test | | After test | | Mass loss (%) | Voltage after test/Voltage pre-test (%) | Status |
|---|---|---|---|---|---|---|---|---|
| | | Mass (g) | Voltage (V) | Mass (g) | Voltage (V) | | | |
| Full charged after one cycle | 1# | 2319.328 | 41.48 | 2319.285 | 41.48 | 0.00 | 100.0 | Pass |
| | 2# | 2319.775 | 41.48 | 2319.726 | 41.45 | 0.00 | 99.9 | Pass |
| | 3# | 2319.382 | 41.48 | 2319.315 | 41.45 | 0.00 | 99.9 | Pass |
| | 4# | 2319.375 | 41.50 | 2319.293 | 41.48 | 0.00 | 100.0 | Pass |
| Full charged after fifty cycles | 9# | 2319.722 | 41.50 | 2319.681 | 41.48 | 0.00 | 100.0 | Pass |
| | 10# | 2319.281 | 41.48 | 2319.216 | 41.45 | 0.00 | 99.9 | Pass |
| | 11# | 2319.533 | 41.48 | 2319.485 | 41.48 | 0.00 | 100.0 | Pass |
| | 12# | 2319.322 | 41.50 | 2319.273 | 41.45 | 0.00 | 99.9 | Pass |

5) External short circuit

| The state of batteries | No. | External Peak temperature(℃) | Status |
|---|---|---|---|
| Full charged after one cycle | 1# | 56.3 | Pass |
| | 2# | 56.5 | Pass |
| | 3# | 55.8 | Pass |
| | 4# | 55.7 | Pass |
| | 9# | 56.1 | Pass |
| | 10# | 56.4 | Pass |
| | 11# | 55.7 | Pass |
| | 12# | 56.6 | Pass |

6) Crush

| The state of cells | No. | External Peak temperature(℃) | Status |
|---|---|---|---|
| 50% charged after one cycle | 17# | 28.5 | Pass |
| | 18# | 27.6 | Pass |
| | 19# | 27.8 | Pass |
| | 20# | 28.2 | Pass |
| | 21# | 28.4 | Pass |

7) Overcharge

| The state of batteries | No. | Status |
|---|---|---|
| Full charged after one cycle | 5# | Pass |
| | 6# | Pass |
| | 7# | Pass |
| | 8# | Pass |
| Full charged after fifty cycles | 13# | Pass |
| | 14# | Pass |
| | 15# | Pass |
| | 16# | Pass |

8) Forced discharge

| The state of cells | No. | Status |
|---|---|---|
| Full discharged after one cycle | 22# | Pass |
| | 23# | Pass |
| | 24# | Pass |
| | 25# | Pass |
| | 26# | Pass |
| | 27# | Pass |
| | 28# | Pass |
| | 29# | Pass |
| | 30# | Pass |
| | 31# | Pass |
| Full discharged after fifty cycles | 32# | Pass |
| | 33# | Pass |
| | 34# | Pass |
| | 35# | Pass |
| | 36# | Pass |
| | 37# | Pass |
| | 38# | Pass |
| | 39# | Pass |
| | 40# | Pass |
| | 41# | Pass |

## Ⅷ、CONCLUSION

| No. | Test item | Sample number | Test reference | Conclusion |
|---|---|---|---|---|
| 1 | Altitude simulation | 1#~4#; 9#~12# | UN Manual of Test and Criteria, part Ⅲ, subsection 38.3.4.1 | Pass |
| 2 | Thermal test | | UN Manual of Test and Criteria, part Ⅲ, subsection 38.3.4.2 | Pass |
| 3 | Vibration | | UN Manual of Test and Criteria, part Ⅲ, subsection 38.3.4.3 | Pass |
| 4 | Shock | | UN Manual of Test and Criteria, part Ⅲ, subsection 38.3.4.4 | Pass |
| 5 | External short circuit | | UN Manual of Test and Criteria, part Ⅲ, subsection 38.3.4.5 | Pass |
| 6 | Impact / Crush | 17#~21# | UN Manual of Test and Criteria, part Ⅲ, subsection 38.3.4.6 | Pass |
| 7 | Overcharge | 5#~8#; 13#~16# | UN Manual of Test and Criteria, part Ⅲ, subsection 38.3.4.7 | Pass |
| 8 | Forced discharge | 22#~41# | UN Manual of Test and Criteria, part Ⅲ, subsection 38.3.4.8 | Pass |

