LITHIUM ION BATTERY SAFETY TESTING REPORT

检验报告

Applicant: 申请者：	Molie Quantum Energy Corporation 台湾三元能源科技股份有限公司 No.16, Changchun St., Xiaogang Dist., Kaohsiung City, 812 Taiwan R.O.C. 高雄市小港区长春街 16 号 Tel: 07-803-7777; Website: https://www.molicel.com; 电话: 07-803-7777; 网站: https://www.molicel.com; E-mail: Mqe.dcc@molicel.com 电子邮件: Mqe.dcc@molicel.com
Manufacturer: 制造商：	Molie Quantum Energy Corporation 台湾三元能源科技股份有限公司 No.16, Changchun St., Xiaogang Dist., Kaohsiung City, Taiwan 高雄市小港区长春街 16 号 Website: https://www.molicel.com; 网站: https://www.molicel.com
Product: 产品：	Lithium ion Rechargeable Cell 可充电式锂离子单电池
Model: 型号：	INR-21700-P45B
Rating: 规格	3.6 Vdc, 4.35 Ah, 15.66 Wh
Test method & Criterion 检验方法与判定标准：	UNITED NATIONS "Recommendations on the TRANSPORT OF DANGEROUS GOODS" Manual of Tests and Criteria ST/SG/AC.10/11/Rev.7/Amend.1 联合国《关于危险货物运输的建议书》试验和标准手册
Appearance 样品外观：	Cylindrical type 圆柱型
Verification Issuing Office Name 试验实验室：	AnTek Certification Inc. 7F, No.351, Yangguang St. Taipei, 11491 Taiwan 暐诚国际验证股份有限公司 11491 台北市内湖区阳光街 351 号 7 楼 电话：+886-2-8752-3779；网址：www.atclab.com.tw; 邮件信箱：atc@atclab.com.tw

Date Received: 收件日期：	2024-03-06
Test Performed Date: 检测起迄日期：	2024-03-11 ~ 2024-04-15
Test Items: 检测项目：	See Page 3 for details. 详见报告第 3 页
Conclusion: 检测结论：	The sample has passed the test items of UN 38.3 经检验，该样品符合联合国《关于危险货物运输的建议书》试验和标准手册 ST/SG/AC.10/11/Rev.7/Amend.1 标准要求
Date of Issued: 报告发行日期：	2024-06-11
Comment: 备注：	--

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TEST ITEMS

检测项目

No. 序号	Name of Test Items 检验项目名称	Conclusion 本项结论	Remark 备注
T1.	**Altitude Simulation** 高度模拟	Passed	--
T2.	**Thermal Test** 温度试验	Passed	--
T3.	**Vibration** 振动	Passed	--
T4.	**Shock** 冲击	Passed	--
T5.	**External Short Circuit** 外部短路	Passed	--
T6.	**Impact** 撞击	Passed	--
	Crush 挤压	N/A	--
T7.	**Overcharge** 过度充电	N/A	--
T8.	**Forced Discharge** 强制放电	Passed	--

Test Environment Condition 试验环境条件	Ambient Temperature: 21.9°C ~ 23.3°C Ambient Humidity: 55% ~ 59% 环境温度：21.9°C ~ 23.3°C 环境湿度：55% ~ 59%

General remarks

The report relates only to the object tested and uncertainty of measurement will not be evaluated.

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SAMPLES FOR TYPE TESTS:

