

UN38.3 Test Report

Client	SHENZHEN LIDEA BATTERY CO., LTD.
Add. of Client	3/F, NO.5 Bidg, Houhai Xufa Tech Park, Loucun, GongMing Town Guangming New District, Shenzhen, China.
Name of Sample	3.0V Lithium-Manganese Dioxide Button Cell
Model	CR1220
Testing Laboratory	Shenzhen TCT Testing Technology Co., Ltd. 1B/F., Building 1, Yibaolai Industrial Park, Qiaotou, Fuyong, Baoan District, Shenzhen, Guangdong, China
Report No.	TCT201214B200
Report Versions	V6.0
Date of Issue	2020. 12. 17
Test Conclusion:	The test results are qualified.

Tested by: Carry WangApproved by: TomsinInspected by: Amy Zeng

Seal of TCT: _____



I、Sample Description

Name of Sample	3.0V Lithium-Manganese Dioxide Button Cell		Model	CR1220	
Manufacturer	SHENZHEN LIDEA BATTERY CO., LTD.				
Address	3/F, NO.5 Bidg, Houhai Xufa Tech Park, Loucun, GongMing Town Guangming New District, Shenzhen, China.				
Trade Mark	LIDEV	Shape	Button	Size (D×T)	(12.4×2.0)mm
Nominal Voltage	3.0V	Rated Capacity	40mAh	Limited Charge Voltage	-
Standard Charge Current	-	Maximum Charge Current	-	End Charge Current	-
Discharge Cut-off Voltage	2.0V	Standard Discharge Current	-	Maximum Discharge Current	-
Cells Number	1PCS	Lithium content	0.012g	Cell Model	CR1220
Start Testing Date	Jul. 15, 2015		Completing Date	Jul. 29, 2015	

II、Standard

Recommendations on the Transport of Dangerous Goods, Manual of Test and Criteria (ST/SG/AC.10/11/Rev.6) Sixth revised edition.

III、Test Item

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

IV、Test Method and Requirement

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. 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;

Test environment condition: ambient temperature: 20 ± 5 °C.

Table 38.3.1: Mass loss limit

Mass M of cell or battery	Mass loss limit
$M < 1 \text{ g}$	0.5%
$1 \text{ g} \leq M \leq 75 \text{ g}$	0.2%
$M > 75 \text{ g}$	0.1%

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

$$\text{Mass loss (\%)} = (M_1 - M_2)/M_1 \times 100$$

Where M_1 is the mass before the test and M_2 is the mass after the test. When mass loss does not exceed the values in Table 38.3.1, it shall be considered as "no mass loss".

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 38.3.1.

Venting means the release of excessive internal pressure from a cell or battery in a manner intended by design to preclude rupture or disassembly.

Disassembly means a vent or rupture where solid matter from any part of a cell or battery penetrates a wire mesh screen (annealed aluminium wire with a diameter of 0.25 mm and grid density of 6 to 7 wires per cm) placed 25 cm away from the cell or battery.

Rupture means the mechanical failure of a cell container or battery case induced by an internal or external cause, resulting in exposure or spillage but not ejection of solid materials.

Fire means that flames are emitted from the test cell or battery.

T.1. Altitude simulation

Test procedure

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).

Requirement

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.

T.2. Thermal test

Test procedure

Test Cells and batteries are to be stored for at least six hours at a test temperature equal to $72 \pm 2^\circ\text{C}$, followed by storage for at least six hours at a test temperature equal to $-40 \pm 2^\circ\text{C}$. 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 ($20 \pm 5^\circ\text{C}$). For large cells and batteries the duration of exposure to the test temperature extremes should be at least 12 hours.

Requirement

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.

T.3. Vibration

Test procedure

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.

Requirement

Cells and batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire during the test and after the test 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.

T.4. Shock

Test procedure

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 shall be subjected to a half-sine shock of peak acceleration of $150 g_n$ and pulse duration of 6 milliseconds. Alternatively, large cells may be subjected to a half-sine shock of peak acceleration of $50 g_n$ and pulse duration of 11 milliseconds.

Each battery shall be subjected to a half-sine shock of peak acceleration depending on the mass of the battery. The pulse duration shall be 6 milliseconds for small batteries and 11 milliseconds for large batteries. The formulas below are provided to calculate the appropriate minimum peak accelerations.

