



UN38.3 Test Report

UN38.3 检测报告

Applicant's name 委托方名称	
Applicant's Address 委托方地址	
Name of Sample 样品名称	Li-ion Battery 锂离子电池
Model 型号	802030
Testing Laboratory 测试实验室	Shenzhen TCT Testing Technology Co., Ltd. 深圳市通测检测技术有限公司 2101 & 2201, Zhenchang Factory, Renshan Industrial Zone, Fuhai Subdistrict, Bao'an District, Shenzhen, Guangdong, China 广东省深圳市宝安区福海街道桥头社区稔山工业区振昌胶粘制品厂 2101、2201
Report No. 报告编号	TCT220425B004
Date of Issue 签发日期	2022. 04. 26
Test Conclusion 测试结论: The test results are qualified. 测试结果为合格。	

Tested by 主检人: Cherry Huang 黄姝玲

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Seal of TCT 报告单位 (盖章):



I、Sample Description 样品描述

Name of Sample 样品名称	Li-ion Battery 锂离子电池	Model 型号	802030		
Manufacturer's name 制造商名称					
Manufacturer's Address 制造商地址					
Manufacturer's Contact Telephone 制造商联系电话					
Trade Mark 商标	----	Shape 形状	Prismatic 棱柱形	Size 尺寸 (L×W×T)	(32.2×20.0×8.0)mm
Nominal Voltage 标称电压	3.7V	Rated Capacity 额定容量	400mAh 1.48Wh	Charge Voltage 充电电压	4.2V
Nominal Charge Current 标称充电电流	80mA	Maximum Charge Current 最大充电电流	400mA	End of Charge Current 结束充电电流	4mA
Discharge Cut-off Voltage 放电截止电压	3.0V	Nominal Discharge Current 标称放电电流	80mA	Maximum Discharge Current 最大放电电流	400mA
Cell Model 电池型号	802030	Cell Nominal Voltage 电池标称电压	3.7V	Cell Rated Capacity 电池额定容量	400mAh
Cells Number 电池数量	1PC	Sample Receiving Date 样品接收日期	2020. 04. 02	Testing Date 测试日期	2020. 04. 02 — 2020. 04. 15

II、Test Standard 检测标准

UNITED NATIONS "Recommendations on the TRANSPORT OF DANGEROUS GOODS Manual of Tests and Criteria" Sixth revised edition Amendment 1 (ST/SG/AC.10/11/Rev.6/Amend.1)

联合国《关于危险货物运输的建议书 试验和标准手册》第六修订版修正 1 (ST/SG/AC.10/11/Rev.6/Amend.1)

III、Test Item 测试项目

- | | |
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| T.1. <input checked="" type="checkbox"/> Altitude simulation 高度模拟 | T.5. <input checked="" type="checkbox"/> External short circuit 外部短路 |
| T.2. <input checked="" type="checkbox"/> Thermal test 温度试验 | T.6. <input type="checkbox"/> Impact / <input checked="" type="checkbox"/> Crush 撞击/挤压 |
| T.3. <input checked="" type="checkbox"/> Vibration 振动 | T.7. <input checked="" type="checkbox"/> Overcharge 过充电 |
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IV、Test Method and Requirement 测试方法和要求

T.1. Altitude simulation 高度模拟

Purpose 目的

This test simulates air transport under low-pressure conditions.

本试验模拟在低压条件下的空运。

Test procedure 测试程序

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).

试验电池和电池组应在压力等于或低于 11.6 千帕和环境温度 (20 ± 5 °C) 下存放至少 6 小时。

Requirement 要求

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.

如果无渗漏、无排气、无解体、无破裂和无起火，并且每个试验电池或电池组在试验后的开路电压不小于其在进行这一试验前电压的 90%，电池和电池组即符合这一要求。有关电压的要求不适用于完全放电状态的试验电池和电池组。

T.2. Thermal test 温度试验

Purpose 目的

This test assesses cell and battery seal integrity and internal electrical connections. The test is conducted using rapid and extreme temperature changes.

本试验评估电池和电池组的密封完善性和内部电连接。试验利用迅速和极端的温度变化进行。

Test procedure 测试程序

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.

试验电池和电池组应先在试验温度等于 72 ± 2 °C 的条件下存放至少 6 小时，接着再在试验温度等于 -40 ± 2 °C 的条件下存放至少 6 小时。两个极端试验温度之间的最大时间间隔为 30 分钟。此程序重复进行，共完成 10 次，接着将所有试验电池和电池组在环境温度 (20 ± 5 °C) 下存放 24 小时。对于大型电池和电池组，暴露于极端试验温度的时间至少应为 12 小时。

Requirement 要求

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.

如果无渗漏、无排气、无解体、无破裂和无起火，并且每个试验电池或电池组在试验后的开路电压不小于其在进行这一试验前电压的 90%，电池和电池组即符合这一要求。有关电压的要求不适用于完全放电状态的试验电池和电池组。

T.3. Vibration 振动

Purpose 目的

This test simulates vibration during transport.

本试验模拟运输过程中的振动。

Test procedure 测试程序

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 gn 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 gn occurs (approximately 50 Hz). A peak acceleration of 8 gn is then maintained until the frequency is increased to 200 Hz.

For large batteries: from 7 Hz to a peak acceleration of 1 gn 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 gn occurs (approximately 25 Hz). A peak acceleration of 2 gn is then maintained until the frequency is increased to 200 Hz.

电池和电池组紧固于振动机平台，但紧固程度不能造成电池变形以致不能准确传递振动。振动应是正弦波形，对数频率扫描从 7 赫兹到 200 赫兹，再回到 7 赫兹，跨度为 15 分钟。这一振动过程须对三个互相垂直的电池安装方位的每一方向重复进行 12 次，总共为时 3 小时。其中一个振动方向必须与端面垂直。

作对数式频率扫描，对总质量不足 12 千克的电池和电池组(电池和小型电池组)，和对 12 千克及更大的电池组(大型电池组)应有所不同。

对电池和小型电池组：从 7 赫兹开始，保持 1 gn 的最大加速度，直到频率达到 18 赫兹。然后将振幅保持在 0.8 毫米(总偏移 1.6 毫米)，并增加频率直到最大加速度达到 8 gn(频率约为 50 赫兹)。将最大加速度保持在 8 gn 直到频率增加到 200 赫兹。

对大型电池组：从 7 赫兹开始，保持 1 gn 的最大加速度，直到频率达到 18 赫兹。然后将振幅保持在 0.8 毫米(总偏移 1.6 毫米)，并增加频率直到最大加速度达到 2 gn(频率约为 25 赫兹)。将最大加速度保持在 2 gn 直到频率增加到 200 赫兹。

Requirement 要求

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 directly after testing in its third perpendicular mounting position 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.

如果试验中和试验后无渗漏、无排气、无解体、无破裂和无起火，并且每个试验电池或电池组在第三个垂直安装方位上的试验后立即测得的开路电压不小于在进行这一试验前电压的 90%，电池和电池组即符合本项要求。有关电压的要求不适用于完全放电状态的试验电池和电池组。

T.4. Shock 冲击

Purpose 目的

This test assesses the robustness of cells and batteries against cumulative shocks.

本试验评估电池和电池组对累积冲击效应的耐受程度。

Test procedure 测试程序

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 gn and pulse duration of 6 milliseconds. Alternatively, large cells may be subjected to a half-sine shock of peak acceleration of 50 gn 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.

试验电池和电池组用坚固支架紧固在试验机上，支架支撑着每个试验电池组的所有安装面。

每个电池须经受最大加速度 150 gn 和脉冲持续时间 6 毫秒的半正弦波冲击。不过，大型电池须经受最大加速度 50 gn 和脉冲持续时间 11 毫秒的半正弦波冲击。

每个电池须经受的正弦波冲击的最大加速度取决于电池组的质量。小型电池组的脉冲持续时间 6 毫秒，大型电池组的脉冲持续时间 11 毫秒。以下公式用于计算合适的最低限度最大加速度。

每个电池或电池组须在三个互相垂直的电池或电池组安装方位的正极方向经受三次冲击，接着在负极方向经受三次冲击，总共经受 18 次冲击。

The formulas below are provided to calculate the appropriate minimum peak accelerations. 以下公式用于计算合适的最低限度最大加速度。

Battery 电池组	Minimum peak acceleration 最低限度最大加速度	Pulse duration 脉冲持续时间
Small batteries 小型电池组	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 大型电池组	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.

*质量用千克表示

Requirement 要求

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.

如果无渗漏、无排气、无解体、无破裂和无起火，并且每个试验电池或电池组在试验后的开路电压不小于其在进行这一试验前电压的 90%，电池和电池组即符合这一要求。有关电压的要求不适用于完全放电状态的试验电池和电池组。

T.5. External short circuit 外部短路

Purpose 目的

This test simulates an external short circuit.