Test Number 试验序号	Cell / Battery Type 电池芯 / 电池组类型	Test Samples 试验样品
T1 ~ T5	☐ Primary Cells 不可充电电池芯	Ten cells in undischarged states Ten cells in fully discharged states 十个未放电状态的电池芯 十个完全放电状态的电池芯
	☐ Primary Batteries (Small Type) 不可充电电池组（小型）	Four batteries in undischarged states Four batteries in fully discharged states 四个未放电状态的小型电池组 四个完全放电状态的小型电池组
	☐ Primary Batteries (Large Type) 不可充电电池组（大型）	Four batteries in undischarged states Four batteries in fully discharged states 四个未放电状态的大型电池组 四个完全放电状态的大型电池组
	☒ Rechargeable Cells 可充电电池芯	Five cells at first cycle, in fully charged states Five cells after 25 cycles ending in fully charged states 五个在第一个充放电周期完全充电状态的电池芯 五个在二十五个充放电周期后完全充电状态的电池芯
	☐ Single Cell type Battery 单电芯电池组	Five cells at first cycle, in fully charged states Five cells after 25 cycles ending in fully charged states 五个在第一个充放电周期完全充电状态的单电芯电池组 五个在二十五个充放电周期后完全充电状态的单电芯电池组
	☐ Rechargeable Batteries (Small Type) 可充式电池组（小型）	Four batteries at first cycle, in fully charged states Four batteries after 25 cycles ending in fully charged states 四个在第一个充放电周期完全充电状态的小型电池组 四个在二十五个充放电周期后完全充电状态的小型电池组
	☐ Rechargeable Batteries (Large Type) 可充式电池组（大型）	Two batteries at first cycle, in fully charged states Two batteries after 25 cycles ending in fully charged states 两个在第一个充放电周期完全充电状态的大型电池组 两个在二十五个充放电周期后完全充电状态的大型电池组
T6	☐ Primary cells 不可充电电池芯	Five cells in undischarged states Five cells in fully discharged states 五个未放电状态的电池芯 五个完全放电状态的电池芯
	☐ Component cells of	Five cells in undischarged states

	primary batteries 不可充电电池组的组件电池芯	Five cells in fully discharged states 五个未放电状态的组件电池芯 五个完全放电状态的组件电池芯
	☒ Rechargeable cells 可充电电池芯	Five cells at first cycle at 50% of the design rated capacity Five cells after 25 cycles ending at 50% of the design rated capacity 五个在第一个充放电周期50%设计额定容量状态的电池芯 五个在二十五个充放电周期后50%设计额定容量状态的电池芯
	☐ Component cells of rechargeable batteries 可充电电池组的组件电池芯	Five cells at first cycle at 50% of the design rated capacity Five cells after 25 cycles ending at 50% of the design rated capacity 五个在第一个充放电周期50%设计额定容量状态的组件电池芯 五个在二十五个充放电周期后50%设计额定容量状态的组件电池芯
T7	☐ Rechargeable Batteries (Small Type) 可充式电池组（小型)	Four batteries at first cycle, in fully charged states Four batteries after 25 cycles ending in fully charged states 四个在第一个充放电周期完全充电状态的小型电池组 四个在二十五个充放电周期后完全充电状态的小型电池组
	☐ Rechargeable Batteries (Large Type) 可充式电池组（大型)	Two batteries at first cycle, in fully charged states Two batteries after 25 cycles ending in fully charged states 两个在第一个充放电周期完全充电状态的大型电池组 两个在二十五个充放电周期后完全充电状态的大型电池组
T8	☐ Primary cells 不可充电电池芯	Ten cells in fully discharged states 十个完全放电状态的电池芯
	☐ Primary component cells 不可充电电池组的组件电池芯	Ten cells in fully discharged states 十个完全放电状态的组件电池芯
	☒ Rechargeable cells 可充电电池芯	Ten cells, at first cycle in fully discharged states Ten cells after 25 cycles ending in fully discharged states 十个在第一个充放电周期完全放电状态的电池芯 十个在二十五个充放电周期后完全放电状态的电池芯
	☐ Rechargeable component cells 可充电电池组的组件电池芯	Ten cells, at first cycle in fully discharged states Ten cells after 25 cycles ending in fully discharged states 十个在第一个充放电周期完全放电状态的组件电池芯 十个在二十五个充放电周期后完全放电状态的组件电池芯

T1: Altitude Simulation-高度模拟

Test procedure 试验程序:

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:

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。

Results 结果:

