华南国家计量测试中心
广东省计量科学研究院
SOUTH CHINA NATIONAL CENTER OF METROLOGY
GUANGDONG INSTITUTE OF METROLOGY

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检测
TESTING
CNAS L0730

检 测 报 告
TEST REPORT

证书编号 DCW201701727 第 1 页，共 17 页
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样品名称 锂离子聚合物电池
Description Li-ion Polymer Battery

型号规格 YDYJ384166
Model/Type

制造厂 深圳市言九电子科技有限公司
Manufacturer YJ POWER GROUP LIMITED

出厂编号 1#～43# 设备编号 ———
Serial No. Equipment No.

接收日期 2017 年 02 月 16 日
Date of Receipt Y M D

结论 见检测结果页
Conclusion Shown in the results of test report

检测日期 2017 年 02 月 20 日
Date of Test Y M D

批 准 人
Approved Signatory

核 验
Inspected by

检 测
Tested by

证书专用章
Stamp

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说　明

证书编号 DCW201701727
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DIRECTIONS

1. 本中心是国家质量监督检验检疫总局在华南地区设立的国家法定计量检定机构，本中心的质量管理体系符合ISO/IEC 17025:2005标准的要求。

This laboratory is the National Legal Metrological Verification Institution in southern China set up by the General Administration of Quality Supervision. The quality system is in accordance with ISO/IEC 17025:2005.

2. 本中心所出具的数据均可溯源至国家计量基准和国际单位制(SI)。

All data issued by this laboratory are traceable to national primary standards and International System of Units (SI).

3. 本次检测的技术依据：

Reference documents for the test:

UN ST/SG/AC.10/11/Rev.6-2015 关于危险货物运输的建议书 试验和标准手册 Recommendations on the transport of dangerous goods Manual of Tests and Criteria

4. 本次检测所使用的主要计量标准器具：

Major standards of measurement used in the test:

设备名称/型号 Name of Equipment /Model	编号 Serial No.	证书号/有效期 Certificate No. /Due Date	计量特性 Metrological Characteristic
高低温冲击试验箱 High and Low Temperatures Shock Tester /TSG2055W	08110652	RZD201606618 /2017-07-21	U=0.3 ℃(k=2)
冲击台 Shock Testing Machine /SKT25	L081001	SSD201604725 /2017-07-27	加速度:U_{rel}=5.0%(k=2) Acceleration:U_{rel}=5.0%(k=2)
电热真空干燥箱 Electrothermal Drying Chamber /ZK-025B	00036	RZD201607691 /2017-07-12	温度波动度≤±1 ℃ Temperature Stability≤±1 ℃
电磁式振动试验机 /EV102-VT630	L141155	SSD201604489 /2017-06-15	加速度:±10%,振动频率:±2% Acceleration:±10%, Vibration Frequency:±2%

5. 检测地点、环境条件：

Place and environmental conditions of the test:

地点 Place 本院鉴定实验室(Authentication Lab)　温度 Temperature (20±5) ℃　相对湿度 R.H. (40～70) %

注：1. 本报告检测结果只与受检测项目有关。
2. 未经本机构书面批准，不得部分复制此报告。

Note:1. The results relate only to the items tested.
2. This report shall not be reproduced except in full, without the written approval of our laboratory.

检 测 结 果
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I Basic information 基本信息

Sample name 样品名称	Li-ion Polymer Battery 锂离子聚合物电池	Type 型号规格	YDYJ384166
Nominal voltage 标称电压	3.7V	Rated capacity 额定容量	1000mAh 3.7Wh
Limited charge voltage 限制充电电压	4.2V	Trade mark 商标	----
Shape 样品外观	Prismatic 菱形	Size (L×W×T) 尺寸(L×W×T)	(64.7×40.5×3.6)mm
Test item 检测项目	Altitude simulation, Thermal test, Vibration, Shock, External short circuit, Impact/Crush, Overcharge, Forced discharge 高度模拟，热冲击，振动，机械冲击，外部短路，重物冲击/挤压，过充电，强制放电		
Test reference 检测依据	Sixth revised edition of *Recommendations on the Transport of Dangerous Goods, Manual of Test and Criteria*, Part III, subsection 38.3. (ST/SG/AC.10/11/Rev.6) 第 6 修订版《关于危险货物运输的建议书：试验和标准手册》第III部分第 38.3 节。(ST/SG/AC.10/11/Rev.6)		
Test conclusion 检测结论	The battery samples pass all of the requirement test items. 经检测，全部检测项目符合要求。 本次检测结论为合格。		
Remark 备注	----		

