

# Lithium Battery UN38.3 Test Report

<b>Prepared For :</b>	Allfine Lithium Energy (Hefei) Co., Ltd. Building 12, Mechatronics Industrial Park, Fengle Road, Hefei High Technology Industry Development Zone, Anhui Province, P.R.China
<b>Samples Name:</b>	Cylindrical Type Lithium ion Battery
<b>Model :</b>	ITR26650-4000mAh
<b>Prepared By :</b>	Shenzhen TCT Testing Technology Co., Ltd. 1F, Building 1, Yibaolai Industrial Park, Qiaotou Village, Fuyong Town, Baoan District, Shenzhen, Guangdong
<b>Report No.:</b>	TCT170112B016
<b>Issued Date:</b>	Feb. 02, 2017
<b>Conclusion:</b>	Shown in the results of test report

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Tested by: 闫学兵 Tim Yan

Inspected by:

Approved by: 徐志强 测试

Approval Date: 2017.02.02



## I、SAMPLE DESCRIPTION

Product Name	Cylindrical Type Lithium ion Battery	Battery Type	ITR26650-4000mAh		
Manufacturer	Allfine Lithium Energy (Hefei) Co., Ltd				
Address	Building 12, Mechatronics Industrial Park, Fengle Road, Hefei High Technology Industry Development Zone, Anhui Province, P.R.China				
Trade Mark	----	Shape	Cylindrical	Size (D×H)	(26.0×65.8)mm
Nominal Voltage	3.6V	Rated Capacity	4000mAh 14.4Wh	Limited Charge Voltage	4.2V
Charge Current	1000mA	Maximum Continuous Charge Current	4000mA	End Charge Current	50mA
Cut-off Voltage	3.0V	Standard Discharge Current	1000mA	Maximum Discharge Current	10000mA
Cell Number	1PCS		Cell Model	ITR26650-4000mAh	
Date of Receipt	Jan. 12, 2017		Date of Test	Jan. 29, 2017	

## 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. <input checked="" type="checkbox"/> Altitude simulation | 5. <input checked="" type="checkbox"/> External short circuit                  |
| 2. <input checked="" type="checkbox"/> Thermal test        | 6. <input checked="" type="checkbox"/> Impact / <input type="checkbox"/> Crush |
| 3. <input checked="" type="checkbox"/> Vibration           | 7. <input type="checkbox"/> Overcharge   |
| 4. <input checked="" type="checkbox"/> Shock               | 8. <input checked="" type="checkbox"/> 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.

Cells of 1#~10# are full charged after one cycle;

Cells of 11#~15# are 50% charged after one cycle;

Cells of 16#~25# are full discharged after one cycle;

Cells of 26#~35# are full discharged after fifty cycle;

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

$$\text{Mass loss (\%)} = (M1-M2)/M1 \times 100$$

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 to 72 ± 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<sub>n</sub> 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<sub>n</sub> occurs (approximately 50 Hz). A peak acceleration of 8 g<sub>n</sub> is then maintained until the frequency is increased to 200 Hz.

For large batteries: from 7 Hz to a peak acceleration of 1 g<sub>n</sub> 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<sub>n</sub> occurs (approximately 25 Hz). A peak acceleration of 2 g<sub>n</sub> 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 half-sine shock of peak acceleration of 150 g<sub>n</sub> 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<sub>n</sub> 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 not more than 18 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