本试验模拟外部短路。

Test procedure 测试程序

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.

对于待试电池或电池组，应加温一段必要的时间，使从外壳测量的温度达到均匀的稳定温度 57 ± 4 °C。这段时间的长短取决于电池或电池组的大小和设计，对于这个持续时间应加以评估和记录。如无法进行这种评估，则小型电池和小型电池组的暴露时间应至少 6 小时，大型电池和大型电池组的暴露时间应至少 12 小时。然后，电池或电池组应在 57 ± 4 °C 条件下经受总外电阻小于 0.1 欧姆的短路条件。这一短路条件应在电池或电池组外壳温度回到 57 ± 4 °C 后继续至少 1 小时，或在大型电池组的情况下外壳温度降幅达试验中所观察到的最高温升幅的二分之一并保持低于该数值。

短路和降温阶段的温度应至少相当于环境温度。

Requirement 要求

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.

如果外壳温度不超过 170°C，并且在试验过程中及试验后 6 小时内无解体、无破裂，无起火，电池和电池组即符合本项要求。

T.6. Impact / Crush 撞击/挤压

Purpose 目的

These tests simulate mechanical abuse from an impact or crush that may result in an internal short circuit.

本节的试验模拟撞击或挤压等可能造成内部短路的机械性破坏。

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

测试程序 – 撞击（适用于直径不小于 18.0 毫米的圆柱形电池）

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.

试样电池或元件电池放在平坦光滑的表面上。一根 316 型不锈钢棒横放在试样中心，钢棒直径 15.8 毫米 \pm 0.1 毫米，长度至少 6 厘米，或电池最长端的尺寸，取二者之长者。将一块 9.1 千克 \pm 0.1 千克的重锤从 61 \pm 2.5 厘米高处跌落到钢棒和试样交叉处，使用一个几乎没有摩擦的、对落体重锤阻力最小的垂直轨道或管道加以控制。垂直轨道或管道用于引导落锤沿与水平支撑表面呈 90 度落下。

接受撞击的试样，纵轴应与平坦表面平行并与横放在试样中心的直径 15.8 \pm 0.1 毫米弯曲表面的纵轴垂直。每一试样只经受一次撞击。

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

测试程序 – 挤压（适用于棱柱形、袋状、硬币/纽扣电池和直径小于 18.0 毫米的圆柱形电池）

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.

- The applied force reaches 13 kN \pm 0.78 kN;
- The voltage of the cell drops by at least 100 mV; or
- 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.

将电池或元件电池放在两个平面之间挤压，挤压力度逐渐加大，在第一个接触点上的速度大约为 1.5 厘米/秒。挤压持续进行，直到出现以下三种情况之一：

- (a)施加的力量达到 13 千牛顿 \pm 0.78 千牛顿；
- (b)电池的电压下降至少 100 毫伏；或
- (c)电池形变达原始厚度的 50%或以上。

一旦达到最大压力、电压下降 100 毫伏或更多，或电池变形至少达原厚度的 50%，即可解除压力。

棱柱形或袋状电池应从最宽的一面施压。纽扣/硬币形电池应从其平坦表面施压。圆柱形电池应从与纵轴垂直的方向施压。

每个试样电池或元件电池只做一次挤压试验。试样应继续观察 6 小时。试验应使用之前未做过其他试验的电池或元件电池进行。

Requirement 要求

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.

如果外壳温度不超过 170 °C，并且在试验过程中及试验后 6 小时内无解体、无破裂，无起火，电池和电池组即符合本项要求。

T.7. Overcharge 过充电

Purpose 目的

This test evaluates the ability of a rechargeable battery or a single cell rechargeable battery to withstand an overcharge condition.

本试验评估可再充电电池组或可再充电单一电池电池组承受过度充电状况的能力。

Test procedure 测试程序

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.

充电电流必须是制造商建议的最大持续充电电流的两倍。试验的最小电压如下：

(a)制造商建议的充电电压不大于 18 伏时，试验的最小电压应是电池组最大充电电压的两倍或 22 伏两者中的较小者。

(b)制造商建议的充电电压大于 18 伏时，试验的最小电压应是最大充电电压的 1.2 倍。

试验应在环境温度下进行。进行试验的时间应为 24 小时。

Requirement 要求

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

充电电池组在试验过程中和试验后 7 天内无解体、无起火，即符合本项要求。

T.8. Forced discharge 强制放电

Purpose 目的

This test evaluates the ability of a primary or a rechargeable cell to withstand a forced discharge condition.

本试验评估原电池或充电电池承受强制放电状况的能力。

Test procedure 测试程序

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

每个电池应在环境温度下与 12 伏直流电源串联在起始电流等于制造商给定的最大放电电流的条件下强制放电。

将适当大小和额定值的电阻负荷与试验电池串联，计算得出给定的放电电流。对每个电池进行强制放电，放电时间(小时)应等于其额定容量除以初始试验电流(安培)。

Requirement 要求

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.

原电池或充电电池如在试验过程中和试验后 7 天内无解体，无起火，即符合本项要求。

V、General terms and definitions 一般术语与定义

Table 38.3.1: Mass loss limit

表 38.3.1: 质量损失限值

Mass M of cell or battery 电池或电池组质量 M	Mass loss limit 质量损失限值
M < 1 g	0.5%
1 g ≤ M ≤ 75 g	0.2%
M > 75 g	0.1%

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

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

质量损失的量化值，可用以下公式计算：

$$\text{质量损失(\%)} = (M_1 - M_2) / M_1 \times 100$$

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 38.3.1, it shall be considered as "no mass loss".

式中：M1 是试验前的质量，M2 是试验后的质量。如果质量损失不超过表 38.3.1 所列的数值，应视为“无质量损失”。

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.

渗漏是指可以看到的电解液或者其他物质从电池或电池组中漏出，或电池或电池组中的物质损失（不包括电池外壳、搬运装置、或标签），质量损失超过表 38.3.1 所列的数值。

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

排气是指按设计方式释放电池或电池组内部过高的压力，防止其破裂或解体。

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.

解体是指排气或破裂使电池或电池组任何部分的固体物质穿过放在离电池或电池 25 cm 处的丝网筛（直径 0.25 mm 的软铝丝，网格密度每厘米 6 至 7 条铝丝）。

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.

破裂是指内部或外部原因引起的电池容器或电池组外壳机械损坏，造成内装物暴露或溢出，但无固体喷射。

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

起火是指试验电池或电池组有火焰冒出。

VI、Main Test Apparatus 主要测试仪器

Serial No. 设备编号	Name of Equipment 设备名称	Model 型号	Calibration Date /Due Date 校准日期/到期日
TC-B01	Low Altitude Simulation Tester 低压高空模拟试验箱	GX-3020-Z	2019. 04. 16
			2020. 04. 15
TC-B04	Vertical Shock Test Instrument 垂直冲击试验台	SY10-2	2019. 09. 06
			2020. 09. 05
TC-B05	Vibration test instrument 振动试验台	ES-3-150	2019. 04. 16
			2020. 04. 15
TC-B07	Battery Test System 电池测试系统	CTS 20V/10A	2019. 04. 17
			2020. 04. 16
TC-B11	Crush Test Instrument 温控型电池挤压试验机	BE-6045T	2019. 04. 16
			2020. 04. 15
TC-B13	Battery Short Circuit Tester 电池短路试验机	GX-6055-B	2019. 04. 17
			2020. 04. 16
TC-B14	Electronic Balance 电子天平	PTT-A+300	2019. 04. 16
			2020. 04. 15
TC-B15	Data Collector 数据采集器	34970A	2019. 04. 16
			2020. 04. 15
TC-B18	DC POWER 直流源	PSW 80-27	2019. 04. 16
			2020. 04. 15
TC-B21	Battery Impact Tester 电池冲击试验机	BE-5066	2019. 04. 16
			2020. 04. 15
TC-B25	Digital Multimeter 数字万用表	15B	2019. 09. 06
			2020. 09. 05
TC-B30	Programmable high & low temperature test chamber 可编程式高低温试验机	GX-3000-150	2019. 09. 06
			2020. 09. 05