Each cell or battery shall be subjected to three shocks in the positive direction and to three shocks in the negative direction in each of three mutually perpendicular mounting positions of the cell or battery for a total of 18 shocks.

Requirement

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.

Battery	Minimum peak acceleration	Pulse duration
Small batteries	150 g _n or result of formula $\text{Acceleration}(g_n) = \sqrt{\left(\frac{100850}{\text{mass}^*}\right)}$ whichever is smaller	6 ms
Large batteries	50 g _n or result of formula $\text{Acceleration}(g_n) = \sqrt{\left(\frac{30000}{\text{mass}^*}\right)}$ whichever is smaller	11 ms

* Mass is expressed in kilograms.

T.5. External short circuit

Test procedure

The cell or battery to be tested shall be heated for a period of time necessary to reach a homogeneous stabilized temperature of 57 ± 4 °C, measured on the external case. This period of time depends on the size and design of the cell or battery and should be assessed and documented. If this assessment is not feasible, the exposure time shall be at least 6 hours for small cells and small batteries, and 12 hours for large cells and large batteries. Then the cell or battery at 57 ± 4 °C shall be subjected to one short circuit condition with a total external resistance of less than 0.1 ohm.

This short circuit condition is continued for at least one hour after the cell or battery external case temperature has returned to 57 ± 4 °C, or in the case of the large batteries, has decreased by half of the maximum temperature increase observed during the test and remains below that value.

The short circuit and cooling down phases shall be conducted at least at ambient temperature.

Requirement

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.

T.6. Impact / Crush

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

The test sample cell or component cell is to be placed on a flat smooth surface. A 15.8 mm $\pm$ 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 $\pm$ 0.1 kg mass is to be dropped from a height of 61 $\pm$ 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 $\pm$ 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 $13 \text{ kN} \pm 0.78 \text{ kN}$;
- (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.

Requirement

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.

T.7. Overcharge

Test procedure

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 18 V, the minimum voltage of the test shall be the lesser of two times the maximum charge voltage of the battery or 22 V.
- (b) When the manufacturer's recommended charge voltage is more than 18 V, 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.

Requirement

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

T.8. Forced discharge

Test procedure

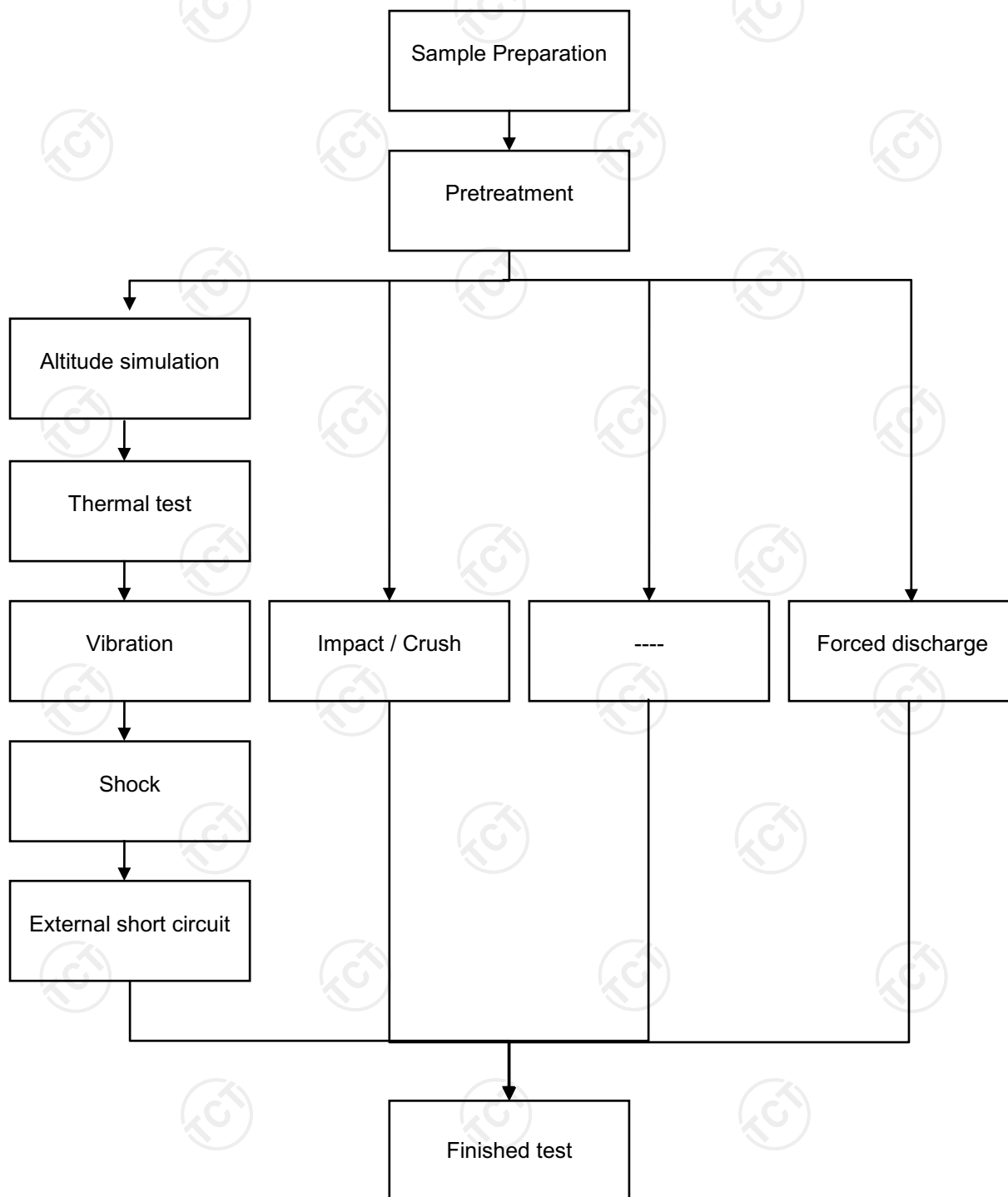
Each cell shall be forced discharged at ambient temperature by connecting it in series with a 12 V D.C. power supply at an initial current equal to the maximum discharge current specified by the manufacturer.

