检测报告
TEST REPORT

NAME OF SAMPLE: Rechargeable Lithium-ion Cell
产品名称：可充电式锂离子电芯

CLIENT: Zhejiang Liwinon Energy Technology Co., Ltd.
委托单位：浙江锂威能源科技有限公司

CLASSIFICATION OF TEST: Commission test
检测类别：委托测试

深圳普瑞赛思检测技术有限公司
Shenzhen Precise Testing Technology Co., Ltd.

Applicant information 申请资料	
Name of samples: 样品名称：	Rechargeable Lithium-ion Cell 可充电式锂离子电芯
Type/ Model: 型号规格：	516384 3.91V 4870mAh 19.05Wh
Lithium content: 锂含量：	—
Trade mark: 商标：	—
Commission by: 委托单位：	Zhejiang Liwinon Energy Technology Co., Ltd. 浙江锂威能源科技有限公司
Commissioner address: 委托单位地址：	111 Yanzhou Road, Lanjiang Street, Lanxi County, Jinhua City, Zhejiang Province, China. 浙江省金华市兰溪市兰江街道雁洲路111号
Manufacturer： 生产单位：	Zhejiang Liwinon Energy Technology Co., Ltd. 浙江锂威能源科技有限公司
Manufacturer address: 生产单位地址：	111 Yanzhou Road, Lanjiang Street, Lanxi County, Jinhua City, Zhejiang Province, China. 浙江省金华市兰溪市兰江街道雁洲路111号
Appearance: 样品外观颜色：	Silver 银色
Sample Type 样品类型	Rechargeable Li-ion Cell 可充式锂离子电芯
Sample status: 样品状态：	Good 完好
Quantity of sample: 样品数量：	40pcs
Sample identification: 样品标识序号：	c1# ~c40#
Receiving date: 接样日期：	2023-04-12
Testing date: 测试开始日期：	2023-04-13
Completing date: 测试完成日期：	2023-04-26

Conclusion/结论：

The submitted samples comply with the requirements of UNITED NATIONS Section 38.3 of the seventh revised edition Amend.1 of the Recommendations on the Transport of Dangerous Goods, Manual of Test and Criteria (ST/SG/AC.10/11/Rev.7/Amend.1/Section 38.3)

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》第七修订版修正 1 第 38.3 节的要求。

Seal/报告专用章：

Date of issue：2023-04-26

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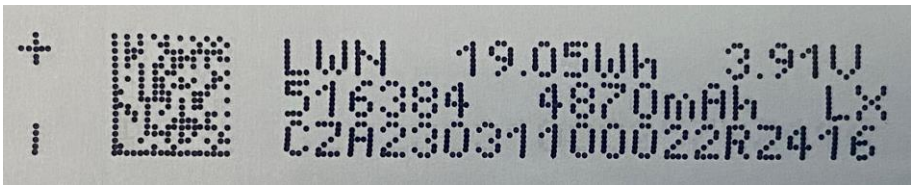
Approved by：报告批准：