The submitted battery and cell were complied with the stated requirements of UN manual of test and criteria, part Ⅲ, subsection 38.3

# Ⅸ、PHOTO OF THE SAMPLE

**Model: SmartScoot**


**Photo 1** Over view

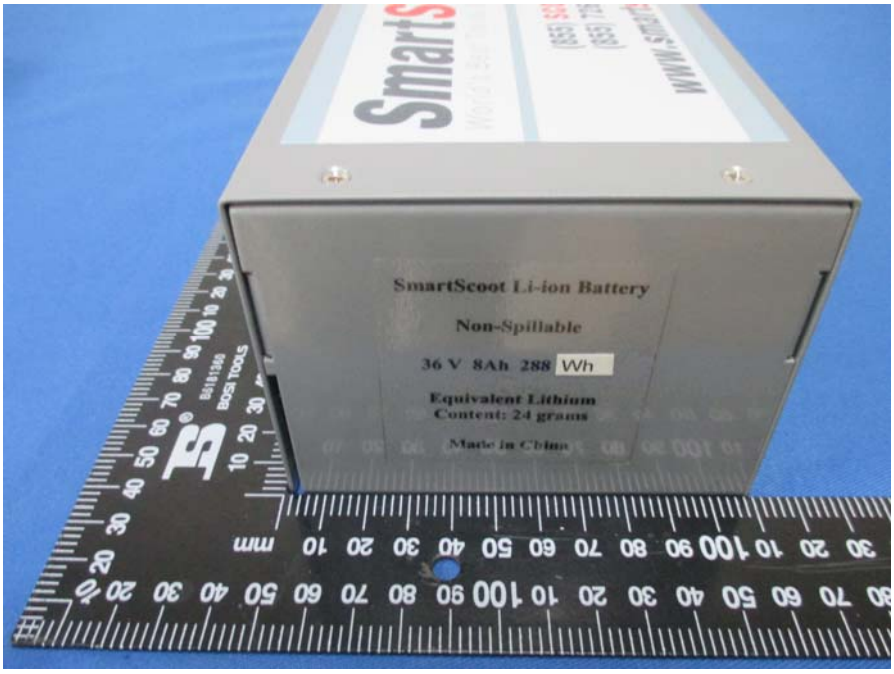