Sample No 样品编号	Sample State 样品状态	Before Test 试验前		After Test 试验后		Mass Loss (%) 质量损失 (%)	Residual Voltage (%) 剩余电压 (%)	Phenomenon 现象
		Mass (g) 质量 (g)	Open-Circuit Voltage (V) 开路电压 (V)	Mass (g) 质量 (g)	Open-Circuit Voltage (V) 开路电压 (V)			
01	A	67.685	4.173	67.677	4.171	0.01	99.95	O
02	A	68.026	4.171	68.014	4.169	0.02	99.95	O
03	A	68.055	4.172	68.052	4.170	0.00	99.95	O
04	A	67.638	4.173	67.632	4.171	0.01	99.95	O
05	A	67.774	4.174	67.770	4.172	0.01	99.95	O
06	B	68.059	4.173	68.057	4.172	0.00	99.98	O
07	B	68.291	4.174	68.290	4.172	0.00	99.95	O
08	B	67.794	4.172	67.794	4.171	0.00	99.98	O
09	B	67.947	4.174	67.947	4.173	0.00	99.98	O
10	B	68.183	4.173	68.183	4.172	0.00	99.98	O

Sample No 样品编号	Sample State 样品状态	Before Test 试验前		After Test 试验后		Mass Loss (%) 质量损失 (%)	Residual Voltage (%) 剩余电压 (%)	Phenomenon 现象
		Mass (g) 质量 (g)	Open-Circuit Voltage (V) 开路电压 (V)	Mass (g) 质量 (g)	Open-Circuit Voltage (V) 开路电压 (V)			

Sample state 样品状态:

A – Battery at first cycle, in fully charged states.
B – Battery after 25 cycles ending in fully charged states.
A –在第一个充放电周期完全充电状态的电池组
B –在二十五个充放电周期后完全充电状态的电池组

Phenomenon 现象:

L – Leakage; V – Venting; D – Disassembly; R – Rupture; F – Fire.
O - No leakage, no venting, no disassembly, no rupture and no fire.
L – 泄漏; V – 漏气; D – 解体; R – 破裂; F – 起火,
O - 无泄漏、无漏气、无解体、无破裂和无起火。

T2: Thermal Test 温度试验

Test procedure 试验程序:

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。

Results 结果:

Sample No 样品编号	Sample State 样品状态	Before Test 试验前		After Test 试验后		Mass Loss (%) 质量损失 (%)	Residual Voltage (%) 剩余电压 (%)	Phenomenon 现象
		Mass (g) 质量 (g)	Open-Circuit Voltage (V) 开路电压 (V)	Mass (g) 质量 (g)	Open-Circuit Voltage (V) 开路电压 (V)			
01	A	67.677	4.171	67.671	4.105	0.01	98.42	O
02	A	68.014	4.169	68.005	4.104	0.01	98.44	O
03	A	68.052	4.170	68.050	4.104	0.00	98.42	O
04	A	67.632	4.171	67.623	4.106	0.01	98.44	O
05	A	67.770	4.172	67.770	4.107	0.00	98.44	O
06	B	68.057	4.172	68.057	4.109	0.00	98.49	O

Sample No 样品编号	Sample State 样品状态	Before Test 试验前		After Test 试验后		Mass Loss (%) 质量损失 (%)	Residual Voltage (%) 剩余电压 (%)	Phenomenon 现象
		Mass (g) 质量 (g)	Open-Circuit Voltage (V) 开路电压 (V)	Mass (g) 质量 (g)	Open-Circuit Voltage (V) 开路电压 (V)			
07	B	68.290	4.172	68.289	4.109	0.00	98.49	O
08	B	67.794	4.171	67.793	4.109	0.00	98.51	O
09	B	67.947	4.173	67.945	4.109	0.00	98.47	O
10	B	68.183	4.172	68.180	4.109	0.00	98.49	O

Sample state 样品状态:

A – Battery at first cycle, in fully charged states.
B – Battery after 25 cycles ending in fully charged states.
A –在第一个充放电周期完全充电状态的电池组
B –在二十五个充放电周期后完全充电状态的电池组

Phenomenon 现象:

L – Leakage; V – Venting; D – Disassembly; R – Rupture; F – Fire.
O - No leakage, no venting, no disassembly, no rupture and no fire.
L – 泄漏; V – 漏气; D – 解体; R – 破裂; F – 起火,
O - 无泄漏、无漏气、无解体、无破裂和无起火。

T3: Vibration 振动

Test procedure 试验程序:

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.

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 Hz 和 200 Hz 之间，再回到 7 Hz，跨度为 15 分钟，这一振动过程需对三个互相垂直的电池安装方位的每一个方向重复进行 12 次，总共为时 3 小时，其中一个振动方向必须与端面垂直。

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).