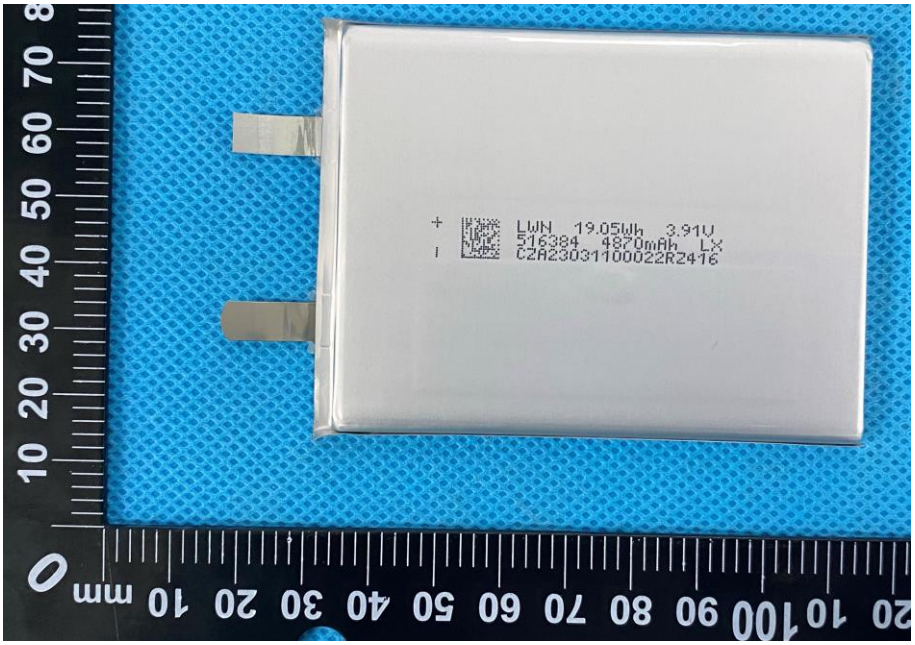
Test Conclusion测试结论

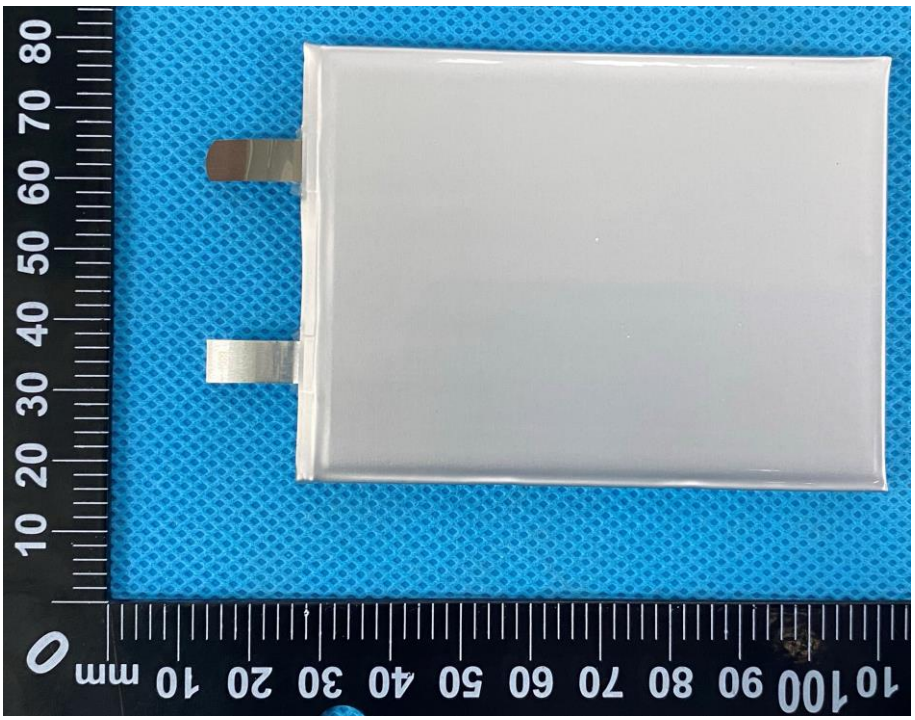
No. 序号	Name of test 测试项目名称	Test result 测试结果	Conclusion 本项结论
1	Altitude simulation 高度模拟	See Appendix 1	P
2	Thermal test 温度测试	See Appendix 2	P
3	Vibration 振动	See Appendix 3	P
4	Shock 冲击	See Appendix 4	P
5	External Short-circuit 外部短路	See Appendix 5	P
6	Crush 挤压	See Appendix 6	P
	Impact 撞击	See Appendix 6	N/A
7	Overcharge 过度充电	See Appendix 7	N/A
8	Forced discharge 强制放电	See Appendix 8	P

Photos of samples and markings
样品及标识照片

CELL(516384 3.91V 4870mAh 19.05Wh)







Appendix 1
附表 1

Test Items 测试项目	Altitude simulation 高度模拟
1.1	**Test procedure** 测试步骤
	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℃). 试验电池芯和电池在环境温度(20±5℃)下，储存在小于等于11.6kPa的压力下至少六小时。
1.2	**Sample status** 样品状态
	c1# ~ c5#, at first cycle in fully charged states; c6# ~ c10#, after 25 cycles ending in fully charged states. c1# ~ c5#, 在第一个循环完全充电；c6# ~ c10#，在第25个循环完全充电。
1.3	**Result** 测试结果