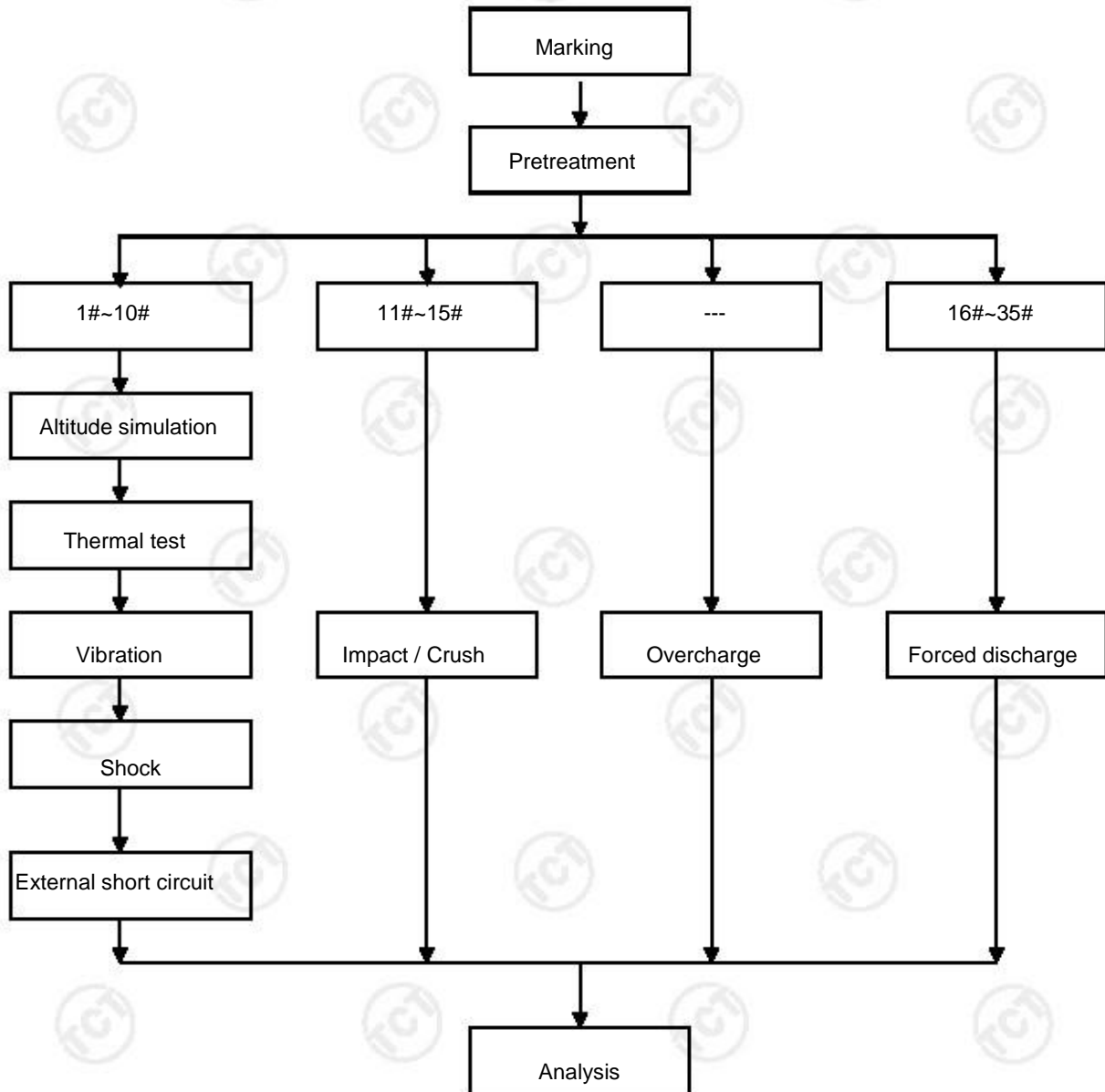
Each cell shall be forced discharged at ambient temperature by connecting it in series with a 12V D.C. power supply at an initial current equal to the maximum discharge current specified by the manufacturer.