VII、Test Data 测试数据

T.1. Altitude simulation 高度模拟

Test sample status 测试样品状态	No. 编号	Pre-test 试验前		After test 试验后		Mass loss 质量损失 (%)	Change ratio 电压比(%)	Status 结果
		Mass 质量 (g)	Voltage 电压 (V)	Mass 质量 (g)	Voltage 电压 (V)			
first cycle, fully charged state 首次循环满电状态	1#	8.703	4.18	8.703	4.18	0.00	100.0	Pass 合格
	2#	8.833	4.18	8.833	4.18	0.00	100.0	Pass 合格
	3#	8.802	4.18	8.801	4.18	0.01	100.0	Pass 合格
	4#	8.793	4.18	8.793	4.17	0.00	99.8	Pass 合格
	5#	8.873	4.19	8.873	4.19	0.00	100.0	Pass 合格
25th cycle, fully charged state 25次循环满电状态	6#	8.826	4.18	8.826	4.18	0.00	100.0	Pass 合格
	7#	8.805	4.19	8.805	4.19	0.00	100.0	Pass 合格
	8#	8.817	4.18	8.817	4.18	0.00	100.0	Pass 合格
	9#	8.785	4.19	8.784	4.18	0.01	99.8	Pass 合格
	10#	8.732	4.19	8.732	4.19	0.00	100.0	Pass 合格

Notes 注释: Ambient temperature 环境温度: 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 %. 测试后, 样品无渗漏、无排气、无解体、无破裂和无起火。电压比不小于 90 %。

T.2. Thermal test 温度试验

Test sample status 测试样品状态	No. 编号	Pre-test 试验前		After test 试验后		Mass loss 质量损失 (%)	Change ratio 电压比(%)	Status 结果
		Mass 质量 (g)	Voltage 电压 (V)	Mass 质量 (g)	Voltage 电压 (V)			
first cycle, fully charged state 首次循环满电状态	1#	8.703	4.18	8.698	4.14	0.06	99.0	Pass 合格
	2#	8.833	4.18	8.828	4.15	0.06	99.3	Pass 合格
	3#	8.801	4.18	8.797	4.14	0.05	99.0	Pass 合格
	4#	8.793	4.17	8.788	4.14	0.06	99.3	Pass 合格
	5#	8.873	4.19	8.869	4.15	0.05	99.0	Pass 合格
25th cycle, fully charged state 25次循环满电状态	6#	8.826	4.18	8.823	4.15	0.03	99.3	Pass 合格
	7#	8.805	4.19	8.802	4.15	0.03	99.0	Pass 合格
	8#	8.817	4.18	8.812	4.15	0.06	99.3	Pass 合格
	9#	8.784	4.18	8.781	4.14	0.03	99.0	Pass 合格
	10#	8.732	4.19	8.728	4.15	0.05	99.0	Pass 合格

Notes 注释: Ambient temperature 环境温度: 23.4 °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 %. 测试后, 样品无渗漏、无排气、无解体、无破裂和无起火。电压比不小于 90 %。

T.3. Vibration 振动

Test sample status 测试样品状态	No. 编号	Pre-test 试验前		After test 试验后		Mass loss 质量损失 (%)	Change ratio 电压比(%)	Status 结果
		Mass 质量 (g)	Voltage 电压 (V)	Mass 质量 (g)	Voltage 电压 (V)			
first cycle, fully charged state 首次循环满电状态	1#	8.698	4.14	8.698	4.14	0.00	100.0	Pass 合格
	2#	8.828	4.15	8.827	4.15	0.01	100.0	Pass 合格
	3#	8.797	4.14	8.797	4.14	0.00	100.0	Pass 合格
	4#	8.788	4.14	8.788	4.14	0.00	100.0	Pass 合格
	5#	8.869	4.15	8.869	4.14	0.00	99.8	Pass 合格
25th cycle, fully charged state 25次循环满电状态	6#	8.823	4.15	8.823	4.15	0.00	100.0	Pass 合格
	7#	8.802	4.15	8.801	4.15	0.01	100.0	Pass 合格
	8#	8.812	4.15	8.812	4.15	0.00	100.0	Pass 合格
	9#	8.781	4.14	8.781	4.14	0.00	100.0	Pass 合格
	10#	8.728	4.15	8.728	4.14	0.00	99.8	Pass 合格

Notes 注释: Ambient temperature 环境温度: 23.3 °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 %. 测试后, 样品无渗漏、无排气、无解体、无破裂和无起火。电压比不小于 90 %。

T.4. Shock 冲击

Test sample status 测试样品状态	No. 编号	Pre-test 试验前		After test 试验后		Mass loss 质量损失 (%)	Change ratio 电压比(%)	Status 结果
		Mass 质量 (g)	Voltage 电压 (V)	Mass 质量 (g)	Voltage 电压 (V)			
first cycle, fully charged state 首次循环满电状态	1#	8.698	4.14	8.698	4.14	0.00	100.0	Pass 合格
	2#	8.827	4.15	8.827	4.15	0.00	100.0	Pass 合格
	3#	8.797	4.14	8.796	4.14	0.01	100.0	Pass 合格
	4#	8.788	4.14	8.788	4.14	0.00	100.0	Pass 合格
	5#	8.869	4.14	8.869	4.14	0.00	100.0	Pass 合格
25th cycle, fully charged state 25次循环满电状态	6#	8.823	4.15	8.822	4.14	0.01	99.8	Pass 合格
	7#	8.801	4.15	8.801	4.15	0.00	100.0	Pass 合格
	8#	8.812	4.15	8.812	4.14	0.00	99.8	Pass 合格
	9#	8.781	4.14	8.781	4.14	0.00	100.0	Pass 合格
	10#	8.728	4.14	8.728	4.14	0.00	100.0	Pass 合格

Notes 注释: Ambient temperature 环境温度: 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 %. 测试后, 样品无渗漏、无排气、无解体、无破裂和无起火。电压比不小于 90 %。

T.5. External short circuit 外部短路

Test sample status 测试样品状态	No. 编号	Maximum external temperature (°C) 表面最高温度(°C)	Status 结果
first cycle, fully charged state 首次循环满电状态	1#	57.3	Pass 合格
	2#	57.4	Pass 合格
	3#	57.3	Pass 合格
	4#	57.4	Pass 合格
	5#	57.6	Pass 合格
25th cycle, fully charged state 25次循环满电状态	6#	57.6	Pass 合格
	7#	57.2	Pass 合格
	8#	57.1	Pass 合格
	9#	57.2	Pass 合格
	10#	57.4	Pass 合格

Notes 注释: Ambient temperature 环境温度: 23.3 °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.

测试样品表面温度不超过 170 °C，测试中与测试后 6 小时内无解体、无破裂、无起火。

T.6. Crush 挤压

Test sample status 测试样品状态	No. 编号	Maximum external temperature (°C) 表面最高温度(°C)	Status 结果
first cycle, 50% charged state 首次循环 50%充电状态	11#	23.6	Pass 合格
	12#	23.3	Pass 合格
	13#	23.2	Pass 合格
	14#	23.2	Pass 合格
	15#	23.5	Pass 合格
25th cycle, 50% charged state 25次循环 50%充电状态	16#	23.4	Pass 合格
	17#	23.3	Pass 合格
	18#	23.3	Pass 合格
	19#	23.2	Pass 合格
	20#	23.3	Pass 合格

Notes 注释: Ambient temperature 环境温度: 23.1 °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.

测试样品表面温度不超过 170 °C，测试中与测试后 6 小时内无解体、无破裂、无起火。

T.7. Overcharge 过充电

Test sample status 测试样品状态	No. 编号	Status 结果
first cycle, fully charged state 首次循环满电状态	21#	Pass 合格
	22#	Pass 合格
	23#	Pass 合格
	24#	Pass 合格
25th cycle, fully charged state 25 次循环满电状态	25#	Pass 合格
	26#	Pass 合格
	27#	Pass 合格
	28#	Pass 合格

Notes 注释: Ambient temperature 环境温度: 23.2 °C。

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

样品在测试中和测试后 7 天内无解体、无起火。

T.8. Forced discharge 强制放电

Test sample status 测试样品状态	No. 编号	Status 结果
first cycle, fully discharged state 首次循环完全放电状态	29#	Pass 合格
	30#	Pass 合格
	31#	Pass 合格
	32#	Pass 合格
	33#	Pass 合格
	34#	Pass 合格
	35#	Pass 合格
	36#	Pass 合格
	37#	Pass 合格
	38#	Pass 合格
25th cycle, fully discharged state 25 次循环完全放电状态	39#	Pass 合格
	40#	Pass 合格
	41#	Pass 合格
	42#	Pass 合格
	43#	Pass 合格
	44#	Pass 合格
	45#	Pass 合格
	46#	Pass 合格
	47#	Pass 合格
	48#	Pass 合格