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 is forced discharged for a time interval (in hours) equal to its rated capacity divided by the initial test current (in ampere).

Requirement

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	Low Altitude Simulation Tester	GX-3020-Z	2015. 04. 26
			2016. 04. 25
TC-B04	Vertical Shock Test Instrument	SY10-2	2015. 04. 26
			2016. 04. 25
TC-B05	Vibration test instrument	ES-3-150	2015. 04. 26
			2016. 04. 25
TC-B07	Battery Test System	CTS 20V/10A	2015. 04. 26
			2016. 04. 25
TC-B10	Programmable Temp.& Humi. Chamber	BE-TH-150M8-4	2015. 04. 26
			2016. 04. 25
TC-B11	Crush Test Instrument	BE-6045T	2015. 04. 26
			2016. 04. 25
TC-B13	Battery Short Circuit Tester	GX-6055-B	2015. 04. 26
			2016. 04. 25
TC-B14	Electronic Balance	PTT-A+300	2015. 04. 26
			2016. 04. 25
TC-B15	Data Collector	34970A	2015. 04. 26
			2016. 04. 25
TC-B18	DC POWER	PSW 80-27	2015. 04. 26
			2016. 04. 25
TC-B21	Battery Impact Tester	BE-5066	2015. 04. 26
			2016. 04. 25
TC-B25	Digital Multimeter	15B	2015. 04. 26
			2016. 04. 25
TC-B29	Battery Short Circuit Explosion-proof	BE-1000W	2015. 04. 26
			2016. 04. 25