**Photo 2** Over view

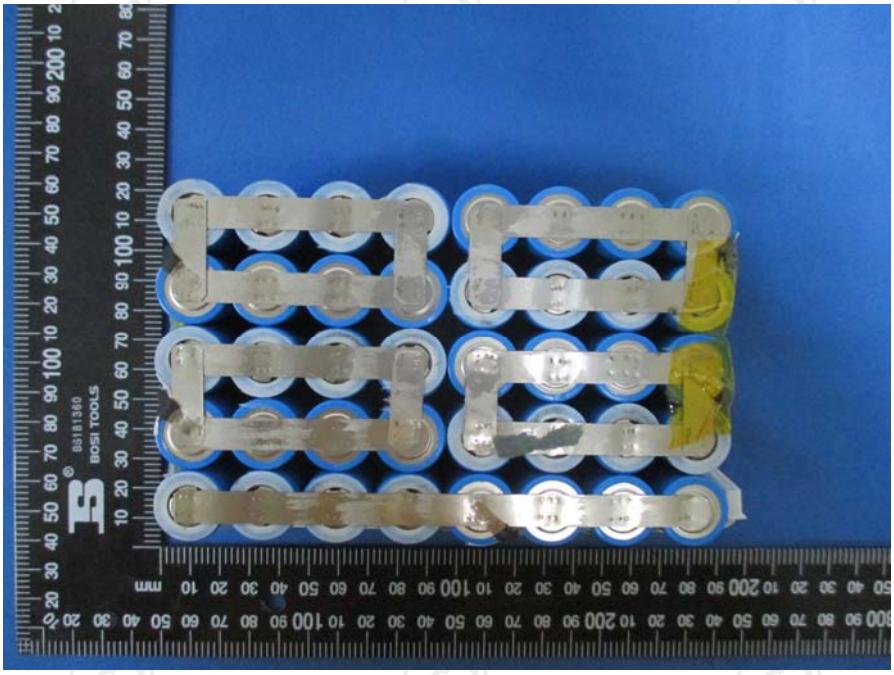


**Photo 3** Internal Cell

**Photo 4** Internal Cell

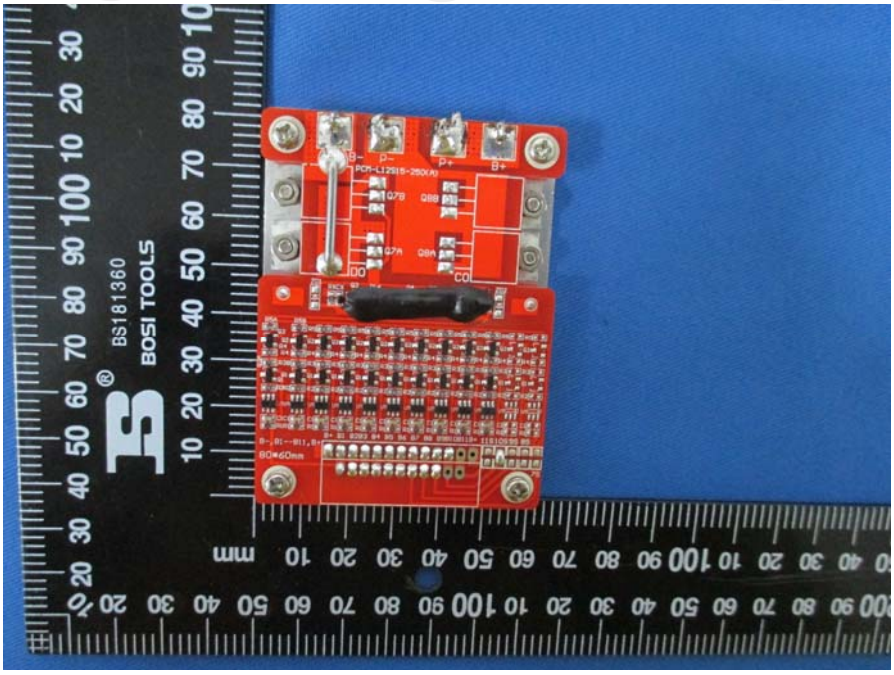



**Photo 5** Protection board

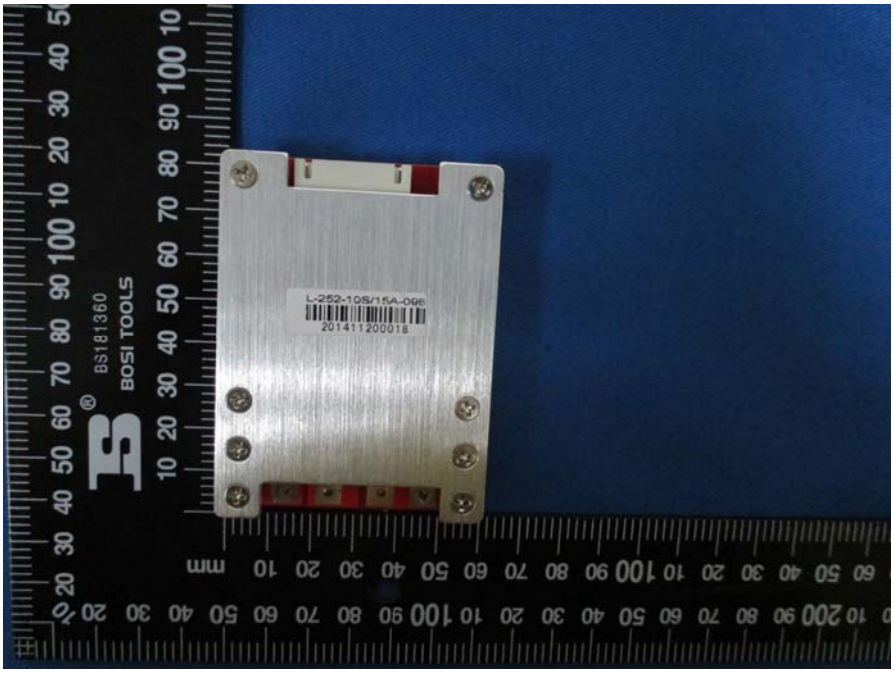



**Photo 6** Protection board

******End of Report******