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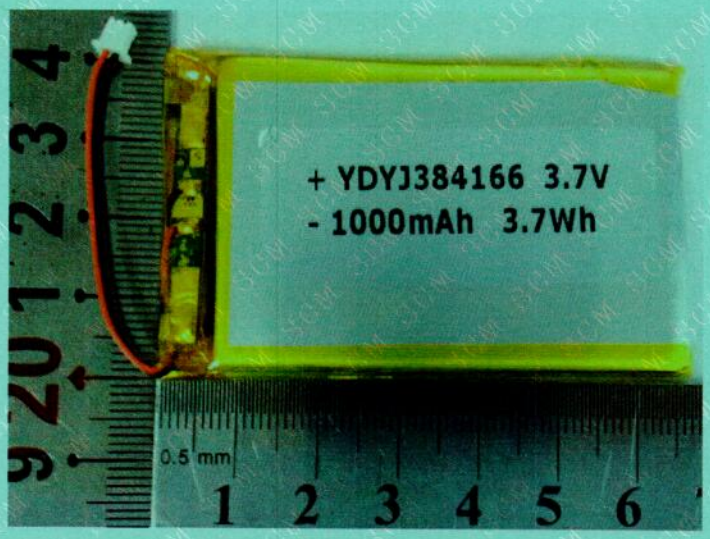
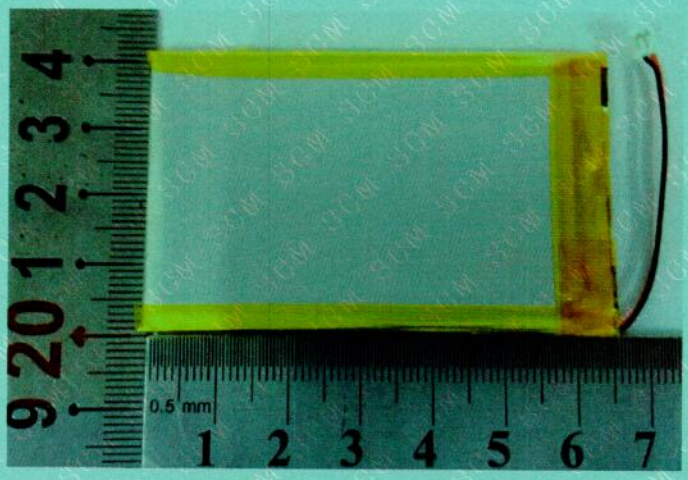
Ⅱ Photos of the Sample 样品照片

Battery 电池





检 测 结 果
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III Abstract of test result 测试结果摘要

Test contents
测试目录

NO. 序号	Test item 试验项目	Test reference 试验依据	Conclusion 结果	Remark 备注
1	Altitude simulation 高度模拟	UN Manual of Tests and Criteria, part III, subsection 38.3.4.1 UN 试验和标准手册，第 3 章节，38.3.4.1 部分。	Pass 合格	----
2	Thermal test 热冲击	UN Manual of Tests and Criteria, part III, subsection 38.3.4.2 UN 试验和标准手册，第 3 章节，38.3.4.2 部分。	Pass 合格	----
3	Vibration 振动	UN Manual of Tests and Criteria, part III, subsection 38.3.4.3 UN 试验和标准手册，第 3 章节，38.3.4.3 部分。	Pass 合格	----
4	Shock 机械冲击	UN Manual of Tests and Criteria, part III, subsection 38.3.4.4 UN 试验和标准手册，第 3 章节，38.3.4.4 部分。	Pass 合格	----
5	External short circuit 外部短路	UN Manual of Tests and Criteria, part III, subsection 38.3.4.5 UN 试验和标准手册，第 3 章节，38.3.4.5 部分。	Pass 合格	----
6	Impact/Crush 重物冲击/挤压	UN Manual of Tests and Criteria, part III, subsection 38.3.4.6 UN 试验和标准手册，第 3 章节，38.3.4.6 部分。	Pass 合格	----
7	Overcharge 过充电	UN Manual of Tests and Criteria, part III, subsection 38.3.4.7 UN 试验和标准手册，第 3 章节，38.3.4.7 部分。	Pass 合格	----