Sample No. 样品编号	Before Test测试前		After Test测试后		Mass loss 质量损失 (%)	Residual OCV 剩余电压 (≥90%)	Test result 测试结果
	Mass 样品质量 (g)	Voltage 开路电压 (V)	Mass 样品质量 (g)	Voltage 开路电压 (V)			
c1#	66.947	4.462	66.947	4.456	0.000	99.87	**O**
c2#	66.894	4.462	66.893	4.457	0.001	99.89	**O**
c3#	66.963	4.462	66.963	4.457	0.000	99.89	**O**
c4#	66.926	4.463	66.924	4.458	0.003	99.89	**O**
c5#	66.708	4.461	66.708	4.454	0.000	99.84	**O**
c6#	66.964	4.463	66.963	4.457	0.001	99.87	**O**
c7#	66.764	4.462	66.763	4.456	0.001	99.87	**O**
c8#	67.048	4.462	67.046	4.456	0.003	99.87	**O**
c9#	66.708	4.463	66.708	4.456	0.000	99.84	**O**
c10#	67.132	4.463	67.131	4.458	0.001	99.89	**O**

Note: **L**-Leakage, **V**-Venting, **D** -Disassembly, **R** -Rupture, **F**-Fire, **O**-No leakage, no venting, no disassembly, no rupture, no fire.

注：L- 泄漏；V- 排气；D- 解体；R- 破裂；F - 起火；O- 无泄漏、无排气、无解体、无破裂、无起火。

Appendix 2
附表 2

Test Items 测试项目	Thermal test 温度测试
1.1	**Test procedure** 测试步骤
	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 in 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℃). 将电芯和电池在温度为72±2℃的条件下贮存不少于6个小时，然后，在温度-40±2℃条件下贮存不少于6个小时，两个温度间的间隔最长为30min,重复操作上述步骤直到10次，然后，将其在环境温度为20±5℃的条件下放置24个小时。
1.2	**Sample status** 样品状态
	c1# ~ c5#, at first cycle in fully charged states; c6# ~ c10#, after 25 cycles ending in fully charged states. c1# ~ c5#, 在第一个循环完全充电；c6# ~ c10#，在第25个循环完全充电。
1.3	**Result** 测试结果

Sample No. 样品编号	Before Test测试前		After Test测试后		Mass loss 质量损失 (%)	Residual OCV 剩余电压 (≥90%)	Test result 测试结果
	Mass 样品质量 (g)	Voltage 开路电压 (V)	Mass 样品质量 (g)	Voltage 开路电压 (V)			
c1#	66.947	4.456	66.928	4.365	0.028	97.96	**O**
c2#	66.893	4.457	66.873	4.365	0.030	97.94	**O**
c3#	66.963	4.457	66.939	4.365	0.036	97.94	**O**
c4#	66.924	4.458	66.901	4.367	0.034	97.96	**O**
c5#	66.708	4.454	66.684	4.358	0.036	97.84	**O**
c6#	66.963	4.457	66.943	4.362	0.030	97.87	**O**
c7#	66.763	4.456	66.742	4.359	0.031	97.82	**O**
c8#	67.046	4.456	67.023	4.362	0.034	97.89	**O**
c9#	66.708	4.456	66.684	4.361	0.036	97.87	**O**
c10#	67.131	4.458	67.107	4.367	0.036	97.96	**O**

Note: **L**-Leakage, **V**-Venting, **D** -Disassembly, **R** -Rupture, **F**-Fire, **O**-No leakage, no venting, no disassembly, no rupture, no fire.

注：L- 泄漏；V- 排气；D- 解体；R- 破裂；F - 起火；O- 无泄漏、无排气、无解体、无破裂、无起火。

Appendix 3
附表 3

Test Items 测试项目	Vibration 振动
1.1	**Test procedure** 测试步骤
	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 wave form 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 position of the cell. 将电芯和电池牢固地安装在振动台的台面上，然后开始振动。振动以正弦波形式，以7Hz增加至200Hz，然后再减少回到7Hz为一个循环，一个循环持续15分钟的对数扫频。每个电芯和电池从三个互相垂直的方向上循环12次，3个小时。
1.2	**Sample status** 样品状态
	c1# ~ c5#, at first cycle in fully charged states; c6# ~ c10#, after 25 cycles ending in fully charged states. c1# ~ c5#, 在第一个循环完全充电；c6# ~ c10#，在第25个循环完全充电。
1.3	**Result** 测试结果