Notes 注释: Ambient temperature 环境温度: 23.3 °C。

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

样品在测试中和测试后 7 天内无解体、无起火。

VIII、Conclusion 结论

No. 序号	Name of test items 测试项目名称	Cause number of standard 标准条款号	Test Result 检查结果	Conclusion 结论	Remark 备注
1	Altitude simulation 高空模拟	38.3 Test T.1 38.3 试验 T.1	See Appendix T.1. Altitude simulation 见附表 T.1. 高度模拟	Pass 合格	/
2	Thermal test 温度试验	38.3 Test T.2 38.3 试验 T.2	See Appendix T.2. Thermal test 见附表 T.2.温度试验	Pass 合格	/
3	Vibration 振动	38.3 Test T.3 38.3 试验 T.3	See Appendix T.3. Vibration 见附表 T.3.振动	Pass 合格	/
4	Shock 冲击	38.3 Test T.4 38.3 试验 T.4	See Appendix T.4. Shock 见附表 T.4.冲击	Pass 合格	/
5	External short circuit 外部短路	38.3 Test T.5 38.3 试验 T.5	See Appendix T.5. External short circuit 见附表 T.5.外部短路	Pass 合格	/
6	Crush 挤压	38.3 Test T.6 38.3 试验 T.6	See Appendix T.6. Crush 见附表 T.6.挤压	Pass 合格	/
7	Overcharge 过度充电	38.3 Test T.7 38.3 试验 T.7	See Appendix T.7. Overcharge 见附表 T.7.过充电	Pass 合格	/
8	Forced discharge 强制放电	38.3 Test T.8 38.3 试验 T.8	See Appendix T.8. Forced discharge 见附表 T.8.强制放电	Pass 合格	/

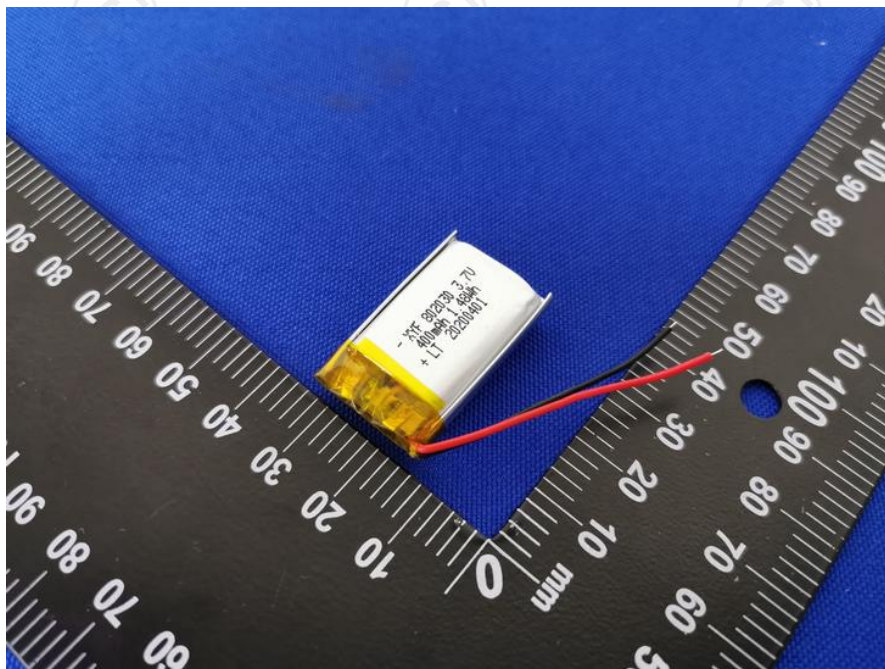
According to the standard:

依据标准:

UNITED NATIONS "Recommendations on the TRANSPORT OF DANGEROUS GOODS Manual of Tests and Criteria" Sixth revised edition Amendment 1 (ST/SG/AC.10/11/Rev.6/Amend.1).

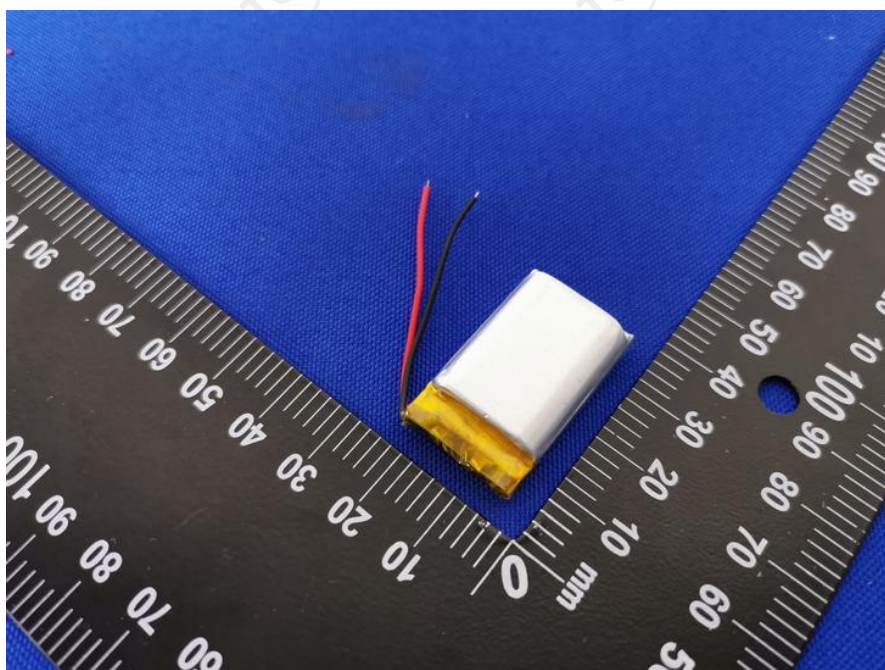
联合国《关于危险货物运输的建议书 试验和标准手册》第六修订版修正 1 (ST/SG/AC.10/11/Rev.6/Amend.1)。