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	2016. 03. 03
			2017. 03. 02
TC-104	Vacuum chamber (for battery test)	GX-3020-Z	2016. 03. 03
			2017. 03. 02
TC-109	Temperature circulation chamber	BE-TH-150M8-4	2016. 03. 03
			2017. 03. 02
TC-113	Vibration test instrument	ES-3-150	2016. 03. 03
			2017. 03. 02
TC-114	Shock test instrument	SY10-2	2016. 03. 03
			2017. 03. 02
TC-110	Battery short circuit test instrument	BE-1000W	2016. 03. 03
			2017. 03. 02
TC-111	Impact test instrument	BE-5066	2016. 03. 03
			2017. 03. 02
TC-112	Crush test instrument	BE-6045T	2016. 03. 03
			2017. 03. 02
TC-009	DC regulated power supply	GPR-3060D	2016. 03. 03
			2017. 03. 02
TC-108	Battery anti-explosion chamber	GX-100	2016. 03. 03
			2017. 03. 02
TC-103	Electronic Balance	PTT-A+300	2016. 03. 03
			2017. 03. 02
TC-001	Digital multimeter	15B	2016. 03. 03
			2017. 03. 02
TC-026	Data acquisition unit	34970A	2016. 03. 03
			2017. 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#	94.123	4.19	94.123	4.18	0.00	99.8	Pass
	2#	94.058	4.19	94.054	4.19	0.00	100.0	Pass
	3#	94.576	4.18	94.571	4.18	0.01	100.0	Pass
	4#	94.347	4.19	94.347	4.18	0.00	99.8	Pass
	5#	94.219	4.18	94.219	4.18	0.00	100.0	Pass
	6#	94.695	4.19	94.694	4.18	0.00	99.8	Pass
	7#	94.573	4.19	94.568	4.18	0.01	99.8	Pass
	8#	94.627	4.18	94.627	4.18	0.00	100.0	Pass
	9#	94.185	4.19	94.185	4.18	0.00	99.8	Pass
	10#	94.397	4.19	94.395	4.19	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#	94.123	4.18	94.084	4.14	0.04	99.0	Pass
	2#	94.054	4.19	94.008	4.15	0.05	99.0	Pass
	3#	94.571	4.18	94.527	4.15	0.05	99.3	Pass
	4#	94.347	4.18	94.291	4.14	0.06	99.0	Pass
	5#	94.219	4.18	94.175	4.14	0.05	99.0	Pass
	6#	94.694	4.18	94.645	4.14	0.05	99.0	Pass
	7#	94.568	4.18	94.523	4.15	0.05	99.3	Pass
	8#	94.627	4.18	94.583	4.14	0.05	99.0	Pass
	9#	94.185	4.18	94.143	4.14	0.04	99.0	Pass
	10#	94.395	4.19	94.354	4.15	0.04	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#	94.084	4.14	94.084	4.13	0.00	99.8	Pass
	2#	94.008	4.15	94.007	4.14	0.00	99.8	Pass
	3#	94.527	4.15	94.522	4.14	0.01	99.8	Pass
	4#	94.291	4.14	94.291	4.14	0.00	100.0	Pass
	5#	94.175	4.14	94.170	4.14	0.01	100.0	Pass
	6#	94.645	4.14	94.645	4.13	0.00	99.8	Pass
	7#	94.523	4.15	94.523	4.14	0.00	99.8	Pass
	8#	94.583	4.14	94.583	4.14	0.00	100.0	Pass
	9#	94.143	4.14	94.138	4.13	0.01	99.8	Pass
	10#	94.354	4.15	94.354	4.14	0.00	99.8	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#	94.084	4.13	94.083	4.13	0.00	100.0	Pass
	2#	94.007	4.14	94.007	4.13	0.00	99.8	Pass
	3#	94.522	4.14	94.517	4.13	0.01	99.8	Pass
	4#	94.291	4.14	94.291	4.13	0.00	99.8	Pass
	5#	94.170	4.14	94.170	4.13	0.00	99.8	Pass
	6#	94.645	4.13	94.640	4.13	0.01	100.0	Pass
	7#	94.523	4.14	94.523	4.13	0.00	99.8	Pass
	8#	94.583	4.14	94.583	4.13	0.00	99.8	Pass
	9#	94.138	4.13	94.133	4.13	0.01	100.0	Pass
	10#	94.354	4.14	94.354	4.13	0.00	99.8	Pass