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8	Forced discharge 强制放电	UN Manual of Tests and Criteria, part III, subsection 38.3.4.8 UN 试验和标准手册，第 3 章节，38.3.4.8 部分。	Pass 合格	----

Procedure 说明

Test T.1 to test T.5 must be conducted in sequence on the same cell or battery. Test T.6 and test 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.

必须用相同的电芯或电池按顺序进行试验 1 到试验 5。试验 6 和试验 8 须用没进行过其它试验的电芯或电池。为了测试循环后的电池，试验 7 可用试验 1 到试验 5 后没损坏的电池。

Batteries of 1#~14# are full charged after one cycle;

电池 1#~14#为一次循环满电状态；

Batteries of 15#~18# are full charged after fifty cycles;

电池 15#~18#为五十次循环满电状态；

Component cells of 19#~23# are 50% charged after one cycle;

组成电芯 19#~23#为一次循环后 50%充电状态；

Component Cells of 24#~33# are full discharged after one cycle;

组成电芯 24#~33#为一次循环完全放电状态；

Component Cells of 34#~43# are full discharged after fifty cycles.

组成电芯 34#~43#为五十次循环后完全放电状态。

1 Altitude simulation 高度模拟

1) 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.

电芯或电池应满足以下要求：没有泄漏、开口、解体、破裂、以及起火，并且每个试验的电芯或电池的开路电压不低于其试验前电压的 90%。要求中有关电压方面不适用于完全放电状态的电芯或电池。

2) Test procedure 试验过程

Test cells and batteries shall be stored at a pressure of 11.6kPa or less for at least six hours at ambient temperature (20±5) ℃.

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试验的电芯或电池应在 11.6kPa 或更少的气压下存放至少 6h，温度控制在(20±5) ℃。

3) Data showed in table 1 数据见表 1

Table 1 表 1

The state of batteries 电池状态	NO. 序号	Pre-test 试验前		After test 试验后		Mass loss 质量损失 (%)	Voltage after test / Voltage pre-test 试验后电压/试验前电压 (%)	Status 结论
		Mass 质量 (g)	Voltage 电压 (V)	Mass 质量 (g)	Voltage 电压 (V)			
Full charged after one cycle 一次循环后满电状态	1#	20.604	4.20	20.603	4.19	0.00	99.8	Pass 合格
	2#	20.334	4.20	20.334	4.19	0.00	99.8	Pass 合格
	3#	20.440	4.20	20.440	4.19	0.00	99.8	Pass 合格
	4#	20.510	4.20	20.510	4.19	0.00	99.8	Pass 合格
	5#	20.310	4.20	20.309	4.19	0.00	99.8	Pass 合格
	6#	20.479	4.20	20.479	4.19	0.00	99.8	Pass 合格
	7#	20.236	4.19	20.236	4.19	0.00	100.0	Pass 合格
	8#	20.406	4.20	20.406	4.19	0.00	99.8	Pass 合格
	9#	20.402	4.20	20.402	4.19	0.00	99.8	Pass 合格
	10#	20.404	4.20	20.403	4.20	0.00	100.0	Pass 合格

2 Thermal test 热冲击

1) 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.

