TCT 通测检测
TESTING CENTRE TECHNOLOGY

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中国认可
国际互认
检测
TESTING
CNAS L6165

# UN38.3 Test Report

# UN38.3 检测报告

| | |
|---|---|
| **Applicant's name**<br>委托方名称 | |
| **Applicant's Address**<br>委托方地址 | |
| **Name of Sample**<br>样品名称 | Polymer Li-ion Battery<br>聚合物锂离子电池 |
| **Model**<br>型号 | LC 502020 |
| **Testing Laboratory**<br>测试实验室 | Shenzhen TCT Testing Technology Co., Ltd.<br>深圳市通测检测技术有限公司<br>2101 & 2201, Zhenchang Factory, Renshan Industrial Zone, Fuhai Subdistrict, Bao'an District, Shenzhen, Guangdong, China<br>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.**<br>报告编号 | TCT220829B027 |
| **Date of Issue**<br>签发日期 | 2022. 09. 26 |
| **Test Conclusion 测试结论:**<br>**The test results are qualified. 测试结果为合格。** | |

**Tested by 主检人:** Mollie wu 吴玲玲 **Approved by 批准人:** Tomsin 汤琼森

**Inspected by 审核人:** Amy Zeng 曾红 **Seal of TCT 报告单位（盖章）**

SHENZHEN TCT TESTING TECHNOLOGY CO., LTD TCT

# Ⅰ、Sample Description 样品描述

| | | | | | |
|---|---|---|---|---|---|
| **Name of Sample 样品名称** | Polymer Li-ion Battery 聚合物锂离子电池 | | **Model 型号** | LC 502020 | |
| **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)** | (21.5×20.1×4.6)mm |
| **Nominal Voltage 标称电压** | 3.7V | **Rated Capacity 额定容量** | 180mAh 0.666Wh | **Charge Voltage 充电电压** | 4.2V |
| **Nominal Charge Current 标称充电电流** | 36mA | **Maximum Charge Current 最大充电电流** | 180mA | **End of Charge Current 结束充电电流** | 1.8mA |
| **Discharge Cut-off Voltage 放电截止电压** | 3.0V | **Nominal Discharge Current 标称放电电流** | 36mA | **Maximum Discharge Current 最大放电电流** | 180mA |
| **Cell Model 电池型号** | LC 502020 | **Cell Nominal Voltage 电池标称电压** | 3.7V | **Cell Rated Capacity 电池额定容量** | 180mA |
| **Cells Number 电池数量** | 1PC | **Sample Receiving Date 样品接收日期** | 2022. 09. 06 | **Testing Date 测试日期** | 2022. 09. 06 — 2022. 09. 26 |

# Ⅱ、Test Standard 检测标准

UN "Manual of Tests and Criteria" ST/SG/AC.10/11/Rev.7/Subsection 38.3.

联合国《试验和标准手册》（第 7 版）38.3 节。

# Ⅲ、Test Item 测试项目

T.1. ☒Altitude simulation 高度模拟
T.2. ☒Thermal test 温度试验
T.3. ☒Vibration 振动
T.4. ☒Shock 冲击
T.5. ☒External short circuit 外部短路
T.6. ☐Impact / ☒Crush 撞击/挤压
T.7. ☒Overcharge 过充电
T.8. ☒Forced discharge 强制放电

# 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 ℃的条件下存放至少 6 小时，接着再在试验温度等于 - 40 ± 2 ℃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 ℃)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<br>电池组 | Minimum peak acceleration<br>最低限度最大加速度 | Pulse duration<br>脉冲持续时间 |
|---|---|---|
| Small batteries<br>小型电池组 | 150 $g_n$ or result of formula<br>$\text{Acceleration}(g_n) = \sqrt{\left(\frac{100850}{\text{mass}^*}\right)}$<br>whichever is smaller | 6 ms |
| Large batteries<br>大型电池组 | 50 $g_n$ or result of formula<br>$\text{Acceleration}(g_n) = \sqrt{\left(\frac{30000}{\text{mass}^*}\right)}$<br>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的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℃，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 ± 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.