VII、DATA

T.1. Altitude simulation

Test sample status	No.	Pre-test		After test		Mass loss (%)	Change ratio (%)	Status
		Mass (g)	Voltage (V)	Mass (g)	Voltage (V)			
ten cells in undischarged states	1#	0.738	3.27	0.737	3.26	0.14	99.7	Pass
	2#	0.740	3.29	0.740	3.27	0.00	99.4	Pass
	3#	0.742	3.35	0.742	3.35	0.00	100.0	Pass
	4#	0.739	3.24	0.739	3.23	0.00	99.7	Pass
	5#	0.734	3.26	0.734	3.26	0.00	100.0	Pass
	6#	0.736	3.34	0.735	3.33	0.14	99.7	Pass
	7#	0.738	3.28	0.738	3.27	0.00	99.7	Pass
	8#	0.737	3.35	0.737	3.35	0.00	100.0	Pass
	9#	0.741	3.35	0.741	3.33	0.00	99.4	Pass
	10#	0.739	3.36	0.739	3.35	0.00	99.7	Pass
ten cells in fully discharged states	11#	0.728	-	0.727	-	0.14	-	Pass
	12#	0.736	-	0.736	-	0.00	-	Pass
	13#	0.743	-	0.743	-	0.00	-	Pass
	14#	0.724	-	0.724	-	0.00	-	Pass
	15#	0.716	-	0.716	-	0.00	-	Pass
	16#	0.735	-	0.735	-	0.00	-	Pass
	17#	0.741	-	0.741	-	0.00	-	Pass
	18#	0.739	-	0.738	-	0.14	-	Pass
	19#	0.743	-	0.743	-	0.00	-	Pass
	20#	0.728	-	0.728	-	0.00	-	Pass

Notes: Ambient temperature: 23.5 °C.

After the test, there is no leakage, no venting, no disassembly, no rupture and no fire. And change ratio is not less than 90 %.

T.2. Thermal test

Test sample status	No.	Pre-test		After test		Mass loss (%)	Change ratio (%)	Status
		Mass (g)	Voltage (V)	Mass (g)	Voltage (V)			
ten cells in undischarged states	1#	0.737	3.26	0.736	3.26	0.14	99.4	Pass
	2#	0.740	3.27	0.739	3.27	0.14	99.4	Pass
	3#	0.742	3.35	0.741	3.35	0.14	99.7	Pass
	4#	0.739	3.23	0.738	3.23	0.14	99.7	Pass
	5#	0.734	3.26	0.733	3.26	0.14	99.1	Pass
	6#	0.735	3.33	0.733	3.33	0.27	99.7	Pass
	7#	0.738	3.27	0.737	3.27	0.14	99.4	Pass
	8#	0.737	3.35	0.736	3.35	0.14	99.4	Pass
	9#	0.741	3.33	0.740	3.33	0.14	99.4	Pass
	10#	0.739	3.35	0.738	3.35	0.14	99.1	Pass
ten cells in fully discharged states	11#	0.727	-	0.726	-	0.14	-	Pass
	12#	0.736	-	0.734	-	0.27	-	Pass
	13#	0.743	-	0.742	-	0.14	-	Pass
	14#	0.724	-	0.723	-	0.14	-	Pass
	15#	0.716	-	0.714	-	0.27	-	Pass
	16#	0.735	-	0.734	-	0.14	-	Pass
	17#	0.741	-	0.740	-	0.14	-	Pass
	18#	0.738	-	0.737	-	0.14	-	Pass
	19#	0.743	-	0.742	-	0.14	-	Pass
	20#	0.728	-	0.727	-	0.14	-	Pass

Notes: Ambient temperature: 23.2 °C.

After the test, there is no leakage, no venting, no disassembly, no rupture and no fire. And change ratio is not less than 90 %.

T.3. Vibration

Test sample status	No.	Pre-test		After test		Mass loss (%)	Change ratio (%)	Status
		Mass (g)	Voltage (V)	Mass (g)	Voltage (V)			
ten cells in undischarged states	1#	0.736	3.26	0.736	3.26	0.00	100.0	Pass
	2#	0.739	3.27	0.739	3.26	0.00	100.0	Pass
	3#	0.741	3.35	0.741	3.35	0.00	99.7	Pass
	4#	0.738	3.23	0.737	3.23	0.14	100.0	Pass
	5#	0.733	3.26	0.733	3.26	0.00	100.0	Pass
	6#	0.733	3.33	0.733	3.33	0.00	100.0	Pass
	7#	0.737	3.27	0.737	3.27	0.00	100.0	Pass
	8#	0.736	3.35	0.735	3.35	0.14	100.0	Pass
	9#	0.740	3.33	0.740	3.33	0.00	100.0	Pass
	10#	0.738	3.35	0.738	3.35	0.00	99.7	Pass
ten cells in fully discharged states	11#	0.726	-	0.726	-	0.00	-	Pass
	12#	0.734	-	0.734	-	0.00	-	Pass
	13#	0.742	-	0.742	-	0.00	-	Pass
	14#	0.723	-	0.723	-	0.00	-	Pass
	15#	0.714	-	0.713	-	0.14	-	Pass
	16#	0.734	-	0.734	-	0.00	-	Pass
	17#	0.740	-	0.740	-	0.00	-	Pass
	18#	0.737	-	0.737	-	0.00	-	Pass
	19#	0.742	-	0.741	-	0.14	-	Pass
	20#	0.727	-	0.727	-	0.00	-	Pass

Notes: Ambient temperature: 23.5 °C.

