Lithium Metal Battery UN38.3 Test Report

Prepared For :	Wuhan Fanso Technology Co., Ltd. Rd.5, Sitai Industrial Park, Yongfeng Avenue, Hanyang District, Wuhan China
Samples Name:	Lithium metal battery
Model :	ER34615M
Prepared By :	Shenzhen TCT Testing Technology Co., Ltd. 1F, Building 1, Yibaolai Industrial Park, Qiaotou Village, Fuyong Town, Baoan District, Shenzhen, Guangdong
Report No.:	TCT161220B032
Issued Date:	Feb. 21, 2017
Conclusion:	Shown in the results of test report

Tested by: Evan Chen

Inspected by:

Approved by: Sunny zhang

Approval Date: 2017. 02. 21

Ⅰ、SAMPLE DESCRIPTION

Product Name	Lithium metal battery		Battery Type	ER34615M	
Manufacturer	Wuhan Fanso Technology Co., Ltd.				
Address	Rd.5, Sitai Industrial Park, Yongfeng Avenue, Hanyang District, Wuhan China				
Trade Mark	FANSO	Shape	Cylindrical	Size (H×D)	(60.0×32.7)mm
Nominal Voltage	3.6V	Rated Capacity	14000mAh	Limited Charge Voltage	-
Charge Current	-	Maximum Continuous Charge Current	-	End Charge Current	-
Cut-off Voltage	-	Standard Discharge Current	-	Maximum Discharge Current	-
Cell Number	1PCS	Lithium content	4.2g	Cell Model	---
Date of Receipt	May 17, 2016		Date of Test	Jun. 02, 2016	

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.

Cells of 1#~10# are ten cells in undischarged states;

Cells of 11#~20# are ten cells in fully discharged states;

Cells of 21#~25# are five cells in undischarged states;

Cells of 26#~30# are five cells in fully discharged states;

Cells of 31#~40# are ten cells in fully discharged states;

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.