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±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±0.1 千克的重锤从 61 ± 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 ± 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.

(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.

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 ± 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 ℃，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<br>电池或电池组质量 M | Mass loss limit<br>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.<br>设备编号 | Name of Equipment<br>设备名称 | Model<br>型号 | Calibration Date /Due Date<br>校准日期/到期日 |
|---|---|---|---|
| TC-B01 | Low Altitude Simulation Tester<br>低压高空模拟试验箱 | GX-3020-Z | 2022. 02. 25<br>2023. 02. 24 |
| TC-B04 | Vertical Shock Test Instrument<br>垂直冲击试验台 | SY10-2 | 2022. 02. 25<br>2023. 02. 24 |
| TC-B05 | Vibration test instrument<br>振动试验台 | ES-3-150 | 2022. 02. 25<br>2023. 02. 24 |
| TC-B07 | Battery Test System<br>电池测试系统 | CTS 20V/10A | 2022. 02. 25<br>2023. 02. 24 |
| TC-B11 | Crush Test Instrument<br>温控型电池挤压试验机 | BE-6045T | 2022. 02. 25<br>2023. 02. 24 |
| TC-B13 | Battery Short Circuit Tester<br>电池短路试验机 | GX-6055-B | 2022. 02. 25<br>2023. 02. 24 |
| TC-B14 | Electronic Balance<br>电子天平 | PTT-A+300 | 2022. 02. 25<br>2023. 02. 24 |
| TC-B15 | Data Collector<br>数据采集器 | 34970A | 2022. 07. 04<br>2023. 07. 03 |
| TC-B18 | DC POWER<br>直流源 | PSW 80-27 | 2022. 02. 25<br>2023. 02. 24 |
| TC-B21 | Battery Impact Tester<br>电池冲击试验机 | BE-5066 | 2022. 02. 25<br>2023. 02. 24 |
| TC-B25 | Digital Multimeter<br>数字万用表 | 15B | 2022. 07. 04<br>2023. 07. 03 |
| TC-B30 | Programmable high & low temperature test chamber<br>可程式高低温试验机 | GX-3000-150 | 2022. 07. 04<br>2023. 07. 03 |

# 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# | 3.423 | 4.19 | 3.423 | 4.19 | 0.00 | 100.0 | Pass 合格 |
| | 2# | 3.440 | 4.18 | 3.440 | 4.18 | 0.00 | 100.0 | Pass 合格 |
| | 3# | 3.454 | 4.19 | 3.454 | 4.18 | 0.00 | 99.8 | Pass 合格 |
| | 4# | 3.403 | 4.18 | 3.402 | 4.18 | 0.03 | 100.0 | Pass 合格 |
| | 5# | 3.373 | 4.17 | 3.373 | 4.17 | 0.00 | 100.0 | Pass 合格 |
| 25th cycle, fully charged state 25 次循环满电状态 | 6# | 3.382 | 4.18 | 3.382 | 4.18 | 0.00 | 100.0 | Pass 合格 |
| | 7# | 3.475 | 4.18 | 3.474 | 4.18 | 0.03 | 100.0 | Pass 合格 |
| | 8# | 3.392 | 4.19 | 3.392 | 4.19 | 0.00 | 100.0 | Pass 合格 |
| | 9# | 3.371 | 4.19 | 3.371 | 4.18 | 0.00 | 99.8 | Pass 合格 |
| | 10# | 3.393 | 4.18 | 3.393 | 4.18 | 0.00 | 100.0 | Pass 合格 |