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。

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.

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

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

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其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。

Results 结果:

Sample No 样品编号	Sample State 样品状态	Before Test 试验前		After Test 试验后		Mass Loss (%) 质量损失 (%)	Residual Voltage (%) 剩余电压 (%)	Phenomenon 现象
		Mass (g) 质量 (g)	Open-Circuit Voltage (V) 开路电压 (V)	Mass (g) 质量 (g)	Open-Circuit Voltage (V) 开路电压 (V)			
01	A	67.671	4.105	67.663	4.105	0.01	100.00	O
02	A	68.005	4.104	67.999	4.103	0.01	99.98	O
03	A	68.050	4.104	68.050	4.104	0.00	100.00	O
04	A	67.623	4.106	67.623	4.106	0.00	100.00	O
05	A	67.770	4.107	67.766	4.107	0.01	100.00	O
06	B	68.057	4.109	68.057	4.109	0.00	100.00	O
07	B	68.289	4.109	68.288	4.109	0.00	100.00	O
08	B	67.793	4.109	67.793	4.109	0.00	100.00	O
09	B	67.945	4.109	67.943	4.109	0.00	100.00	O
10	B	68.180	4.109	68.178	4.109	0.00	100.00	O

Sample state 样品状态:

A – Battery at first cycle, in fully charged states.
B – Battery after 25 cycles ending in fully charged states.
A –在第一个充放电周期完全充电状态的电池组
B –在二十五个充放电周期后完全充电状态的电池组

Phenomenon 现象:

L – Leakage; V – Venting; D – Disassembly; R – Rupture; F – Fire.
O - No leakage, no venting, no disassembly, no rupture and no fire.
L – 泄漏; V – 漏气; D – 解体; R – 破裂; F – 起火,
O - 无泄漏、无漏气、无解体、无破裂和无起火。

T4: Shock 冲击

Test procedure 试验程序:

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.

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。

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.

每个电池需经受最大加速度 150 gn 和脉冲持续时间 6 毫秒的正半弦波冲击；大型电池需经受最大加速度 50 gn 和脉冲持续时间 11 毫秒的正半弦波冲击。

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.

每个电池组需经受基于电池组本身质量的最大加速度的正半弦波冲击，小型电池组的脉冲持续时间为 6 毫秒，大型电池组的脉冲持续时间为 11 毫秒，提供以下公式以计算适当的最小加速度。

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

[a] Mass is expressed in kilograms.

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.

每个电池或电池组需在三个互相垂直的电池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。

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。

Results 结果:

Sample No 样品编号	Sample State 样品状态	Before Test 试验前		After Test 试验后		Mass Loss (%) 质量损失 (%)	Residual Voltage (%) 剩余电压 (%)	Phenomenon 现象
		Mass (g) 质量 (g)	Open-Circuit Voltage (V) 开路电压 (V)	Mass (g) 质量 (g)	Open-Circuit Voltage (V) 开路电压 (V)			
01	A	67.663	4.105	67.656	4.105	0.01	100.00	O
02	A	67.999	4.103	67.997	4.103	0.00	100.00	O
03	A	68.050	4.104	68.049	4.104	0.00	100.00	O
04	A	67.623	4.106	67.621	4.106	0.00	100.00	O
05	A	67.766	4.107	67.760	4.107	0.01	100.00	O
06	B	68.057	4.109	68.055	4.109	0.00	100.00	O
07	B	68.288	4.109	68.287	4.109	0.00	100.00	O
08	B	67.793	4.109	67.793	4.109	0.00	100.00	O
09	B	67.943	4.109	67.941	4.109	0.00	100.00	O
10	B	68.178	4.109	68.178	4.109	0.00	100.00	O

Sample state 样品状态:

A – Battery at first cycle, in fully charged states.
B – Battery after 25 cycles ending in fully charged states.
A –在第一个充放电周期完全充电状态的电池组
B –在二十五个充放电周期后完全充电状态的电池组

Phenomenon 现象:

L – Leakage; V – Venting; D – Disassembly; R – Rupture; F – Fire.
O - No leakage, no venting, no disassembly, no rupture and no fire.
L – 泄漏; V – 漏气; D – 解体; R – 破裂; F – 起火,
O - 无泄漏、无漏气、无解体、无破裂和无起火。

T5: External Short Circuit 外部短路

Test procedure 试验程序:

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.