After the test, there is no leakage, no venting, no disassembly, no rupture and no fire. And change ratio is not less than 90 %.

T.4. Shock

Test sample status	No.	Pre-test		After test		Mass loss (%)	Change ratio (%)	Status
		Mass (g)	Voltage (V)	Mass (g)	Voltage (V)			
ten cells in undischarged states	1#	0.736	3.26	0.736	3.26	0.00	100.0	Pass
	2#	0.739	3.26	0.739	3.26	0.00	100.0	Pass
	3#	0.741	3.35	0.741	3.35	0.00	99.7	Pass
	4#	0.737	3.23	0.736	3.23	0.14	100.0	Pass
	5#	0.733	3.26	0.733	3.26	0.00	100.0	Pass
	6#	0.733	3.33	0.733	3.33	0.00	100.0	Pass
	7#	0.737	3.27	0.737	3.27	0.00	100.0	Pass
	8#	0.735	3.35	0.734	3.35	0.14	99.7	Pass
	9#	0.740	3.33	0.740	3.33	0.00	100.0	Pass
	10#	0.738	3.35	0.738	3.35	0.00	100.0	Pass
ten cells in fully discharged states	11#	0.726	-	0.725	-	0.14	-	Pass
	12#	0.734	-	0.734	-	0.00	-	Pass
	13#	0.742	-	0.742	-	0.00	-	Pass
	14#	0.723	-	0.722	-	0.14	-	Pass
	15#	0.713	-	0.713	-	0.00	-	Pass
	16#	0.734	-	0.733	-	0.14	-	Pass
	17#	0.740	-	0.740	-	0.00	-	Pass
	18#	0.737	-	0.737	-	0.00	-	Pass
	19#	0.741	-	0.740	-	0.14	-	Pass
	20#	0.727	-	0.727	-	0.00	-	Pass

Notes: Ambient temperature: 23.6 °C.

After the test, there is no leakage, no venting, no disassembly, no rupture and no fire. And change ratio is not less than 90 %.

T.5. External short circuit

Test sample status	No.	External Peak temperature(°C)	Status
ten cells in undischarged states	1#	68.6	Pass
	2#	69.4	Pass
	3#	67.7	Pass
	4#	71.5	Pass
	5#	75.3	Pass
	6#	68.4	Pass
	7#	72.3	Pass
	8#	75.0	Pass
	9#	68.4	Pass
	10#	66.3	Pass
ten cells in fully discharged states	11#	67.4	Pass
	12#	66.8	Pass
	13#	68.2	Pass
	14#	67.0	Pass
	15#	68.6	Pass
	16#	66.5	Pass
	17#	68.4	Pass
	18#	67.3	Pass
	19#	73.6	Pass
	20#	67.5	Pass

Notes: Ambient temperature: 23.8 °C.

Test sample 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.

T.6. Crush

Test sample status	No.	External Peak temperature(°C)	Status
five cells in undischarged states	21#	25.8	Pass
	22#	25.6	Pass
	23#	25.7	Pass
	24#	25.8	Pass
	25#	25.9	Pass
five cells in fully discharged states	26#	25.8	Pass
	27#	25.6	Pass
	28#	25.7	Pass
	29#	25.4	Pass
	30#	25.8	Pass

Notes: Ambient temperature: 23.4 °C.

Test sample 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.