**Notes 注释:** Ambient temperature 环境温度: 23.7 °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# | 3.423 | 4.19 | 3.422 | 4.14 | 0.03 | 98.8 | Pass 合格 |
| | 2# | 3.440 | 4.18 | 3.439 | 4.14 | 0.03 | 99.0 | Pass 合格 |
| | 3# | 3.454 | 4.18 | 3.453 | 4.15 | 0.03 | 99.3 | Pass 合格 |
| | 4# | 3.402 | 4.18 | 3.401 | 4.14 | 0.03 | 99.0 | Pass 合格 |
| | 5# | 3.373 | 4.17 | 3.372 | 4.14 | 0.03 | 99.3 | Pass 合格 |
| 25th cycle, fully charged state 25 次循环满电状态 | 6# | 3.382 | 4.18 | 3.381 | 4.13 | 0.03 | 98.8 | Pass 合格 |
| | 7# | 3.474 | 4.18 | 3.473 | 4.14 | 0.03 | 99.0 | Pass 合格 |
| | 8# | 3.392 | 4.19 | 3.391 | 4.14 | 0.03 | 98.8 | Pass 合格 |
| | 9# | 3.371 | 4.18 | 3.370 | 4.15 | 0.03 | 99.3 | Pass 合格 |
| | 10# | 3.393 | 4.18 | 3.392 | 4.14 | 0.03 | 99.0 | Pass 合格 |

**Notes 注释:** Ambient temperature 环境温度: 23.9 °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# | 3.422 | 4.14 | 3.422 | 4.13 | 0.00 | 99.8 | Pass 合格 |
| | 2# | 3.439 | 4.14 | 3.439 | 4.14 | 0.00 | 100.0 | Pass 合格 |
| | 3# | 3.453 | 4.15 | 3.452 | 4.15 | 0.03 | 100.0 | Pass 合格 |
| | 4# | 3.401 | 4.14 | 3.401 | 4.14 | 0.00 | 100.0 | Pass 合格 |
| | 5# | 3.372 | 4.14 | 3.372 | 4.14 | 0.00 | 100.0 | Pass 合格 |
| 25th cycle, fully charged state 25 次循环满电状态 | 6# | 3.381 | 4.13 | 3.381 | 4.13 | 0.00 | 100.0 | Pass 合格 |
| | 7# | 3.473 | 4.14 | 3.473 | 4.14 | 0.00 | 100.0 | Pass 合格 |
| | 8# | 3.391 | 4.14 | 3.390 | 4.13 | 0.03 | 99.8 | Pass 合格 |
| | 9# | 3.370 | 4.15 | 3.370 | 4.15 | 0.00 | 100.0 | Pass 合格 |
| | 10# | 3.392 | 4.14 | 3.392 | 4.14 | 0.00 | 100.0 | Pass 合格 |

**Notes 注释:** Ambient temperature 环境温度: 23.8 °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# | 3.422 | 4.13 | 3.422 | 4.13 | 0.00 | 100.0 | Pass 合格 |
| | 2# | 3.439 | 4.14 | 3.438 | 4.14 | 0.03 | 100.0 | Pass 合格 |
| | 3# | 3.452 | 4.15 | 3.452 | 4.14 | 0.00 | 99.8 | Pass 合格 |
| | 4# | 3.401 | 4.14 | 3.401 | 4.14 | 0.00 | 100.0 | Pass 合格 |
| | 5# | 3.372 | 4.14 | 3.372 | 4.14 | 0.00 | 100.0 | Pass 合格 |
| 25th cycle, fully charged state 25 次循环满电状态 | 6# | 3.381 | 4.13 | 3.381 | 4.13 | 0.00 | 100.0 | Pass 合格 |
| | 7# | 3.473 | 4.14 | 3.472 | 4.14 | 0.03 | 100.0 | Pass 合格 |
| | 8# | 3.390 | 4.13 | 3.390 | 4.13 | 0.00 | 100.0 | Pass 合格 |
| | 9# | 3.370 | 4.15 | 3.370 | 4.14 | 0.00 | 99.8 | Pass 合格 |
| | 10# | 3.392 | 4.14 | 3.392 | 4.14 | 0.00 | 100.0 | Pass 合格 |