对于待试验电池或电池组，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纪录。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 条件下经受总外电组小于 0.1 奥姆的短路条件。

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.

这一短路条件应在电池或电池组外壳温度回到 57 ± 4 °C 后持续至少 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最高温升幅的二分之一并保持低于该值。

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

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 小时无解体、无破裂及无起火，电池和电池组即符合本项要求。

Results 结果:

Sample No 样品编号	Sample State 样品状态	External Highest Temperature (°C) 样品表面最高温度 (°C)	Initial Voltage(V) 开路电压(V)	External resistance(mΩ) 外部阻值(mΩ)	Phenomenon 现象
01	A	99.0	4.105	94.5	O
02	A	95.8	4.103	90.6	O
03	A	94.4	4.104	89.3	O

Sample No 样品编号	Sample State 样品状态	External Highest Temperature (°C) 样品表面最高温度 (°C)	Initial Voltage(V) 开路电压(V)	External resistance(mΩ) 外部阻值(mΩ)	Phenomenon 现象
04	A	94.4	4.106	95.6	O
05	A	91.6	4.107	89.9	O
06	B	85.8	4.109	95.1	O
07	B	83.7	4.109	93.1	O
08	B	93.1	4.109	93.3	O
09	B	86.2	4.109	93.5	O
10	B	87.9	4.109	94.3	O

Sample state 样品状态:
A – Battery at first cycle, in fully charged states.
B – Battery after 25 cycles ending in fully charged states.
A –在第一个充放电周期完全充电状态的电池组
B –在二十五个充放电周期后完全充电状态的电池组
Phenomenon 现象:
L – Leakage; V – Venting; D – Disassembly; R – Rupture; F – Fire.
O - No leakage, no venting, no disassembly, no rupture and no fire.
L – 泄漏; V – 漏气; D – 解体; R – 破裂; F – 起火,
O - 无泄漏、无漏气、无解体、无破裂和无起火。

T6: Impact/Crush 撞击/挤压

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

试验程序 – 撞击 (适用于直径不小于18.0 mm的圆柱型电池)

The test sample cell or component cell is to be placed on a flat smooth surface. A 15.8 mm ± 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 kg ± 0.1kg 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.

试样电池或组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 mm± 0.1 mm，长度至少 6 cm，或电池最长端的尺度，取两者之长者。将一块 9.1 kg ± 0.1kg 的重锤从 61 ± 2.5 cm 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成 90 度落下。

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 ± 0.1 mm diameter curved surface lying across the centre of the test sample. Each sample is to be subjected to only a single impact.

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 mm ± 0.1 mm 弯曲表面的纵轴垂直。每一试样只经受一次冲击。

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

试验程序 – 挤压 (适用于棱柱型、袋状、硬币/钮扣电池和直径小于18.0 mm的圆柱型电池)

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.

将电池或组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 cm/秒，挤压持续进行，直到出现以下三种情况之一：

(a) The applied force reaches 13 kN ± 0.78 kN;
施加的力量达到 13 kN ± 0.78 kN；
Example: The force shall be applied by a hydraulic ram with a 32 mm diameter piston until a pressure of 17 MPa is reached on the hydraulic ram.
例如：用一个活塞直径 32 mm 的液压顶施力，直到液压顶的压力达到 17 MPa。

(b) The voltage of the cell drops by at least 100 mV; or

电池的电压下降至少 100 mV；或

(c) The cell is deformed by 50% or more of its original thickness.
电池变形达原始厚度的 50%或以上。

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.

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

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.

棱柱型或袋状电池应从最宽的一面施压。钮扣/硬币型电池应从其平坦表面施压。圆柱型电池应从纵轴垂直的方向施压。

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.

Note: Diameter here refers to the design parameter (for example the diameter of 18650 cells is 18.0 mm).