IX、 Picture of the sample 样品图片



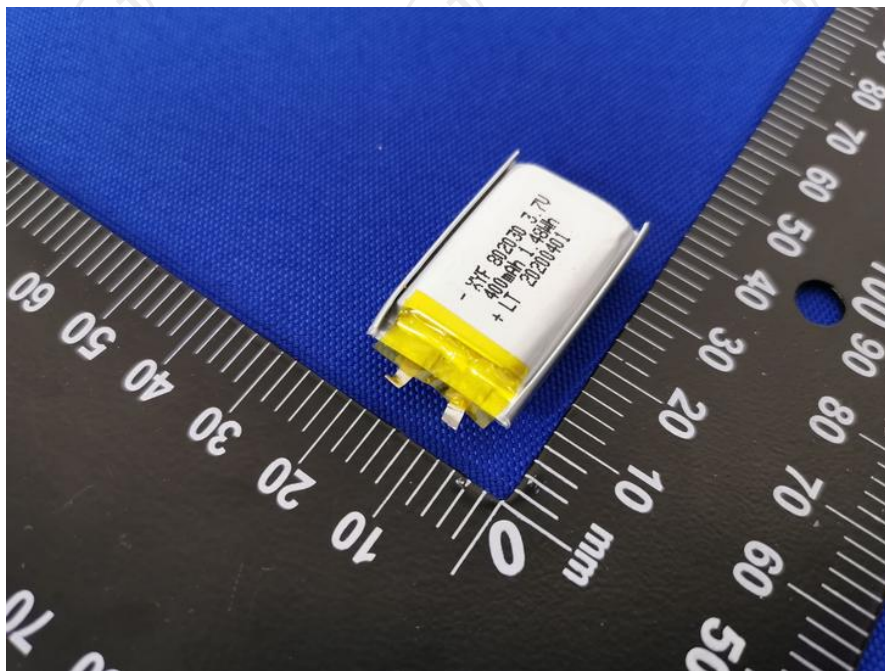
Picture 1. Battery view

图片 1. 电池组视图



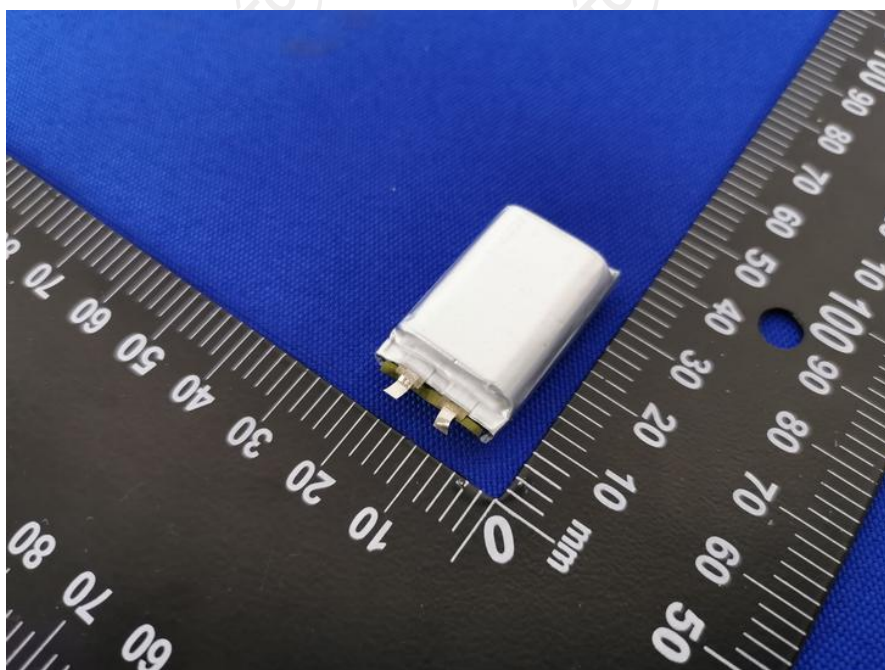
Picture 2. Battery view

图片 2. 电池组视图



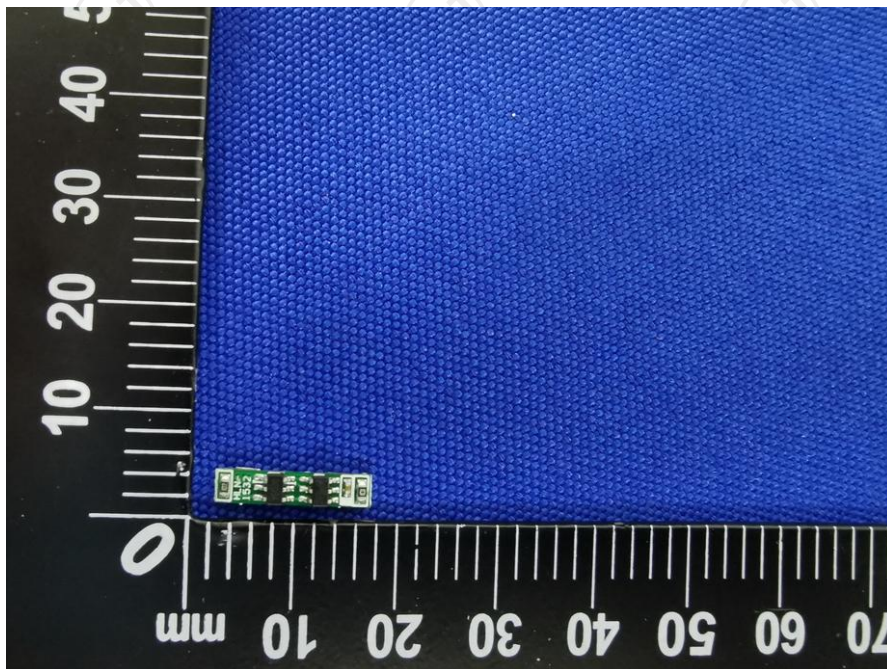
Picture 3. Cell view

图片 3. 电池视图



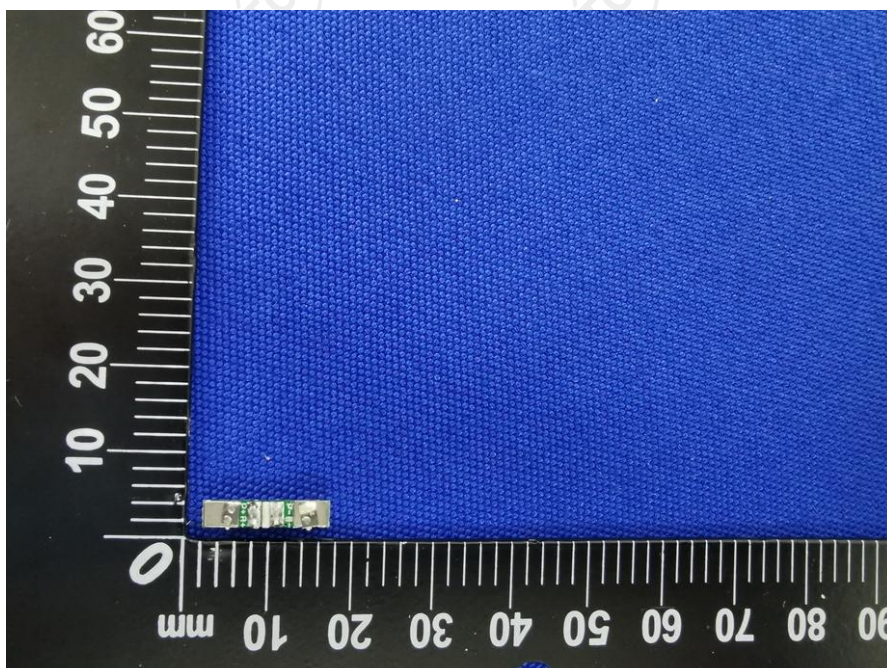
Picture 4. Cell view

图片 4. 电池视图



Picture 5. Protection board view

图片 5. 保护板视图



Picture 6. Protection board view

图片 6. 保护板视图

*****End of Report 报告结束*****

Important Notice

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7. The Chinese contents in this report are only for reference.
本报告中的中文内容仅供参考。



PONY

Pony Testing International Group

报告编号(Report ID): MPI83PTL733967U5



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检测
TESTING
CNAS L3192

UN38.3 测试报告 UN38.3 Test Report

样品名称及型号

锂锰扣式电池 型号: CR1620

Sample Name &
Model

Li-MnO₂ Button cell Model: CR1620

(3.0V 70mAh 合计锂含量/Aggregate lithium content: 0.018g)

委托单位

Applicant

生产单位

Manufacturer

P O N Y



谱尼测试
Pony Testing International Group

www.ponytest.com



No.: MPI83PTL733967U5

Code: it2gmutrj

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I、样品描述 Sample Description

样品名称 Sample name	锂锰扣式电池 Li-MnO ₂ Button cell	样品型号 Sample model	CR1620
委托单位 Applicant			
生产商 Manufacturer	名称 Name		
	地址 Address		
	电话 Tel.		
	邮箱 E-mail		
	网址 Website		
标称电压 Nominal voltage	3.0V	额定容量 Rated capacity	70mAh
充电电流 Charge current	---	最大连续充电电流 Maximum continuous charge current	---
充电限制电压 Limited charge voltage	---	充电截止电流 End charge current	---
放电终止电压 Discharge Cut-off voltage	2.0V	最大放电电流 Maximum discharge current	6mA
放电电流 Discharge current	0.2mA	质量 Mass	1.24g
电池芯生产厂家 Manufacturer of cell			
电池芯型号 Cell model	CR1620	电池芯个数 Cell number	1PCS
电池芯标称电压 Cell nominal voltage	3.0V	电池芯额定容量 Cell rated capacity	70mAh
委托日期 Entrust date	2021-12-01	完成日期 Finished date	2021-12-20

II、测试标准 Test Standard

《试验和标准手册》第七修订版第III部分 38.3 章节

Manual of Tests and Criteria (ST/SG/AC.10/11/Rev.7 Part III sub-section 38.3)

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III、测试项目及结论 Test Item & Conclusion

测试项目 Item	测试样品编号 Sample Number	结论 Conclusion
T.1 高度模拟 Altitude simulation	N1~N20	通过 PASS
T.2 温度试验 Thermal test		通过 PASS
T.3 振动 Vibration		通过 PASS
T.4 冲击 Shock		通过 PASS
T.5 外部短路 External short circuit		通过 PASS
T.6 挤压 Crush	N21~N30	通过 PASS
T.7 过度充电 Overcharge	---	不适用 Not applicable
T.8 强制放电 Forced discharge	N31~N40	通过 PASS

经测试, 该样品符合《试验和标准手册》(ST/SG/AC.10/11/Rev.7), 第 III 部分 38.3 章节要求。
The Samples has passed the test items of Manual of Tests and Criteria (ST/SG/AC.10/11/Rev.7), Part III sub-section 38.3.