**Notes 注释:** Ambient temperature 环境温度: 24.0 °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# | 57.6 | Pass 合格 |
| | 2# | 57.7 | Pass 合格 |
| | 3# | 57.9 | Pass 合格 |
| | 4# | 57.8 | Pass 合格 |
| | 5# | 57.7 | Pass 合格 |
| 25th cycle, fully charged state 25 次循环满电状态 | 6# | 57.6 | Pass 合格 |
| | 7# | 57.9 | Pass 合格 |
| | 8# | 57.8 | Pass 合格 |
| | 9# | 57.6 | Pass 合格 |
| | 10# | 57.7 | Pass 合格 |
| **Notes 注释:** Ambient temperature 环境温度: 23.8 °C。<br>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.<br>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# | 23.8 | Pass 合格 |
| | 12# | 23.6 | Pass 合格 |
| | 13# | 23.7 | Pass 合格 |
| | 14# | 23.8 | Pass 合格 |
| | 15# | 23.6 | Pass 合格 |
| 25th cycle, 50% charged state 25 次循环 50%充电状态 | 16# | 23.8 | Pass 合格 |
| | 17# | 23.7 | Pass 合格 |
| | 18# | 23.6 | Pass 合格 |
| | 19# | 23.8 | Pass 合格 |
| | 20# | 23.7 | Pass 合格 |
| **Notes 注释:** Ambient temperature 环境温度: 23.2 °C。<br>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.<br>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<br>测试样品状态 | No.<br>编号 | Status<br>结果 |
|---|---|---|
| first cycle, fully charged state<br>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<br>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: 23.9 °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<br>测试样品状态 | No.<br>编号 | Status<br>结果 |
|---|---|---|
| first cycle, fully discharged state<br>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<br>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: 24.0 °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。