Sample No. 样品编号	Before Test测试前		After Test测试后		Mass loss 质量损失 (%)	Residual OCV 剩余电压 (≥90%)	Test result 测试结果
	Mass 样品质量（g)	Voltage 开路电压 (V)	Mass 样品质量 (g)	Voltage 开路电压 (V)			
c1#	66.928	4.365	66.926	4.363	0.003	99.95	**O**
c2#	66.873	4.365	66.872	4.364	0.001	99.98	**O**
c3#	66.939	4.365	66.938	4.362	0.001	99.93	**O**
c4#	66.901	4.367	66.901	4.365	0.000	99.95	**O**
c5#	66.684	4.358	66.682	4.356	0.003	99.95	**O**
c6#	66.943	4.362	66.943	4.359	0.000	99.93	**O**
c7#	66.742	4.359	66.739	4.356	0.004	99.93	**O**
c8#	67.023	4.362	67.021	4.359	0.003	99.93	**O**
c9#	66.684	4.361	66.683	4.357	0.001	99.91	**O**
c10#	67.107	4.367	67.106	4.365	0.001	99.95	**O**

Note: **L**-Leakage, **V**-Venting, **D** -Disassembly, **R** -Rupture, **F**-Fire, **O**-No leakage, no venting, no disassembly, no rupture, no fire.

注：L- 泄漏；V- 排气；D- 解体；R- 破裂；F - 起火；O- 无泄漏、无排气、无解体、无破裂、无起火。

Appendix 4
附表 4

Test Items 测试项目	Shock 冲击
1.1	**Test procedure** 测试步骤
	Test cells and batteries shall be secured to the testing machine, and each cell shall be subjected to a half-sine shock of peak acceleration of 150g_n and pulse duration of 6 milliseconds. Large cells may be subjected to a half-sine shock of peak acceleration of 50g_n and pulse duration of 11 milliseconds. Small batteries shall be subjected to a half-sine shock of peak acceleration of 150g_n (or Acceleration(g_n)= $\sqrt{\left(\frac{100850}{mass}\right)}$,which is smaller) and pulse duration of 6 milliseconds, large batteries shall be subjected to a half-sine of peak acceleration of 50g_n (or Acceleration(g_n)= $\sqrt{\left(\frac{30000}{mass}\right)}$,which is smaller)and pulse duration of 11 milliseconds. Each cell or battery shall be subjected to three shocks in the positive direction followed by three shocks in the negative direction of three mutually perpendicular mounting positions of the cell or battery for a total of 18 shocks 以稳固的托架固定住每个电芯和电池样品的全部配件表面。对每个电芯以峰值为150g_n的半正弦的加速度撞击，脉冲持续6毫秒，大型电芯须经受最大加速度50g_n和脉冲持续时间11毫秒的半正弦波冲击。对每个电池以峰值为150g_n（或与$\sqrt{\left(\frac{100850}{mass}\right)}$中的较小值）的半正弦的加速度撞击，脉冲持续6毫秒，大型电池组须经受最大加速度50g_n（或与$\sqrt{\left(\frac{30000}{mass}\right)}$中的较小值）和脉冲持续时间11毫秒的半正弦波冲击。每个电池或电池组须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。
1.2	**Sample status** 样品状态
	c1# ~ c5#, at first cycle in fully charged states; c6# ~ c10#, after 25 cycles ending in fully charged states. c1# ~ c5#, 在第一个循环完全充电；c6# ~ c10#，在第25个循环完全充电。
1.3	**Result** 测试结果

Sample No. 样品编号	Before Test测试前		After Test测试后		Mass loss 质量损失 (%)	Residual OCV 剩余电压 (≥90%)	Test result 测试结果
	Mass 样品质量 (g)	Voltage 开路电压 (V)	Mass 样品质量 (g)	Voltage 开路电压 (V)			
c1#	66.926	4.363	66.926	4.363	0.000	100.00	**O**
c2#	66.872	4.364	66.872	4.364	0.000	100.00	**O**
c3#	66.938	4.362	66.938	4.362	0.000	100.00	**O**
c4#	66.901	4.365	66.901	4.365	0.000	100.00	**O**
c5#	66.682	4.356	66.682	4.356	0.000	100.00	**O**
c6#	66.943	4.359	66.943	4.359	0.000	100.00	**O**
c7#	66.739	4.356	66.739	4.356	0.000	100.00	**O**
c8#	67.021	4.359	67.021	4.359	0.000	100.00	**O**
c9#	66.683	4.357	66.683	4.357	0.000	100.00	**O**
c10#	67.106	4.365	67.106	4.365	0.000	100.00	**O**

Note: **L**-Leakage, **V**-Venting, **D**-Disassembly, **R**-Rupture, **F**-Fire, **O**-No leakage, no venting, no disassembly, no rupture, no fire.