每个试样电池或组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组件电池进行。

注：这里的直径是指设计参数（例如 18650 电池的直径为 18.0mm）

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、无起火，电池即符合本项要求。

Results 结果:

Sample No 样品编号	Sample State 样品状态	External Highest Temperature (°C) 样品表面最高温度(°C)	Phenomenon 现象
11	A	22.4	O
12	A	22.5	O
13	A	23.5	O
14	A	31.6	O
15	A	24.5	O

Sample No 样品编号	Sample State 样品状态	External Highest Temperature (°C) 样品表面最高温度(°C)	Phenomenon 现象
16	B	38.4	O
17	B	26.2	O
18	B	32.6	O
19	B	26.6	O
20	B	31.3	O

Sample state 样品状态:
A – Cell at first cycle at 50% of the design rated capacity.
B – Cell after 25 cycles ending at 50% of the design rated capacity.
A –在第一个充放电周期 50%设计额定容量状态的电池芯
B –在二十五个充放电周期后 50%设计额定容量状态的电池芯
Phenomenon 现象:
D – Disassembly; F – Fire; O - No disassembly and no fire;
D – 解体; F – 起火; O – 无解体和无起火。

T7: Overcharge 过度充电

Test procedure 试验程序：

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

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) 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.
制造商建议的充电电压不大于 18V 时，试验的最小电压是电池组最大充电电压的两倍或 22V 两者中的较小者。

(b) when the manufacturer's recommended charge voltage is more than 18V, the minimum voltage of the test shall be 1.2 times the maximum charge voltage.
制造商建议的充电电压大于 18V 时，试验的最小电压应为最大充电电压的 1.2 倍。

Tests are to be conducted at ambient temperature. The duration of the test shall be 24 hours.

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。

Results 结果:

Sample No 样品编号	Sample State 样品状态	During Test 试验期间		Phenomenon 现象
		Charge Current 充电电流	Charge Voltage 充电电压	
--	--	--	--	--
--	-	--	--	--
--	--	--	--	--
--	-	--	--	--
--	--	--	--	--
--	-	--	--	--
--	--	--	--	--

--	-	--	--	--

Sample state 样品状态:
A – Battery at first cycle, in fully charged states.
B – Battery after 25 cycles ending in fully charged states.
A –在第一个充放电周期完全充电状态的电池组
B –在二十五个充放电周期后完全充电状态的电池组
Phenomenon 现象:
D – Disassembly; F – Fire; O - No disassembly and no fire.
D – 解体; F – 起火; O – 无解体和无起火。

T8: Forced Discharge 强制放电

Test procedure 试验程序：

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.

每个电池应在环境温度下与 12 V 直流电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。

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).

将适当大小和额定值的电阻负荷与试验电池连接，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.

不可充电或可充电电池芯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。

Results 结果:

Sample No 样品编号	Sample State 样品状态	Discharge Current 放电电流	Discharge Duration 放电时间	Phenomenon 现象
21	A	60 A	0.08 h	O
22	A	60 A	0.08 h	O
23	A	60 A	0.08 h	O
24	A	60 A	0.08 h	O
25	A	60 A	0.08 h	O
26	A	60 A	0.08 h	O
27	A	60 A	0.08 h	O
28	A	60 A	0.08 h	O
29	A	60 A	0.08 h	O
30	A	60 A	0.08 h	O
31	B	60 A	0.08 h	O
32	B	60 A	0.08 h	O
33	B	60 A	0.08 h	O
34	B	60 A	0.08 h	O

Sample No 样品编号	Sample State 样品状态	Discharge Current 放电电流	Discharge Duration 放电时间	Phenomenon 现象
35	B	60 A	0.08 h	O
36	B	60 A	0.08 h	O
37	B	60 A	0.08 h	O
38	B	60 A	0.08 h	O
39	B	60 A	0.08 h	O
40	B	60 A	0.08 h	O

Sample state 样品状态:
A – Cell at first cycle in fully discharged states.
B – Cell after 25 cycles ending in fully discharged states.
A –在第一个充放电周期完全放电状态的电池芯
B –在二十五个充放电周期后完全放电状态的电池芯
Phenomenon 现象:
D – Disassembly; F – Fire; O - No disassembly and no fire.
D – 解体; F – 起火; O – 无解体和无起火。

Photographs 照片

<Fig. #1>

<Fig. #2>