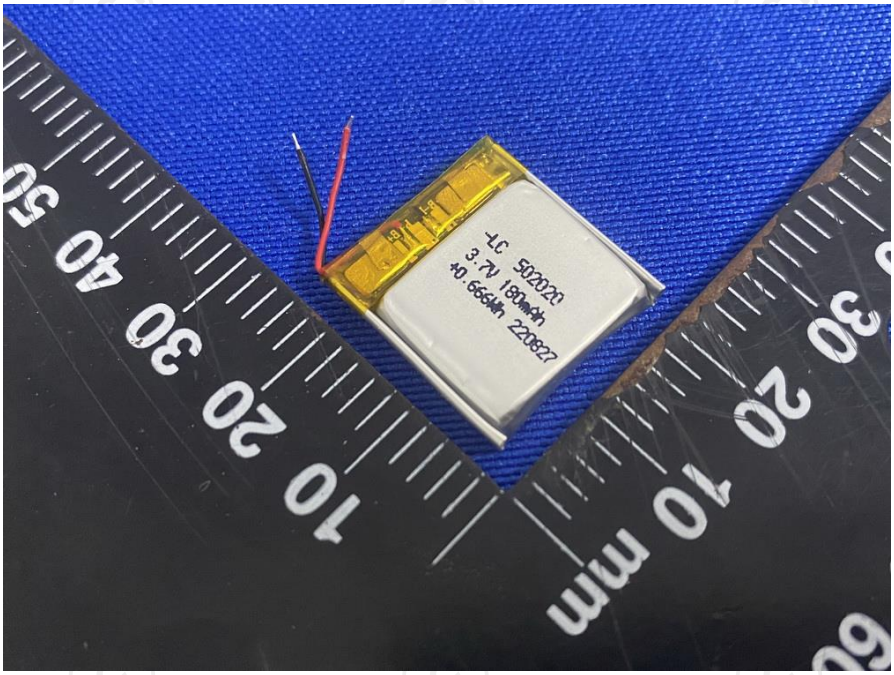
## Ⅷ、Conclusion 结论

| 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:**

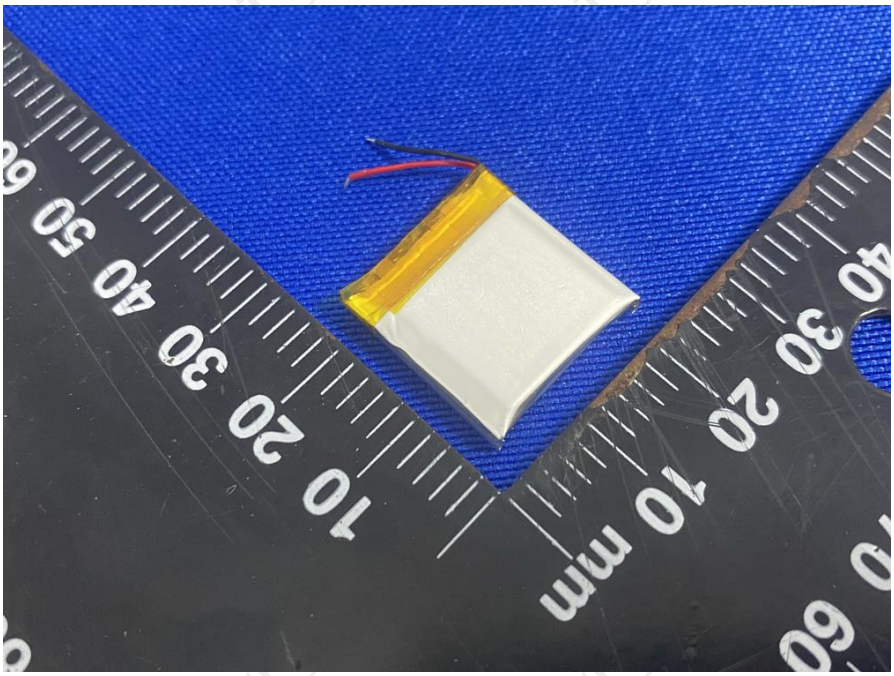
UN "Manual of Tests and Criteria" ST/SG/AC.10/11/Rev.7/Subsection 38.3.
联合国《试验和标准手册》（第 7 版）38.3 节。