5) External short circuit

The state of cells	No.	External Peak temperature(°C)	Status
Full charged after one cycle	1#	96.5	Pass
	2#	98.4	Pass
	3#	96.7	Pass
	4#	89.1	Pass
	5#	86.5	Pass
	6#	97.4	Pass
	7#	94.6	Pass
	8#	93.8	Pass
	9#	93.4	Pass
	10#	95.6	Pass

6) Impact

The state of cells	No.	External Peak temperature(°C)	Status
50% charged after one cycle	11#	26.3	Pass
	12#	25.9	Pass
	13#	26.4	Pass
	14#	26.5	Pass
	15#	25.8	Pass

7) Overcharge  
(Not Applicable)

8) Forced discharge

The state of cells	No.	Status
Full discharged after one cycle	16#	Pass
	17#	Pass
	18#	Pass
	19#	Pass
	20#	Pass
	21#	Pass
	22#	Pass
	23#	Pass
	24#	Pass
	25#	Pass
Full discharged after fifty cycles	26#	Pass
	27#	Pass
	28#	Pass
	29#	Pass
	30#	Pass
	31#	Pass
	32#	Pass
	33#	Pass
	34#	Pass
	35#	Pass

**VIII、CONCLUSION**

No.	Test item	Sample number	Test reference	Conclusion
1	Altitude simulation	1#~10#	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	11#~15#	UN Manual of Test and Criteria, part III, subsection 38.3.4.6	Pass
7	Overcharge	-	UN Manual of Test and Criteria, part III, subsection 38.3.4.7	Not Applicable
8	Forced discharge	16#~35#	UN Manual of Test and Criteria, part III, subsection 38.3.4.8	Pass

The submitted 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: ITR26650-4000mAh