电芯或电池应满足以下要求：没有泄漏、开口、解体、破裂、以及起火，并且每个试验的电芯或电池的开路电压不低于其试验前电压的 90%。要求中有关电压方面不适用于完全放电状态的电芯或电池。

2) Test procedure 试验过程

Test cells and batteries are to be stored for at least six hours at a test temperature equal to (72±2) ℃, followed by storage for at least six hours at a test temperature equal to (-40±2) ℃. 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

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temperature (20±5) ℃. For large cells and batteries the duration of exposure to the test temperature extremes should be at least 12 hours.

试验的电芯或电池应在温度为(72±2) ℃的条件下至少放置 6h，然后在温度为(-40±2) ℃的条件下至少放置 6h。试验温度限值变化的最大时间间隔为 30min。此过程重复进行 10 次，试验后所有试验的电芯或电池应在环境温度为(20±5) ℃下存放 24h。对于大电池或大电芯，在极端温度下放置时间应为 12h。

3) Data showed in table 2 数据见表 2

Table 2 表 2

The state of batteries 电池状态	NO. 序号	Pre-test 试验前		After test 试验后		Mass loss 质量损失 (%)	Voltage after test / Voltage pre-test 试验后电压/试验前电压 (%)	Status 结论
		Mass 质量 (g)	Voltage 电压 (V)	Mass 质量 (g)	Voltage 电压 (V)			
Full charged after one cycle 一次循环后满电状态	1#	20.603	4.19	20.597	4.14	0.03	98.8	Pass 合格
	2#	20.334	4.19	20.328	4.13	0.03	98.6	Pass 合格
	3#	20.440	4.19	20.435	4.14	0.02	98.8	Pass 合格
	4#	20.510	4.19	20.505	4.14	0.02	98.8	Pass 合格
	5#	20.309	4.19	20.289	4.14	0.10	98.8	Pass 合格
	6#	20.479	4.19	20.472	4.14	0.03	98.8	Pass 合格
	7#	20.236	4.19	20.232	4.14	0.02	98.8	Pass 合格
	8#	20.406	4.19	20.405	4.13	0.00	98.6	Pass 合格
	9#	20.402	4.19	20.402	4.14	0.00	98.8	Pass 合格
	10#	20.403	4.20	20.403	4.14	0.00	98.6	Pass 合格

3 Vibration 振动

1) 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 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.

电芯或电池应满足以下要求：没有泄漏、开口、解体、破裂、以及起火，并且每个试验的电芯或电池

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的开路电压不低于其试验前电压的 90%。要求中有关电压方面不适用于完全放电状态的电芯或电池。

2) Test procedure 试验过程

Cells and batteries are firmly secured to the platform of the vibration machine without distorting the cells in such a manner as to faithfully transit 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 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.

电芯或电池固定在振动仪器的平台上，并且没有扭曲，以此保证有效的振动传播。振动应为一个正弦波，在 15min 内完成对数频率转换从 7Hz 到 200Hz 再回到 7Hz 的过程。这个循环应在电池的三个空间正交位置各进行 12 次（总时间为 3h）。每个方向必须正交到终端面。

对于对数频率扫描，质量小于 12kg 的电池或电芯（电芯或小电池）与质量大于 12kg 的大电池应有所不同。

对于电芯或小电池：从 7Hz 起以峰值加速度 $1g_n$ 持续到 18Hz。振幅维持在 0.8mm（总共 1.6mm）和频率增加直到峰值加速度为 $8g_n$（大约为 50Hz）。然后频率以峰值加速度为 $8g_n$ 上升持续到 200Hz。

对于大电池：从 7Hz 起以峰值加速度 $1g_n$ 持续到 18Hz。振幅维持在 0.8mm（总共 1.6mm）和频率增加直到峰值加速度为 $2g_n$（大约为 25Hz）。然后频率以峰值加速度为 $2g_n$ 上升持续到 200Hz。

3) Data showed in table 3 数据见表 3

Table 3 表 3

The state of batteries 电池状态	NO. 序号	Pre-test 试验前		After test 试验后		Mass loss 质量损失 (%)	Voltage after test / Voltage pre-test 试验后电压/试验前电压 (%)	Status 结论
		Mass 质量 (g)	Voltage 电压 (V)	Mass 质量 (g)	Voltage 电压 (V)			
Full charged	1#	20.597	4.14	20.591	4.11	0.03	99.3	Pass 合格
	2#	20.328	4.13	20.328	4.13	0.00	100.0	Pass 合格