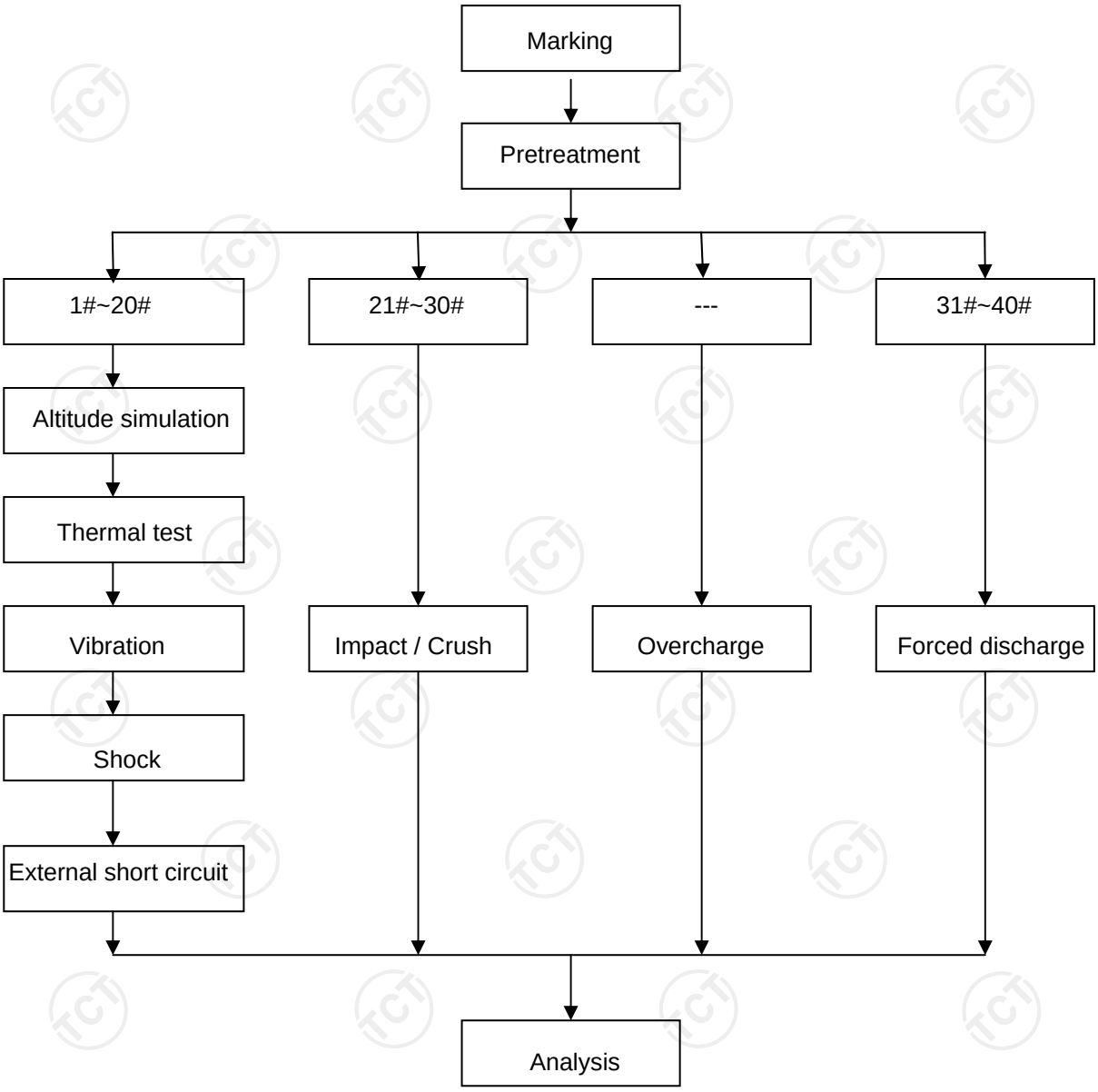
8. Forced discharge

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-B01	Vacuum chamber (for battery test)	GX-3020-Z	2016. 04. 26
			2017. 04. 25
TC-B04	Shock test instrument	SY10-2	2016. 04. 26
			2017. 04. 25
TC-B05	Vibration test instrument	ES-3-150	2016. 04. 26
			2017. 04. 25
TC-B07	Rechargeable battery test system	CTS-20V/10A-GGS	2016. 04. 26
			2017. 04. 25
TC-B10	Temperature circulation chamber	BE-TH-150M8-4	2016. 04. 26
			2017. 04. 25
TC-B12	Crush test instrument	BE-6045T	2016. 04. 26
			2017. 04. 25
TC-B13	Battery short circuit test instrument	BE-1000W	2016. 04. 26
			2017. 04. 25
TC-B14	Electronic Balance	PTT-A+300	2016. 04. 26
			2017. 04. 25
TC-B15	Data acquisition unit	34970A	2016. 04. 26
			2017. 04. 25
TC-B18	DC regulated power supply	PSW 80-27	2016. 04. 26
			2017. 04. 25
TC-B21	Impact test instrument	BE-5066	2016. 04. 26
			2017. 04. 25
TC-B24	Digital Multimeter	15B	2016. 04. 26
			2017. 04. 25
TC-B25	Battery anti-explosion chamber	GX-100	2016. 04. 26
			2017. 04. 25