T.7. Overcharge

(Not Applicable)

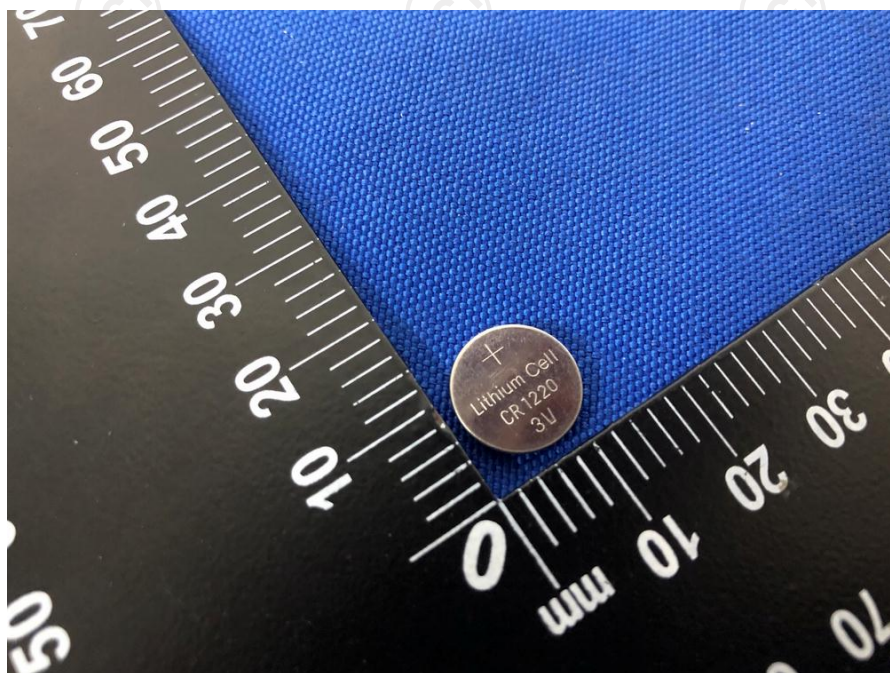
T.8. Forced discharge

Test sample status	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

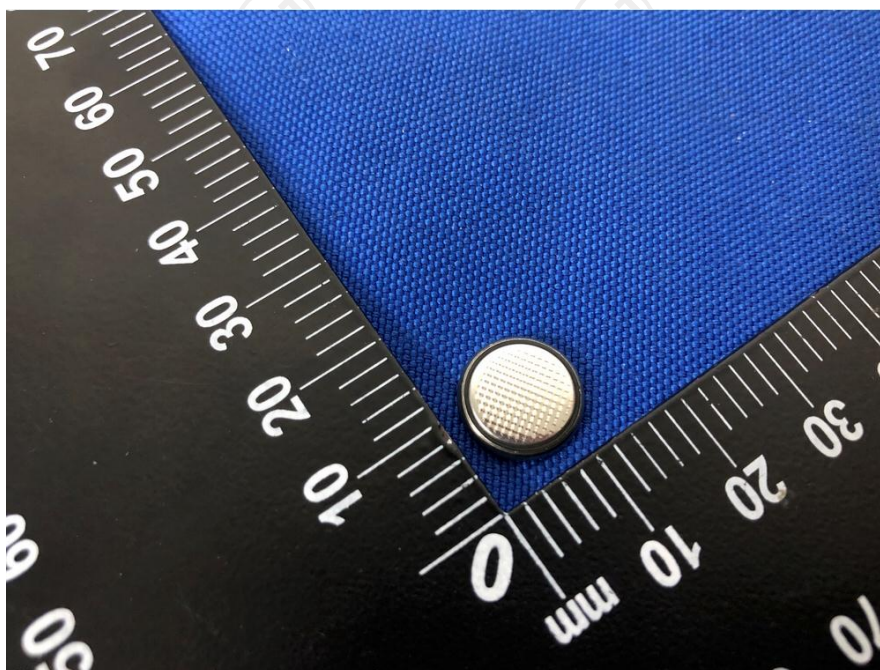
Notes: Ambient temperature: 23.3 °C.

There is no disassembly and no fire during the test and within seven days after the test.

VIII、Picture of the sample 样品图片



Picture 1. Cell view



Picture 2. Cell view

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

Important Notice

1. The test report is invalid without the official stamp of TCT.
2. Nobody is allowed to photocopy or partly photocopy this test report without written permission of TCT.
3. The test report is invalid without the signatures of Ratifier, Reviewer and Testing engineer.
4. The report is invalid when anything of following happens – illegal transfer, reproduce, embezzlement, imposture, modification or tampering in any media form.
5. Objections to the test report must be submitted to TCT within 15 days.
6. The test report is valid for the tested samples only.
7. This report belongs to quote for the record, the reference test report TCT190505B051