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after one cycle 一次循环后满电状态	3#	20.435	4.14	20.435	4.11	0.00	99.3	Pass 合格
	4#	20.505	4.14	20.501	4.14	0.02	100.0	Pass 合格
	5#	20.289	4.14	20.289	4.14	0.00	100.0	Pass 合格
	6#	20.472	4.14	20.472	4.11	0.00	99.3	Pass 合格
	7#	20.232	4.14	20.231	4.14	0.00	100.0	Pass 合格
	8#	20.405	4.13	20.405	4.13	0.00	100.0	Pass 合格
	9#	20.402	4.14	20.402	4.14	0.00	100.0	Pass 合格
	10#	20.403	4.14	20.403	4.14	0.00	100.0	Pass 合格

4 Shock 机械冲击

1) 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.

电芯或电池应满足以下要求：没有泄漏、开口、解体、破裂、以及起火，并且每个试验的电芯或电池的开路电压不低于其试验前电压的 90%。要求中有关电压方面的不适用于完全放电状态的电芯或电池。

2) Test procedure 试验过程

Test cells and batteries shall be secured to the testing machine by means of rigid mount which will support all mounting surfaces of each test battery.

Each cell or battery shall be subjected to a half-sine shock of peak acceleration of $150g_n$ 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.

Battery	Minimum peak acceleration	Pulse duration
Small batteries	150 gn or result of formula Acceleration $(g_n) = \sqrt{\left(\frac{100850}{mass}\right)}$	6ms

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	whichever is smaller	
Large batteries	50 g_n or result of formula Acceleration（g_n）= $\sqrt{\left(\frac{30000}{mass}\right)}$ whichever is smaller	11ms

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.

试验电芯或电池应固定在试验仪器上，用刚性的衬底支撑每一测试电池的所有表面。每一电芯或电池应进行峰值加速度为 150g_n 和脉宽 6ms 的半正弦波冲击。另外大电芯应进行峰值加速度为 50g_n 脉宽为 11ms 的正弦波冲击。

每块电池应进行正弦波冲击的峰值加速度值应根据电池的质量来定。小电池的冲击脉冲宽度应为 6ms，而大电池的冲击脉冲宽度应为 11ms。电池适当的冲击峰值加速度值由下面公式算出。

电池	最小峰值加速度	脉冲宽度
小电池	150g_n 或以下公式的结果： 加速度（g_n）= $\sqrt{\left(\frac{100850}{电池质量}\right)}$ 以上两者取最小值	6ms
大电池	50g_n 或以下公式的结果： 加速度（g_n）= $\sqrt{\left(\frac{30000}{电池质量}\right)}$ 以上两者取最小值	11ms

每一电芯或电池应在正的方向进行 3 次冲击，在反方向进行 3 次冲击，即电芯或电池总共在 3 个正交位置上进行 18 次冲击。

3) Data showed in table 4 数据见表 4

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Table 4

The state of batteries 电池状态	NO. 序号	Pre-test 试验前		After test 试验后		Mass loss 质量损失 (%)	Voltage after test / Voltage pre-test 试验后电压/试验前电压 (%)	Status 结论
		Mass 质量 (g)	Voltage 电压 (V)	Mass 质量 (g)	Voltage 电压 (V)			
Full charged after one cycle 一次循环后满电状态	1#	20.591	4.11	20.591	4.11	0.00	100.0	Pass 合格
	2#	20.328	4.13	20.326	4.12	0.01	99.8	Pass 合格
	3#	20.435	4.11	20.435	4.11	0.00	100.0	Pass 合格
	4#	20.501	4.14	20.501	4.13	0.00	99.8	Pass 合格
	5#	20.289	4.14	20.288	4.13	0.00	99.8	Pass 合格
	6#	20.472	4.11	20.472	4.11	0.00	100.0	Pass 合格
	7#	20.231	4.14	20.231	4.13	0.00	99.8	Pass 合格
	8#	20.405	4.13	20.403	4.13	0.01	100.0	Pass 合格
	9#	20.402	4.14	20.402	4.13	0.00	99.8	Pass 合格
	10#	20.403	4.14	20.401	4.14	0.01	100.0	Pass 合格

5 External short circuit　外部短路

1) Requirement　要求

Cells and batteries meet this requirement if their external temperature does not exceed 170℃ and there is no disassembly, no rupture and no fire during the test and within six hours after the test.