注：L- 泄漏；V- 排气；D- 解体；R- 破裂；F - 起火；O- 无泄漏、无排气、无解体、无破裂、无起火。

Appendix 5
附表 5

Test Items 测试项目	External short circuit 外部短路		
1.1	**Test procedure** 测试步骤		
	The cell or battery to be tested shall be temperature stabilized so that its external case temperature reaches 57±4℃ and then the cell or battery shall be subjected to a short circuit condition with a total external resistance of less than 0.1 ohm at 57±4℃, This short circuit condition is continued for at least one hour after the cell or battery external case temperature has returned to 57±4℃, the cell or battery must be observed for a further six hour for the test to be concluded. 保持试验环境温度稳定在57±4℃，以使电芯或电池样品外表温度达到57±4℃，然后，在此温度下，将其正负极用小于0.1欧姆的线路短接，待电芯或电池的外表温度恢复到57±4℃之后再持续1小时以上，对电芯或电池必须进一步观察6个小时才能下结论。		
1.2	**Sample status** 样品状态		
	c1# ~ c5#, at first cycle in fully charged states; c6# ~ c10#, after 25 cycles ending in fully charged states. c1# ~ c5#, 在第一个循环完全充电；c6# ~ c10#，在第25个循环完全充电。		
1.3	**Result** 测试结果		
Sample No. 样品编号	Max. External Temperature 样品表面最高温度 (℃)	Test result 测试结果	Remark 备注
c1#	120.3	**O**	/
c2#	99.9	**O**	/
c3#	115.1	**O**	/
c4#	104.3	**O**	/
c5#	102.3	**O**	/
c6#	123.4	**O**	/
c7#	121.8	**O**	/
c8#	122.5	**O**	/
c9#	116.3	**O**	/
c10#	107.6	**O**	/
Note: **D** –Disassembly, **R** –Rupture, **F** –Fire, **OT** –Over Temperature, **O** –no disassembly, no rupture, no fire, no Over temperature 注： D- 解体；R- 破裂；F– 起火；OT– 超过170℃；O– 无解体、无破裂、无起火、不超过170℃			

Appendix 6 附表 6	
Test Items 测试项目	Crush 挤压/Impact 撞击
1.1	**Test procedure** 测试步骤
	☒ **Crush 挤压** 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 13kN±0.78kN; (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 100mV or more, or the cell is deformed by at least 50% of its original thickness, the pressure shall be released. 电池芯或组成电池芯在两个平面间挤压。挤压在第一个接触点以约1.5cm/s 的速度慢慢进行，直到下面三个选项之一达到为止： (a)作用力达到 13kN±0.78kN； (b)电池芯电压降至少达到100mV； (c)电池厚度和最初比较变形至少50%。 一旦达到最大压力，电压降超过100 mV或者电池芯变形超过50%，压力应该解除。 ☐ **Impact 撞击** (applicable to cylindrical cells not less than 18mm in diameter) The 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 ± 0.1 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 ± 0.1 mm diameter curved surface lying across the centre of the test sample. Each sample is to be subjected to only a single impact.

Appendix 6
附表 6

Test Items 测试项目	Crush 挤压/Impact 撞击		
	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. （适用于直径不小于18毫米的圆柱形电池）将电池或元件电池样品平放在一个平面上，其纵轴平行于测试台面年，将一直径为15.8mm±0.1 mm的316型不锈钢棒横放在电池中心位置。然后，将一质量为9.1kg±0.1kg的物体从61±2.5 cm的高度落向样品。样品在进行试验时，其外表温度应不超过170℃。且试验结束后6个小时之内，样品应无解体、无起火现象发生。		
1.2	**Sample status** 样品状态		
	c11# ~ c15#, at first cycle at 50% of the design rated capacity; c16# ~ c20#, after 25 cycles ending at 50% of the design rated capacity. c11# ~ c15#, 在第一个循环50%的额定容量；c16# ~ c20#, 在第25个循环50%的额定容量。		
1.3	**Result** 测试结果		
Sample No. 样品编号	Max. External Temperature 样品表面最高温度(℃)	Test result 测试结果	Remark 备注
c11#	24.6	**O**	/
c12#	24.1	**O**	/
c13#	24.2	**O**	/
c14#	23.0	**O**	/
c15#	24.2	**O**	/
c16#	24.2	**O**	/
c17#	24.4	**O**	/
c18#	24.4	**O**	/
c19#	24.2	**O**	/
c20#	24.0	**O**	/