## Ⅸ、Picture of the sample 样品图片



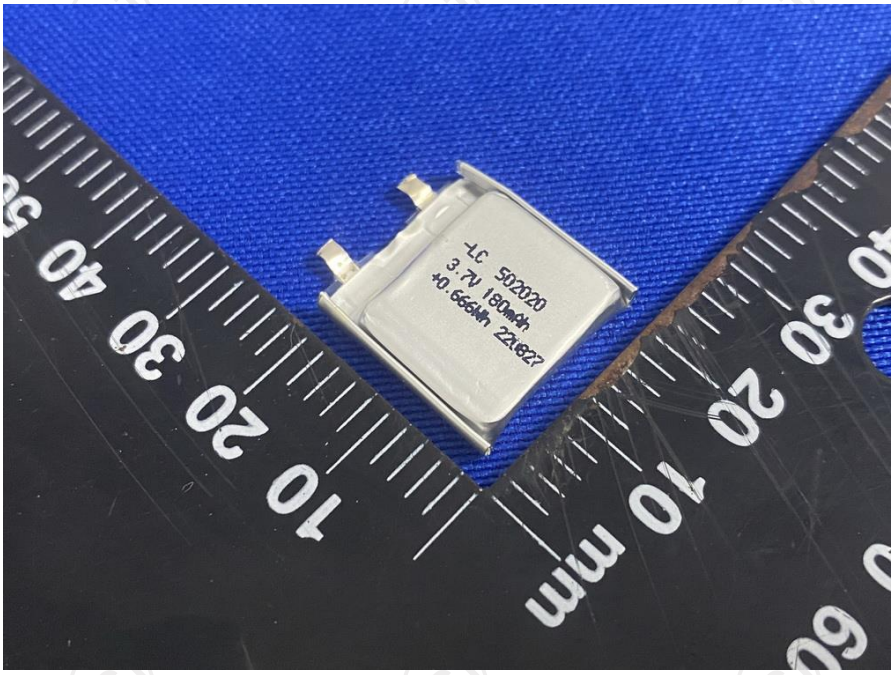

**Picture 1. Battery view**

图片 1. 电池视图



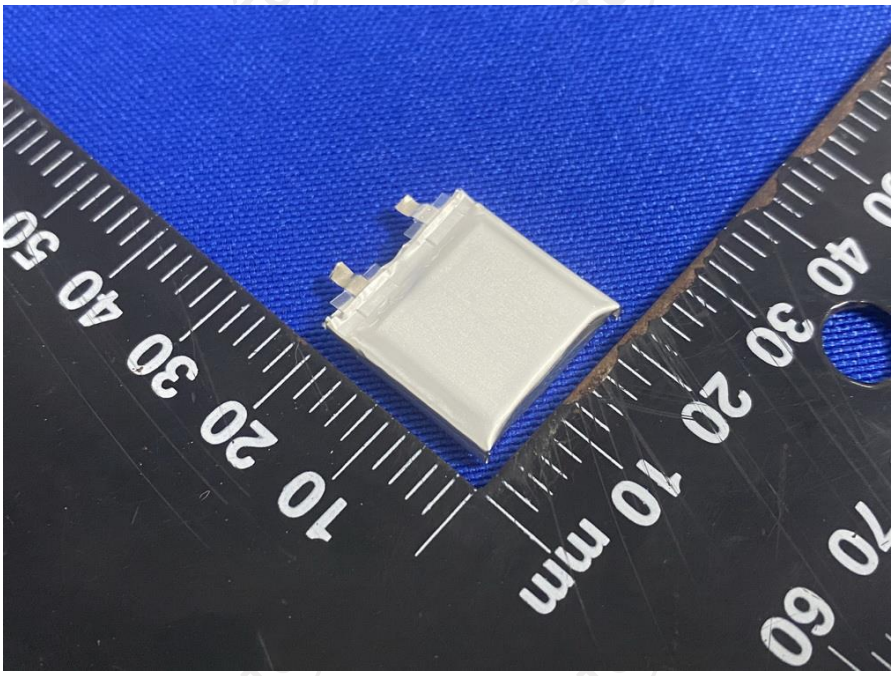
**Picture 2. Battery view**

图片 2. 电池视图



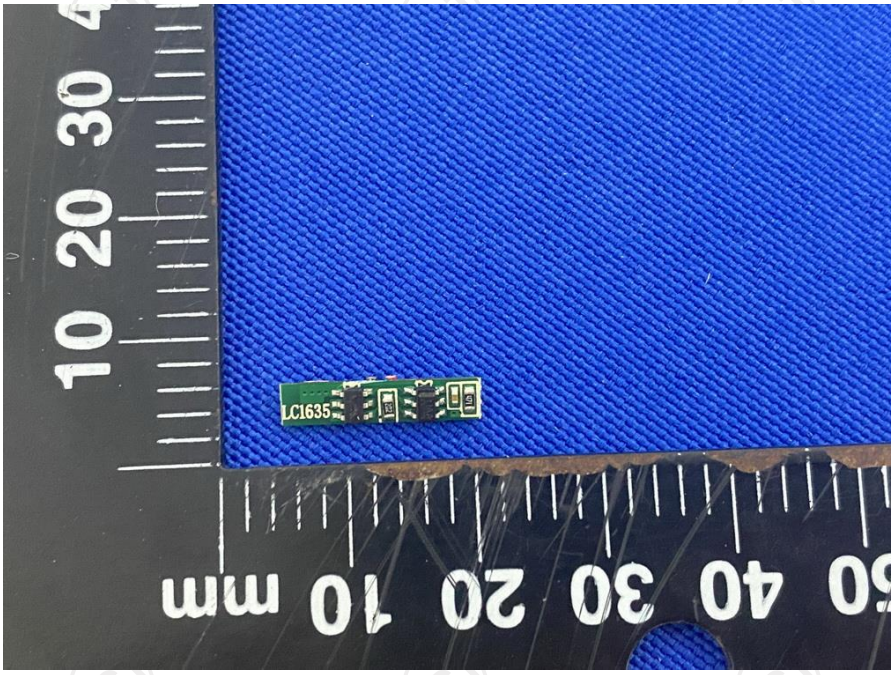

**Picture 3. Cell view**

图片 3. 电池视图



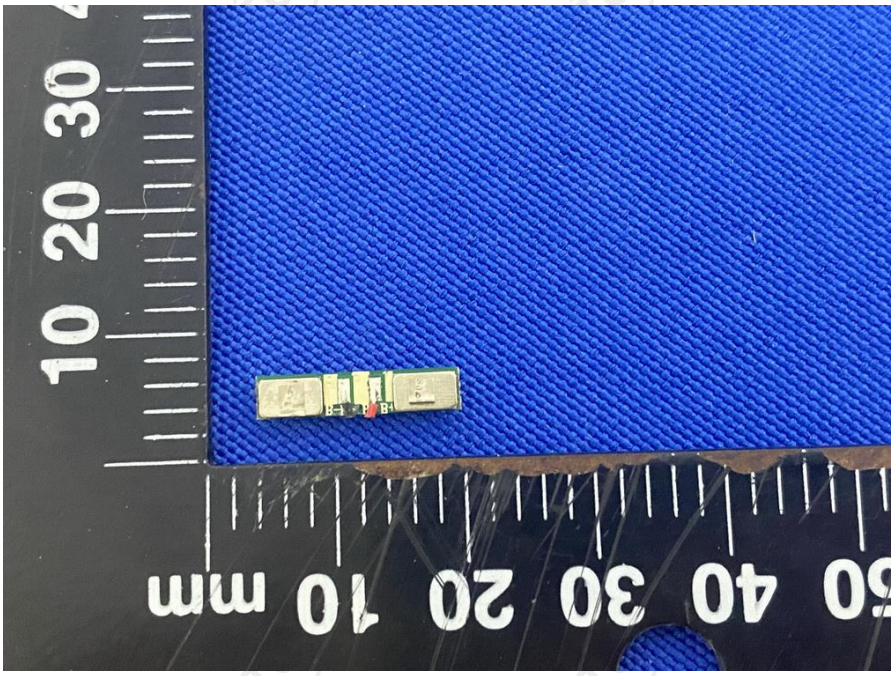
**Picture 4. Cell view**

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

# 注意事项

1. The test report is invalid without the official stamp of TCT.
   本报告书无 TCT 盖章无效。
2. Nobody is allowed to photocopy or partly photocopy this test report without written permission of TCT.
   未经 TCT 书面同意，不得复制或部分地复制本报告书。
3. The test report is invalid without the signatures of Ratifier, Reviewer and Testing engineer.
   本报告书无批准人、审核人、及主检人签名无效。
4. The report is invalid when anything of following happens – illegal transfer, reproduce, embezzlement, imposture, modification or tampering in any media form.
   私自转让、复制、盗用、冒用、涂改、或以任何媒体形式篡改的报告书无效。
5. Objections to the test report must be submitted to TCT within 15 days.
   对报告书若有异议，应于收到报告之日起 15 天内向本公司提出。
6. The test report is valid for the tested samples only.
   本报告仅对本次测试样品有效。
7. The Chinese contents in this report are only for reference.
   本报告中的中文内容仅供参考。