电芯或电池应满足以下要求：在试验过程中以及试验后 6h 内不起火、不解体、无破裂、表面温度不超过 170℃。

2) Test procedure　试验过程

The cell or battery to be tested shall be 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

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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.

测试的电芯或电池先加热一段时间直到电芯或电池的表面温度能均匀稳定在(57 ± 4)°C，加热时间取决于电芯或电池的外形设计与尺寸且应把加热时间评估记录下来，如果加热时间无法评估那么小电池或小电芯的加热时间至少为 6h，大电池或大电芯的加热时间至少为 12h。然后(57 ± 4)°C 的电芯或电池在外部线路电阻小于 0.1Ω这一条件下进行外部短路。

在电池或电芯的表面温度回到(57 ± 4)°C 后这一外部短路情况还要再持续至少 1h；如果是大电池或大电芯其表面温度升到最高值再降回到最高值的一半后，还要再持续短路 1h 以上。

此外部短路和降温过程至少应在环境温度下进行。

3) Data showed in table 5 数据见表 5

Table 5 表 5

The state of batteries 电池状态	NO. 序号	External Peak temperature (℃) 表面最高温度 (℃)	Status 结论
Full charged after one cycle 一次循环后满电状态	1#	55.7	Pass 合格
	2#	55.9	Pass 合格
	3#	55.6	Pass 合格
	4#	56.2	Pass 合格
	5#	55.5	Pass 合格
	6#	55.4	Pass 合格
	7#	55.8	Pass 合格
	8#	55.7	Pass 合格
	9#	55.6	Pass 合格
	10#	55.9	Pass 合格
Battery heating time 电池加热时间	2h		

6 Impact/Crush 重物冲击/挤压

1) Requirement 要求

Cells and component cells meet this requirement if their external temperature does not exceed 170℃ and there is no disassembly and no fire during the test and within six hours after the test.

电芯或组成电芯应满足以下要求：在试验过程中及试验后 6h 内不起火、不解体、表面温度不超过 170

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℃。

2) Test procedure-Impact (applicable to cylindrical cells not less than 18.0mm in diameter) 试验过程－重物冲击（适用于直径不小于 18.0mm 的圆柱形电芯）

The test sample cell or component cell is to be placed on a flat surface. A (15.8±0.1) mm 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±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 of channel with minimal drag on the falling mass. The vertical track of 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±0.1) mm diameter curved surface lying across the centre of the test sample. Each sample is to be subjected to only a single impact.

试验电芯或组成电芯样品放在一个平坦表面上。一根直径为(15.8±0.1) mm 的长度取 6cm 或比电芯更长的尺寸中的最长那个的不锈钢棒横放在样品中心，一块（9.1±0.1）kg 的重锤从（61±2.5cm）高处跌落到钢棒与试验样品交叉点上。重锤跌落由一个没有摩擦的、对重锤阻力最小的垂直轨道或管道加以控制用以引导落锤沿与水平支撑表面呈 90° 落下。

接受撞击的样品应使长轴线与平坦表面平行地横放在表面上，钢棒与长轴线垂直地横放到电池表面上进行撞击。每块电芯只经受一次撞击。

3) Test procedure-Crush (applicable to prismatic, pouch, coin/button cells and cylindrical cells less than 18.0 mm in diameter) 试验过程－挤压（适用于菱形、袋状、纽扣电芯和直径小于 18.0mm 的圆柱形电芯）

A cell or component cell is to be crushed between two flat surfaces. The crushing is to be gradual with a speed of approximately 1.5cm/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±0.78) kN;

(b) The voltage of the cell drops by at least 100mV; 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 100mV or more, or the cell is deformed by at least 50%of its original thickness, the pressure shall be released.