Note: **D** -Disassembly, **R** -Rupture, **F**-Fire, **OT** –Over Temperature, **O**- no disassembly, no fire, no Over temperature

注：D- 解体；R- 破裂；F - 起火；OT– 超过170℃；O-无解体、无起火、不超过170℃

Appendix 7
附表 7

Test Items 测试项目	Overcharge 过度充电		
1.1	**Test procedure** 测试步骤		
	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 or 22V，whichever is less. When the manufacturer's recommended charge voltage is more than 18V, the charging voltage of the test shall be 1.2 times maximum charge voltage. The charging current is 2 times of the maximum charging current recommended by the manufacturer。 如果厂家推荐的充电电压不超过18V，本测试的最小充电电压应该是两倍的厂家标定最大充电电压或者是22V，取其中较小者。如果厂家推荐的充电电压超过18V，充电电压应该为 1.2倍的厂家标定最大充电电压。充电电流为厂家推荐的最大充电电流2倍。		
1.2	**Sample status** 样品状态		
	/		
1.3	**Result** 测试结果		
Sample No. 样品编号	Voltage Before test(V) 测试前开路电压(V)	Test result 测试结果	Remark 备注
/	/	/	/
/	/	/	/
/	/	/	/
/	/	/	/
/	/	/	/
/	/	/	/
/	/	/	/
/	/	/	/

Note: **D** -Disassembly, **F**-Fire, **O**- no disassembly, no fire.
注： D- 解体；F - 起火；O-无解体、无起火。

Appendix 8
附表 8

Test Items 测试项目	Forced discharge 强制放电				
1.1	**Test procedure** 测试步骤				
	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 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). 在20±5℃的环境温度下，将单个电芯连接在12V的直流电源上进行强制放电，此直流电源提供每个电芯初始电流为制造厂指定的最大放电电流，放电时间为额定容量除以初始电流。				
1.2	**Sample status** 样品状态				
	c21# ~ c30#, at first cycle in fully discharged states; c31# ~ c40#, after 25 cycles ending in fully discharged states. c21# ~ c30#，在第一个循环完全放电； c31# ~ c40#，在第25个循环完全放电。				
1.3	**Result** 测试结果				
Sample No. 样品编号	Voltage Before test 测试前开路电压(V)	Test result 测试结果	Sample No. 样品编号	Voltage Before test 测试前开路电压(V)	Test result 测试结果
c21#	3.539	**O**	c31#	3.560	**O**
c22#	3.554	**O**	c32#	3.556	**O**
c23#	3.555	**O**	c33#	3.558	**O**
c24#	3.560	**O**	c34#	3.562	**O**
c25#	3.563	**O**	c35#	3.558	**O**
c26#	3.558	**O**	c36#	3.555	**O**
c27#	3.553	**O**	c37#	3.561	**O**
c28#	3.562	**O**	c38#	3.556	**O**
c29#	3.553	**O**	c39#	3.562	**O**
c30#	3.554	**O**	c40#	3.545	**O**

Note: **D** -Disassembly, **F**-Fire, **O**- no disassembly, no fire.
注： D- 解体；F - 起火；O-无解体、无起火。

注 意 事 项
Important Information

1. 本报告无批准人签名和 “报告专用章”无效。
   The test report is effective only with both the signature of approver and the report stamp of the laboratory.

2. 除全文复制外，未经批准不得部分复制报告。
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3. 本报告私自转让、盗用、冒用、涂改、或以任何媒体形式篡改均属无效。
   The test report is invalid when anything of the following happens-illegal transfer, embezzlement, imposture, modification or tampering in any media form.

4. 对检测报告若有异议，应于收到报告之日起十五天内向检测单位提出。
   Objections to the test report must be submitted to lab within 15 days.

5. 本报告检测结果仅对受试样品有效。
   The results shown in the report only apply to the sample(s) as tested.

6. 本检测结果中“N/A”表示“不适用”，“P”表示“通过”，“F”表示“不通过”。
   As for the test result “N/A” means “Not Applicable”, “P” means “Pass” and “F” means “Fail”.

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