Photo 1 Over view

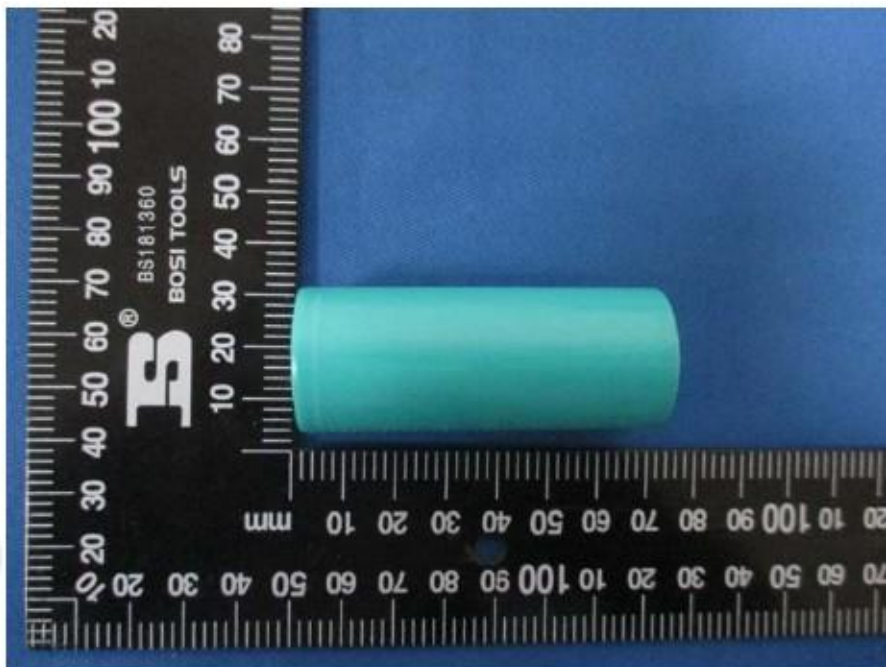


Photo 2 Over view



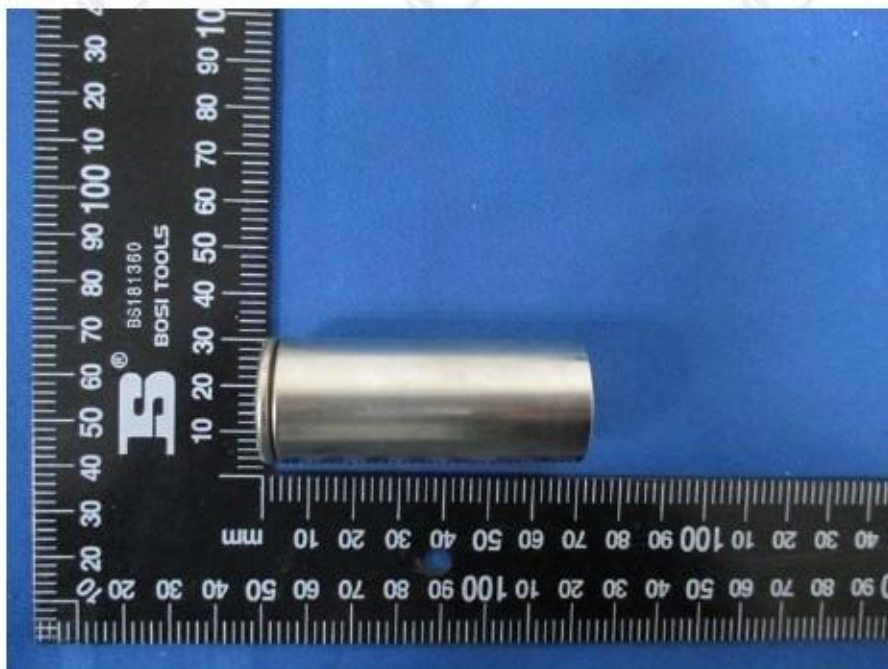


Photo 3 Internal Cell

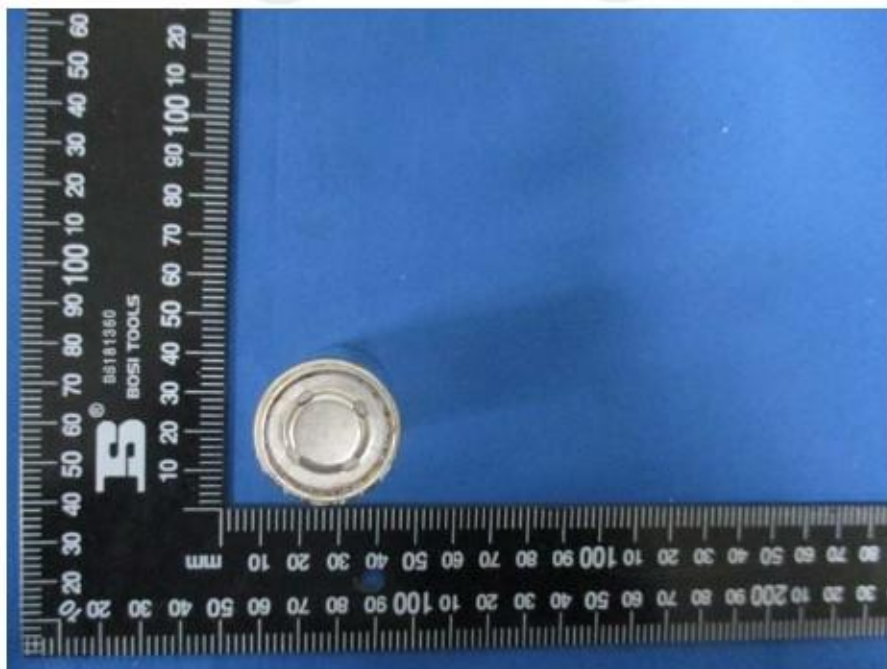


Photo 4 Internal Cell

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