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)			
ten cells in undischarged states	1#	94.987	3.493	94.971	3.481	0.02	99.7	Pass
	2#	95.068	3.496	95.061	3.483	0.01	99.6	Pass
	3#	94.874	3.498	94.854	3.481	0.02	99.5	Pass
	4#	94.906	3.495	94.901	3.481	0.01	99.6	Pass
	5#	95.017	3.497	95.002	3.485	0.02	99.7	Pass
	6#	95.026	3.494	95.013	3.487	0.01	99.8	Pass
	7#	94.905	3.496	94.884	3.482	0.02	99.6	Pass
	8#	94.938	3.492	94.932	3.481	0.01	99.7	Pass
	9#	95.034	3.495	95.018	3.481	0.02	99.6	Pass
	10#	95.057	3.495	95.047	3.487	0.01	99.8	Pass
ten cells in fully discharged states	11#	94.985	-	94.975	-	0.01	-	Pass
	12#	95.066	-	95.046	-	0.02	-	Pass
	13#	95.024	-	95.004	-	0.02	-	Pass
	14#	95.037	-	95.027	-	0.01	-	Pass
	15#	95.017	-	95.003	-	0.01	-	Pass
	16#	95.024	-	95.014	-	0.01	-	Pass
	17#	94.901	-	94.891	-	0.01	-	Pass
	18#	94.935	-	94.915	-	0.02	-	Pass
	19#	94.871	-	94.851	-	0.02	-	Pass
	20#	94.903	-	94.893	-	0.01	-	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)			
ten cells in undischarged states	1#	94.971	3.481	94.931	3.461	0.04	99.4	Pass
	2#	95.061	3.483	95.031	3.453	0.03	99.1	Pass
	3#	94.854	3.481	94.824	3.461	0.03	99.4	Pass
	4#	94.901	3.481	94.851	3.451	0.05	99.1	Pass
	5#	95.002	3.485	94.972	3.465	0.03	99.4	Pass
	6#	95.013	3.487	94.983	3.457	0.03	99.1	Pass
	7#	94.884	3.482	94.844	3.442	0.04	98.9	Pass
	8#	94.932	3.481	94.902	3.451	0.03	99.1	Pass
	9#	95.018	3.481	94.988	3.461	0.03	99.4	Pass
	10#	95.047	3.487	94.998	3.457	0.05	99.1	Pass
ten cells in fully discharged states	11#	94.975	-	94.945	-	0.03	-	Pass
	12#	95.046	-	94.995	-	0.05	-	Pass
	13#	95.004	-	94.974	-	0.03	-	Pass
	14#	95.027	-	94.994	-	0.03	-	Pass
	15#	95.003	-	94.964	-	0.04	-	Pass
	16#	95.014	-	94.974	-	0.04	-	Pass
	17#	94.891	-	94.851	-	0.04	-	Pass
	18#	94.915	-	94.891	-	0.03	-	Pass
	19#	94.851	-	94.801	-	0.05	-	Pass
	20#	94.893	-	94.863	-	0.03	-	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)			
ten cells in undischarged states	1#	94.931	3.461	94.921	3.451	0.01	99.7	Pass
	2#	95.031	3.453	95.008	3.443	0.02	99.7	Pass
	3#	94.824	3.461	94.814	3.441	0.01	99.4	Pass
	4#	94.851	3.451	94.831	3.441	0.02	99.7	Pass
	5#	94.972	3.465	94.962	3.445	0.01	99.4	Pass
	6#	94.983	3.457	94.973	3.447	0.01	99.7	Pass
	7#	94.844	3.442	94.824	3.432	0.02	99.7	Pass
	8#	94.902	3.451	94.892	3.431	0.01	99.4	Pass
	9#	94.988	3.461	94.978	3.451	0.01	99.7	Pass
	10#	94.998	3.457	94.988	3.447	0.01	99.7	Pass
ten cells in fully discharged states	11#	94.945	-	94.935	-	0.01	-	Pass
	12#	94.995	-	94.985	-	0.01	-	Pass
	13#	94.974	-	94.964	-	0.01	-	Pass
	14#	94.994	-	94.974	-	0.02	-	Pass
	15#	94.964	-	94.954	-	0.01	-	Pass
	16#	94.974	-	94.964	-	0.01	-	Pass
	17#	94.851	-	94.841	-	0.01	-	Pass
	18#	94.891	-	94.871	-	0.02	-	Pass
	19#	94.801	-	94.791	-	0.01	-	Pass
	20#	94.863	-	94.853	-	0.01	-	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)			
ten cells in undischarged states	1#	94.921	3.451	94.911	3.441	0.01	99.7	Pass
	2#	95.008	3.443	95.001	3.433	0.01	99.7	Pass
	3#	94.814	3.441	94.804	3.434	0.01	99.8	Pass
	4#	94.831	3.441	94.823	3.432	0.01	99.7	Pass
	5#	94.962	3.445	94.955	3.437	0.01	99.8	Pass
	6#	94.973	3.447	94.953	3.431	0.02	99.5	Pass
	7#	94.824	3.432	94.817	3.422	0.01	99.7	Pass
	8#	94.892	3.431	94.882	3.421	0.01	99.7	Pass
	9#	94.978	3.451	94.968	3.441	0.01	99.7	Pass
	10#	94.988	3.447	94.968	3.439	0.02	99.8	Pass
ten cells in fully discharged states	11#	94.935	-	94.925	-	0.01	-	Pass
	12#	94.985	-	94.978	-	0.01	-	Pass
	13#	94.964	-	94.959	-	0.01	-	Pass
	14#	94.974	-	94.967	-	0.01	-	Pass
	15#	94.954	-	94.946	-	0.01	-	Pass
	16#	94.964	-	94.955	-	0.01	-	Pass
	17#	94.841	-	94.831	-	0.01	-	Pass
	18#	94.871	-	94.861	-	0.01	-	Pass
	19#	94.791	-	94.771	-	0.02	-	Pass
	20#	94.853	-	94.843	-	0.01	-	Pass

5) External short circuit

The state of cells	No.	External Peak temperature(℃)	Status
ten cells in undischarged states	1#	68.4	Pass
	2#	69.3	Pass
	3#	67.8	Pass
	4#	65.5	Pass
	5#	70.5	Pass
	6#	68.5	Pass
	7#	72.3	Pass
	8#	75.4	Pass
	9#	68.4	Pass
	10#	66.3	Pass
ten cells in fully discharged states	11#	26.4	Pass
	12#	26.9	Pass
	13#	28.2	Pass
	14#	27.1	Pass
	15#	28.6	Pass
	16#	26.5	Pass
	17#	28.4	Pass
	18#	27.5	Pass
	19#	25.6	Pass
	20#	27.6	Pass

6) Impact

The state of cells	No.	External Peak temperature(℃)	Status
five cells in undischarged states	21#	25.5	Pass
	22#	25.6	Pass
	23#	25.6	Pass
	24#	25.7	Pass
	25#	25.2	Pass
five cells in fully discharged states	26#	25.8	Pass
	27#	25.2	Pass
	28#	25.6	Pass
	29#	25.4	Pass
	30#	25.5	Pass

7) Overcharge

（Not Applicable）

8) Forced discharge

The state of cells	No.	Status
ten cells in fully discharged states	31#	Pass
	32#	Pass
	33#	Pass
	34#	Pass
	35#	Pass
	36#	Pass
	37#	Pass
	38#	Pass
	39#	Pass
	40#	Pass

Ⅷ、CONCLUSION

No.	Test item	Sample number	Test reference	Conclusion
1	Altitude simulation	1#~20#	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	21#~30#	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	31#~40#	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: ER34615M

Photo 1 Over view

Photo 2 Over view

******End of Report 报告结束******