说明 Notes

N1~N10; N21~N25 为未放电电池芯
Cells in undischarged states

N11~N20; N26~N40 为完全放电电池芯
Cells in fully discharged states

主检

Tested by:

审核

Checker by:

批准

Approver by:

签发日期 Issue date 2021-12-20

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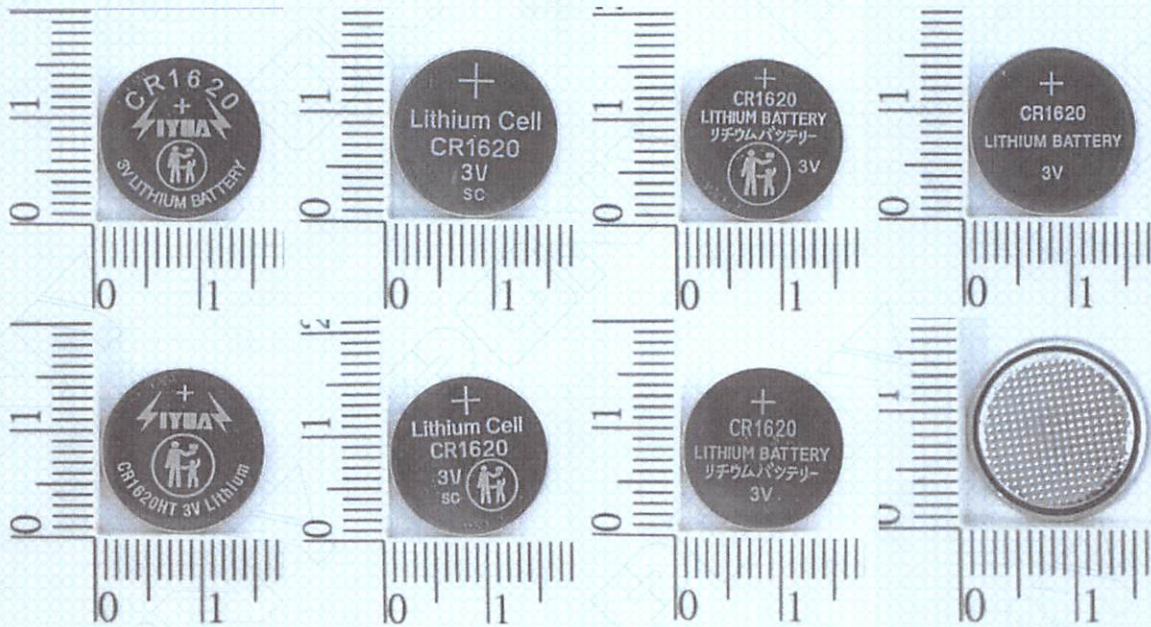
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IV、样品照片 Photo of The Sample

样品编号/Sample No.: L733967U5



仅对原报告照片中的样品负责

Authenticate the photo on original report only

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V、测试方法 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.

小型电池或电池组必须按顺序进行试验 T.1 至 T.5。试验 T.6 和 T.8 应使用未另外试验过的电池或电池组。试验 T.7 可以使用原先在试验 T.1 至 T.5 中使用过的未损坏电池组进行, 以便测试经过充放电的电池组。

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

质量损失依照下式计算:

Mass loss 质量损失 (%) = $(M_1 - M) / M_1 \times 100$

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 below, it shall be considered as “no mass loss”.

式中 M_1 是试验前的质量, M_2 是试验后的质量。如质量损失不超过下表所列数值, 即视为“无质量损失”。

Mass M of cell or battery 电池或电池组质量 M	Mass loss limit 质量损失限值
$M < 1g$	0.5%
$1g \leq M \leq 75g$	0.2%
$M > 75g$	0.1%

T.1 Altitude simulation 高度模拟

Test cells and batteries shall be stored at a pressure of 11.6kPa or less for at least six hours at ambient temperature ($20^\circ\text{C} \pm 5^\circ\text{C}$).

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.

试验电池和电池组应在压力等于或低于 11.6 千帕和环境温度 ($20^\circ\text{C} \pm 5^\circ\text{C}$) 下存放至少 6 小时。

要求电池和电池组无渗漏、无排气、无解体、无破裂和无起火, 并且每个试验电池或电池组在试验后的开路电压不小于其在进行这一试验前电压的 90%。有关电压的要求不适用于完全放电状态的试验电池和电池组。

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T.2 Thermal test 温度试验

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

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.

试验电池和电池组应先在试验温度等于 $72^{\circ}\text{C} \pm 2^{\circ}\text{C}$ 的条件下存放至少 6 小时, 接着再在试验温度等于 $-40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ 的条件下存放至少 6 小时。两个极端试验温度之间的最大时间间隔为 30 分钟。此程序重复进行, 共完成 10 次, 接着将所有试验电池和电池组在环境温度 ($20^{\circ}\text{C} \pm 5^{\circ}\text{C}$) 下存放 24 小时。对于大型电池和电池组, 暴露于极端试验温度的时间至少应为 12 小时。

要求电池和电池组无渗漏、无排气、无解体、无破裂和无起火, 并且每个试验电池或电池组在试验后的开路电压不小于其在进行这一试验前电压的 90%。有关电压的要求不适用于完全放电状态的试验电池和电池组。

T.3 Vibration 振动

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 7Hz and 200Hz and back to 7Hz 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 12kg (cells and small batteries), and for batteries with a gross mass of more than 12kg (large batteries).

For cells and small batteries: from 7Hz a peak acceleration of $1g_n$ is maintained until 18Hz is reached. The amplitude is then maintained at 0.8mm (1.6mm total excursion) and the frequency increased until a peak acceleration of $8g_n$ occurs (approximately 50Hz). A peak acceleration of $8g_n$ is then maintained until the frequency is increased to 200Hz.

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

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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 in its perpendicular mounting position 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.

电池和电池组紧固于振动机平台, 但不得造成电池变形, 并能准确可靠地传播振动。振动应是正弦波形, 对数扫描频率在 7 赫兹和 200 赫兹之间, 再回到 7 赫兹, 跨度为 15 分钟。这一振动过程须对三个互相垂直的电池安装方位的每一方向重复进行 12 次, 总共为时 3 小时。其中一个振动方向必须与端面垂直。

作对数式频率扫描, 对总质量不足 12 千克的电池和电池组 (电池和小型电池组), 和对 12 千克及更大的电池组 (大型电池组) 有所不同。

对电池和小型电池组: 从 7 赫兹开始, 保持 $1g_n$ 的最大加速度, 直到频率达到 18 赫兹。然后将振幅保持在 0.8 毫米 (总偏移 1.6 毫米), 并增加频率直到最大加速度达到 $8g_n$ (频率约为 50 赫兹)。将最大加速度保持在 $8g_n$ 直到频率增加到 200 赫兹。

对大型电池组: 从 7 赫兹开始, 保持 $1g_n$ 的最大加速度, 直到频率达到 18 赫兹。然后将振幅保持在 0.8 毫米 (总偏移 1.6 毫米), 并增加频率直到最大加速度达到 $2g_n$ (频率约为 25 赫兹)。将最大加速度保持在 $2g_n$ 直到频率增加到 200 赫兹。

要求电池和电池组试验中和试验后无渗漏、无排气、无解体、无破裂和无起火, 并且每个试验电池或电池组在第三个垂直安装方位上的试验后测得的开路电压不小于在进行这一试验前电压的 90%。有关电压的要求不适用于完全放电状态的试验电池和电池组。

T.4 Shock 冲击

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

试验电池和电池组用坚硬支架紧固在试验装置上, 支架支撑着每个试验电池组的所有安装面。

每个小型电池必须经受峰值加速度 $150g_n$ 和脉冲持续时间 6 毫秒的半正弦波冲击。针对大型电池必须经受最大加速度 $50g_n$ 和脉冲持续时间 11 毫秒的半正弦波冲击。

每个电池须经受的正弦波冲击的最低限度最大加速度依照下式计算。对于小型电池组的脉冲持续时间应为 6 毫秒, 对于大型电池组的脉冲持续时间应为 11 毫秒。



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Battery 电池组	Minimum peak acceleration 最小峰值加速度	Pulse duration 脉冲持续时间
Small batteries 小型电池组	150g _n or result of formula 150g _n 或公式计算结果 $\text{Acceleration 加速度 (g}_n\text{)} = \sqrt{\frac{100850}{\text{mass / 质量}^*}}$ Whichever is smaller 中的较小值	6ms
Large batteries 大型电池组	50g _n or result of formula 50g _n 或公式计算结果 $\text{Acceleration 加速度 (g}_n\text{)} = \sqrt{\frac{30000}{\text{mass / 质量}^*}}$ Whichever is smaller 中的较小值	11ms

* Mass is expressed in kilograms /质量单位用千克计算

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.

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.

每个电池或电池组须在三个互相垂直的安装方位的正方向经受三次冲击,接着在反方向经受三次冲击,总共经受18次冲击。

要求电池和电池组无渗漏、无排气、无解体、无破裂和无起火,并且每个试验电池或电池组在试验后的开路电压不小于其在进行这一试验前电压的90%。有关电压的要求不适用于完全放电状态的试验电池和电池组。

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T.5 External short circuit 外部短路

The cell or battery to be tested shall be heated for a period of time necessary to reach a homogeneous stabilized temperature of $57^{\circ}\text{C} \pm 4^{\circ}\text{C}$, 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 $57^{\circ}\text{C} \pm 4^{\circ}\text{C}$ 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 $57^{\circ}\text{C} \pm 4^{\circ}\text{C}$, 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.

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.