A prismatic of 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 6h. The test shall be conducted using test cells of component cells that have not previously been subjected to other tests.

将一块电芯或组成电芯放在两个平面之间进行挤压。挤压应以缓慢的速度进行，初步接触时速度为

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1.5cm/s，挤压持续进行直到出现以下三种情况之一：

（a） 施加的力值达到(13±0.78) kN；

（b） 电芯的电压下降至少 100mV；或

（c） 电芯比原来变形 50%以上。

菱形和袋状电芯应从最宽的一面施压，纽扣电芯应从平坦表面施压，圆柱形电芯应从与纵轴垂直的方向施压。

每块电芯或组成电芯只进行一次挤压试验，试验样品应持续观察 6h。本试验应用从未进行过其他试验的电芯或组成电芯。

4) Data showed in table 6 数据见表 6

Table 6 表 6

The state of cells 电芯状态	NO. 序号	External Peak temperature (℃) 表面最高温度	Status 结论
50% charged after one cycle 一次循环后 50%充电状态	19#	27.6	Pass 合格
	20#	27.5	Pass 合格
	21#	26.9	Pass 合格
	22#	27.7	Pass 合格
	23#	27.2	Pass 合格

7 Overcharge 过充电

1) 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.

可充电电池应满足以下要求：在试验过程中及试验后七天内不解体、不起火。

2) Test procedure 试验过程

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

(a) When the manufacturer's recommended charge voltage is not more than 18V, the minimum voltage of the test shall be the lesser of two times the maximum charge voltage of the battery or 22V.

(b) When the manufacturer's recommended charge voltage is more than 18 V, the minimum voltage of the test shall be 1.2 times the maximum charge voltage.

Test shall be conducted at ambient temperature. The duration of the test shall be 24 hours.

充电电流为制造商建议的最大连续充电电流值的两倍，试验最小充电电压如下：

(a) 当制造商建议的充电电压不超过 18V，试验电压最小值应取最大充电电压的两倍或 22V 中的较小者。

(b) 当制造商建议的充电电压超过 18V，试验电压最小值应为最大充电电压的 1.2 倍.

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试验应在环境温度下进行。试验持续时间为 24h。

3) Data showed in table 7 数据见表 7

Table 7 表 7

The state of batteries 电池状态	NO. 序号	Status 结论
Full charged after one cycle 一次循环后满电状态	11#	Pass 合格
	12#	Pass 合格
	13#	Pass 合格
	14#	Pass 合格
Full charged after fifty cycles. 五十次循环后满电状态	15#	Pass 合格
	16#	Pass 合格
	17#	Pass 合格
	18#	Pass 合格

8 Forced discharge 强制放电

1) 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.

一次或可充电电芯应满足以下要求：在实验后七天内不解体、不起火。

2) Test procedure 试验过程

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).

每块电芯应在环境温度下与一台 12V 直流电源连接进行强制放电，此直流电源的初始电流等于生产厂家规定的最大放电电流。

电芯与一个适当大小的电阻负载串联以调节到规定大小的放电电流。每块电芯的放电时间（单位为 h）等于电芯的额定容量除以实验初始放电电流大小（单位为 A）。

3) Data showed in table 8 数据见表 8

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Table 8

The state of cells 电芯状态	NO. 序号	Status 结论
Fully discharged after one cycle 一次循环后完全放电状态	24#	Pass 合格
	25#	Pass 合格
	26#	Pass 合格
	27#	Pass 合格
	28#	Pass 合格
	29#	Pass 合格
	30#	Pass 合格
	31#	Pass 合格
	32#	Pass 合格
	33#	Pass 合格
Fully discharged after fifty cycles 50 次循环后完全放电状态	34#	Pass 合格
	35#	Pass 合格
	36#	Pass 合格
	37#	Pass 合格
	38#	Pass 合格
	39#	Pass 合格
	40#	Pass 合格
	41#	Pass 合格
	42#	Pass 合格
	43#	Pass 合格