待测试的电池或电池组应加热一段必要时间,以从外壳测量的温度达到均匀稳定的 $57^{\circ}\text{C} \pm 4^{\circ}\text{C}$ 的温度,应对加热持续时间进行评估和记录;如果这种评估不可行,对于小型电池和小型电池组至少在 $57^{\circ}\text{C} \pm 4^{\circ}\text{C}$ 的环境下存放 6 小时,对于大型电池和大型电池组至少在 $57^{\circ}\text{C} \pm 4^{\circ}\text{C}$ 的环境下存放 12 小时。然后,电池或电池组在 $57^{\circ}\text{C} \pm 4^{\circ}\text{C}$ 的环境中,应接受一个外部总电阻小于 0.1 欧姆的短路条件。这一短路条件应在电池或电池组外壳温度回到 $57^{\circ}\text{C} \pm 4^{\circ}\text{C}$ 后继续至少 1 小时,或对于大型电池组其外壳温度降幅达试验中观察到最高温升幅的二分之一,并保持低于该值。进行短路和降温阶段试验的温度至少相当于环境温度。

要求电池和电池组外壳温度不超过 170°C ,并且在试验过程中及试验后 6 小时内无解体、无破裂、无起火。

T.6 Crush 挤压

Crush (applicable to prismatic, pouch, coin/button cells and cylindrical cells less 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.

- The applied force reaches $13 \text{ kN} \pm 0.78 \text{ kN}$;
- The voltage of the cell drops by at least 100 mV; or
- 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.



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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.

挤压（适用于棱柱形、袋装、硬币/纽扣电池和直径小于 18 毫米的圆柱形电池）

将电池或元件电池放在两个平面之间挤压，挤压力度逐渐加大，在第一个接触点上的速度大约为 1.5 厘米/秒。挤压持续进行，直到出现以下三种情况之一：

- 施加的力量达到 13 千牛± 0.78 千牛；
- 电池的电压下降至少 100 毫伏；或
- 电池变形达原始厚度的 50%或以上。

一旦达到最大压力、电压下降 100 毫伏或更多，或电池变形至少达原厚度的 50%，即可解除压力。

棱柱形或袋装电池应从最宽的一面施压。纽扣/硬币形电池应从其平坦表面施压。圆柱形电池应从与纵轴垂直的方向施压。

每个试样电池或元件电池只做一次挤压试验。试样应继续观察 6 小时。试验应使用之前未做过其他试验的电池或元件电池进行。

要求电池和电池组外壳温度不超过 170°C，并且在试验过程中及试验后 6 小时内无解体、无起火。

T.7 Overcharge 过度充电

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

- 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.
- 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.

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充电电流必须是制造商建议的最大持续充电电流的两倍。试验的最小电压如下:

(a) 制造商建议的充电电压不大于 18 伏时, 试验的最小电压应是电池组最大充电电压的两倍或 22 伏两者中的较小者;

(b) 制造商建议的充电电压大于 18 伏时, 试验的最小电压应为最大充电电压的 1.2 倍。

试验应在环境温度下进行, 进行试验的时间应为 24 小时。

要求充电电池组在试验过程中和试验后 7 天内无解体, 无起火。

T.8 Forced discharge 强制放电

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.

每个电池应在环境温度下与 12 伏直流电源串联在起始电流等于制造商给定的最大放电电流的条件下强制放电。

将适当大小和额定值的电阻负荷与试验电池串联, 计算得出给定的放电电流。对每个电池进行强制放电, 放电时间 (小时) 应等于其额定容量除以初始试验电流 (安培)。

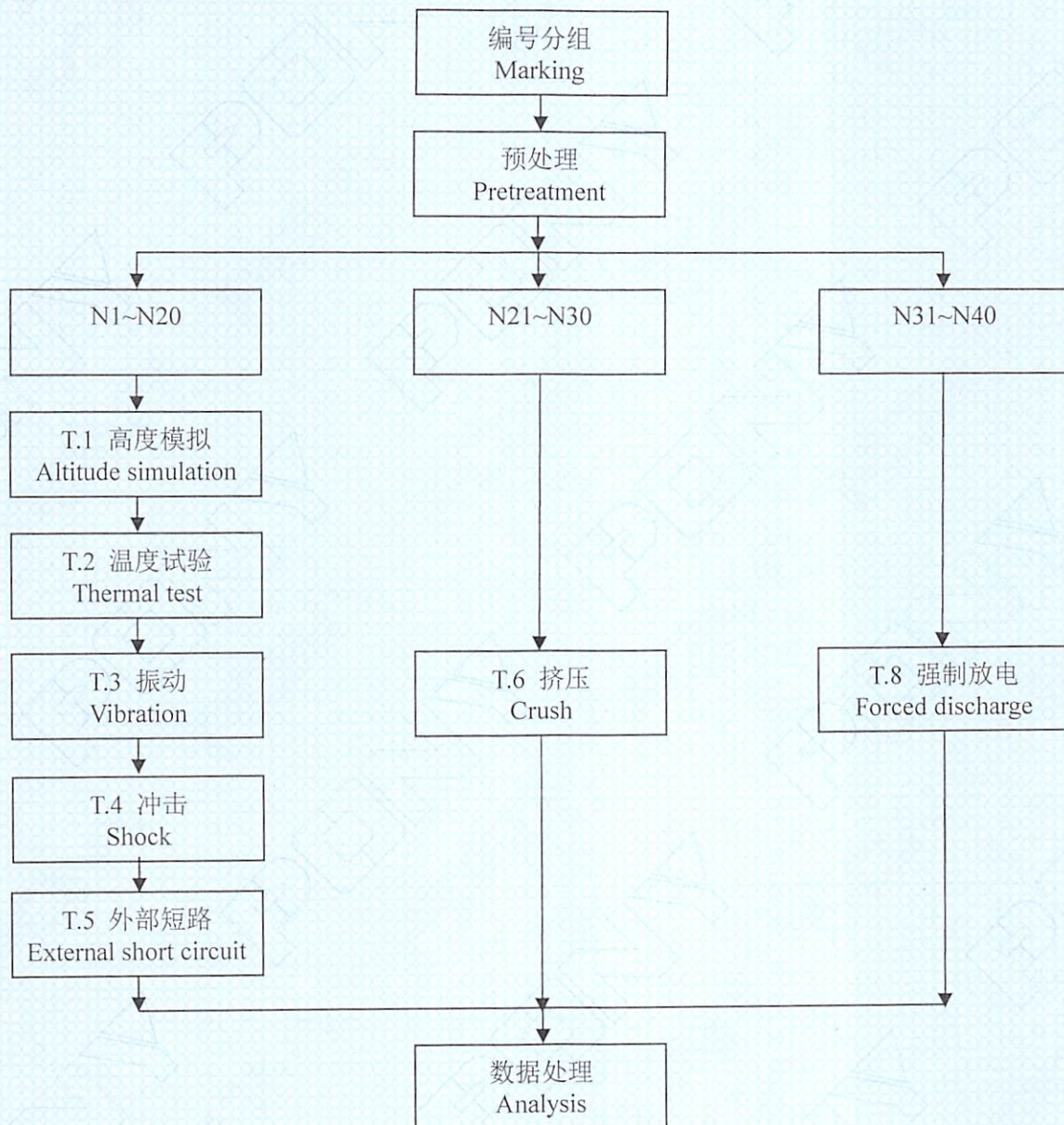
要求原电池或充电电池在试验过程中和试验后 7 天内无解体, 无起火。



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VI、测试程序 Test Procedure





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VII、测试设备 Test Apparatus

IE-0121	高精度电池测试系统	High precision battery test system
IE-0434	真空干燥箱	Vacuum drying oven
IE-0090	万用表	Multimeter
IE-0824	高原空盒气压表	Tableland air pressure gauge
IE-0259	电子天平	Electronic balance
IE-0219	快速温变箱	Rapid temperature change test chamber
IE-0128	电动振动试验系统	Electric vibration test system
IE-0664	气动垂直冲击试验台	Pneumatic vertical impact testing platform
IE-0281	温控短路试验机	Temperature controlled short circuit testing machine
IE-0185	数字温度表(电热偶)	The digital thermometer (TC)
IE-0568	多功能数字式毫欧计	Multi-function digital milliohm meter
IE-0198	电池挤压试验机	Battery crush testing machine
IE-0544	高速程控电源	High speed programmable power supply

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VIII、测试数据 Test Data

T.1 高度模拟 Altitude simulation

编号 No.	测试前 Pre-test		测试后 After test		质量亏损 Mass loss (%)	电压亏损 Voltage loss (%)	有无泄露, 排气, 解体, 破裂和起火 Whether leakage, venting, disassembly, rupture, fire (Yes/No)
	质量 Mass (g)	电压 Voltage (V)	质量 Mass (g)	电压 Voltage (V)			
N1	1.256	3.309	1.256	3.309	0.000	0.000	无 (No)
N2	1.245	3.330	1.245	3.330	0.000	0.000	无 (No)
N3	1.245	3.331	1.245	3.331	0.000	0.000	无 (No)
N4	1.251	3.331	1.251	3.330	0.000	0.030	无 (No)
N5	1.245	3.279	1.245	3.279	0.000	0.000	无 (No)
N6	1.263	3.395	1.262	3.394	0.079	0.029	无 (No)
N7	1.250	3.409	1.250	3.408	0.000	0.029	无 (No)
N8	1.241	3.395	1.241	3.395	0.000	0.000	无 (No)
N9	1.247	3.325	1.247	3.325	0.000	0.000	无 (No)
N10	1.245	3.345	1.245	3.345	0.000	0.000	无 (No)
N11	1.238	---	1.238	---	0.000	---	无 (No)
N12	1.240	---	1.240	---	0.000	---	无 (No)
N13	1.256	---	1.255	---	0.080	---	无 (No)
N14	1.245	---	1.245	---	0.000	---	无 (No)
N15	1.229	---	1.229	---	0.000	---	无 (No)
N16	1.256	---	1.256	---	0.000	---	无 (No)
N17	1.256	---	1.255	---	0.080	---	无 (No)
N18	1.250	---	1.250	---	0.000	---	无 (No)
N19	1.240	---	1.240	---	0.000	---	无 (No)
N20	1.258	---	1.258	---	0.000	---	无 (No)



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T.2 温度试验 Thermal test

编号 No.	测试前 Pre-test		测试后 After test		质量亏损 Mass loss (%)	电压亏损 Voltage loss (%)	有无泄露, 排气, 解体, 破裂和起火 Whether leakage, venting, disassembly, rupture, fire (Yes/No)
	质量 Mass (g)	电压 Voltage (V)	质量 Mass (g)	电压 Voltage (V)			
N1	1.256	3.309	1.255	3.290	0.080	0.574	无 (No)
N2	1.245	3.330	1.245	3.310	0.000	0.601	无 (No)
N3	1.245	3.331	1.244	3.306	0.080	0.751	无 (No)
N4	1.251	3.330	1.251	3.309	0.000	0.631	无 (No)
N5	1.245	3.279	1.245	3.259	0.000	0.610	无 (No)
N6	1.262	3.394	1.261	3.376	0.079	0.530	无 (No)
N7	1.250	3.408	1.250	3.383	0.000	0.734	无 (No)
N8	1.241	3.395	1.240	3.374	0.081	0.619	无 (No)
N9	1.247	3.325	1.247	3.301	0.000	0.722	无 (No)
N10	1.245	3.345	1.245	3.320	0.000	0.747	无 (No)
N11	1.238	---	1.238	---	0.000	---	无 (No)
N12	1.240	---	1.240	---	0.000	---	无 (No)
N13	1.255	---	1.254	---	0.080	---	无 (No)
N14	1.245	---	1.244	---	0.080	---	无 (No)
N15	1.229	---	1.228	---	0.081	---	无 (No)
N16	1.256	---	1.255	---	0.080	---	无 (No)
N17	1.255	---	1.254	---	0.080	---	无 (No)
N18	1.250	---	1.250	---	0.000	---	无 (No)
N19	1.240	---	1.240	---	0.000	---	无 (No)
N20	1.258	---	1.257	---	0.079	---	无 (No)

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T.3 振动 Vibration

编号 No.	测试前 Pre-test		测试后 After test		质量亏损 Mass loss (%)	电压亏损 Voltage loss (%)	有无泄露, 排气, 解体, 破裂和起火 Whether leakage, venting, disassembly, rupture, fire (Yes/No)
	质量 Mass (g)	电压 Voltage (V)	质量 Mass (g)	电压 Voltage (V)			
N1	1.255	3.290	1.255	3.287	0.000	0.091	无 (No)
N2	1.245	3.310	1.245	3.306	0.000	0.121	无 (No)
N3	1.244	3.306	1.244	3.304	0.000	0.060	无 (No)
N4	1.251	3.309	1.251	3.306	0.000	0.091	无 (No)
N5	1.245	3.259	1.245	3.255	0.000	0.123	无 (No)
N6	1.261	3.376	1.261	3.373	0.000	0.089	无 (No)
N7	1.250	3.383	1.249	3.380	0.080	0.089	无 (No)
N8	1.240	3.374	1.240	3.370	0.000	0.119	无 (No)
N9	1.247	3.301	1.247	3.298	0.000	0.091	无 (No)
N10	1.245	3.320	1.244	3.317	0.080	0.090	无 (No)
N11	1.238	---	1.238	---	0.000	---	无 (No)
N12	1.240	---	1.240	---	0.000	---	无 (No)
N13	1.254	---	1.253	---	0.080	---	无 (No)
N14	1.244	---	1.244	---	0.000	---	无 (No)
N15	1.228	---	1.228	---	0.000	---	无 (No)
N16	1.255	---	1.255	---	0.000	---	无 (No)
N17	1.254	---	1.254	---	0.000	---	无 (No)
N18	1.250	---	1.249	---	0.080	---	无 (No)
N19	1.240	---	1.239	---	0.081	---	无 (No)
N20	1.257	---	1.257	---	0.000	---	无 (No)



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T.4 冲击 Shock

编号 No.	测试前 Pre-test		测试后 After test		质量亏损 Mass loss (%)	电压亏损 Voltage loss (%)	有无泄露, 排气, 解体, 破裂和起火 Whether leakage, venting, disassembly, rupture, fire (Yes/No)
	质量 Mass (g)	电压 Voltage (V)	质量 Mass (g)	电压 Voltage (V)			
N1	1.255	3.287	1.254	3.287	0.080	0.000	无 (No)
N2	1.245	3.306	1.245	3.306	0.000	0.000	无 (No)
N3	1.244	3.304	1.244	3.304	0.000	0.000	无 (No)
N4	1.251	3.306	1.251	3.305	0.000	0.030	无 (No)
N5	1.245	3.255	1.245	3.254	0.000	0.031	无 (No)
N6	1.261	3.373	1.260	3.373	0.079	0.000	无 (No)
N7	1.249	3.380	1.249	3.379	0.000	0.030	无 (No)
N8	1.240	3.370	1.240	3.370	0.000	0.000	无 (No)
N9	1.247	3.298	1.246	3.297	0.080	0.030	无 (No)
N10	1.244	3.317	1.244	3.317	0.000	0.000	无 (No)
N11	1.238	---	1.238	---	0.000	---	无 (No)
N12	1.240	---	1.240	---	0.000	---	无 (No)
N13	1.253	---	1.252	---	0.080	---	无 (No)
N14	1.244	---	1.244	---	0.000	---	无 (No)
N15	1.228	---	1.228	---	0.000	---	无 (No)
N16	1.255	---	1.254	---	0.080	---	无 (No)
N17	1.254	---	1.254	---	0.000	---	无 (No)
N18	1.249	---	1.249	---	0.000	---	无 (No)
N19	1.239	---	1.239	---	0.000	---	无 (No)
N20	1.257	---	1.256	---	0.080	---	无 (No)



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T.5 外部短路 External short circuit

编号 No.	最高温度 Peak temperature (°C)	有无解体, 破裂, 起火 Whether disassembly, rupture, fire (Yes/No)
N1	61.2	无 (No)
N2	65.4	无 (No)
N3	66.5	无 (No)
N4	64.2	无 (No)
N5	63.5	无 (No)
N6	62.7	无 (No)
N7	63.4	无 (No)
N8	63.5	无 (No)
N9	67.2	无 (No)
N10	63.5	无 (No)
N11	57.5	无 (No)
N12	57.2	无 (No)
N13	57.2	无 (No)
N14	57.3	无 (No)
N15	57.1	无 (No)
N16	57.2	无 (No)
N17	57.4	无 (No)
N18	57.3	无 (No)
N19	57.2	无 (No)
N20	57.2	无 (No)

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T.6 挤压 Crush

编号 No.	测试前电压 Pre-test Voltage (V)	最高温度 Peak temperature (°C)	有无解体, 起火 Whether disassembly, fire (Yes/No)
N21	3.331	24.7	无 (No)
N22	3.336	24.8	无 (No)
N23	3.335	24.7	无 (No)
N24	3.338	24.7	无 (No)
N25	3.340	24.6	无 (No)
N26	2.778	24.1	无 (No)
N27	2.779	24.2	无 (No)
N28	2.802	24.1	无 (No)
N29	2.778	24.2	无 (No)
N30	2.790	24.1	无 (No)

T.7 过度充电 Overcharge

不适用 Not applicable

T.8 强制放电 Forced discharge

编号 No.	测试前电压 Pre-test Voltage (V)	有无解体, 起火 Whether disassembly, fire (Yes/No)
N31	2.746	无 (No)
N32	2.813	无 (No)
N33	2.757	无 (No)
N34	2.767	无 (No)
N35	2.778	无 (No)
N36	2.768	无 (No)
N37	2.779	无 (No)
N38	2.786	无 (No)
N39	2.778	无 (No)
N40	2.805	无 (No)

报告结束 End of report