



产 品 规 格 书

LP54173207-180Ah 磷酸铁锂蓄电池

力神动力电池系统有限公司

www.lishen.com.cn



Product Specification

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1 适用范围

本规格书适用于力神动力电池系统有限公司生产的 LP54173207-180Ah 磷酸铁锂蓄电池。

2 常规指标

2.1 符号与缩略语说明

C_1 —— 1 小时率额定容量(Ah);

I_1 —— 1 小时率电流, 其数值等于 C_1 (A); 本规格书中 $1 I_1 = 180 A$;

P_1 —— 1 小时率功率, 本规格书中 $1P_1=576(W)$; $nP_1(W)$ 为 $1/n$ 小时率功率, $nP_1=n*576(W)$; 比如 $0.5P_1(W)$ 为 2 小时率功率, $0.5P_1=288(W)$;

SOC——荷电状态。

2.2 该产品常规指标

表 1 产品常规指标

序 号	项 目	条 件	规 格
1	电池型号	N.A.	LP54173207
2	标称容量	$(25 \pm 2) ^\circ C$, $1 I_1$, 2.5V~3.65V	180Ah
3	标称能量	$(25 \pm 2) ^\circ C$, $1P_1$, 2.5V~3.65V	576Wh
4	标称电压	$(25 \pm 2) ^\circ C$, $1 I_1$, 2.5V~3.65V	3.2 V
5	交流内阻	$(25 \pm 2) ^\circ C$, 1KHz, 30%SOC, 新电池	$\leq 0.3m\Omega$
6	电池重量	N.A.	$4.0 \pm 0.1kg$
7	室温标准功率	充电	$(25 \pm 2) ^\circ C$, 3.65V
		放电	$(25 \pm 2) ^\circ C$, 2.5V
8	室温最大功率	充电	$(25 \pm 2) ^\circ C$, 0%SOC
		放电	$(25 \pm 2) ^\circ C$, 100%SOC
9	终止电压	充电	N.A.
		放电	$0^\circ C < \text{温度} < 55^\circ C$
			$-30^\circ C \leq \text{温度} \leq 0^\circ C$
10	最大工作温度范围 (环境)	充电	$0^\circ C \sim 55^\circ C$
		放电	$-30^\circ C \sim 55^\circ C$
11	最佳工作温度范围 (环境)	充电	$15^\circ C \sim 35^\circ C$
		放电	$15^\circ C \sim 35^\circ C$
12	储藏温度	1 个月内	电池电压为 3.275V~3.304V, 20%-40%SOC 状态下保存
		6 个月内	$-40^\circ C \sim 45^\circ C$ $-20^\circ C \sim 35^\circ C$



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备注：以上表格中所示温度均为电芯温度，即接入电池的温度传感器测量的电芯的温度。无论电芯处在何种充、放电模式，一旦发现电芯温度超过最大工作温度范围即停止使用。

3 外观和尺寸

外观和尺寸见图 1，电池厚度测量不施加压力，电芯厚度为包绝缘蓝膜后的厚度，蓝膜厚度为：0.1mm。

4 性能

4.1 测试条件

进货一个月内进行测试，测试前循环充放电次数不得超过五次。除非有其他说明，实验和测量须在温度 $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ 、相对湿度 15%~90%，大气压为 86kPa~106kPa 的条件下进行。本规格书中所提到的室温，是指 $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ 。

4.2 测量设备

- a) 伏特计 内阻 $>1000\ \Omega/\text{V}$
- b) 游标卡尺 精度为 0.02 mm
- c) 内阻表 在 AC 1kHz 条件下测量
- d) 天平 精度 0.001g

4.3 测试过程及其标准

4.3.1 初始化充电

电池在室温下搁置 5h，以 $0.5P_1$ (W) 恒功率放电至 2.5V，搁置 30min。以 $0.5P_1$ (W) 恒功率充电至 3.65V，搁置 30min。

4.3.2 初始化放电

电池在室温下搁置 5h，以 $0.5P_1$ (W) 恒功率充电至 3.65V，搁置 30min。以 $0.5P_1$ (W) 恒功率放电至 2.5V，搁置 30min。

4.3.3 测试项目及标准

具体测试项目及标准见表 2。

表 2 测试项目及标准

序号	项目	测试程序	标准
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1	外观	在良好的光线条件下，用目测法检验电池单体的外观。	外观无变形及裂纹，表面干燥、平整无毛刺、无外伤、无污物，且标识清晰、正确。
2	尺寸	游标卡尺测量	尺寸见图 1，成品电池质量检验尺寸为厚度、宽度和高度。
3	重 量	电子天平称量	(4.0 ± 0.1) kg
4	室温放电容量	1) 以 $1 I_1$ (A)恒流充电至 3.65V 转恒压充电，至电流降至 $0.05 I_1$ (A)截止，搁置 30min; 2) 以 $1 I_1$ (A)恒流放电至 2.5V，记录放电容量，搁置 30min; 3) 重复 1) ~2) 步骤 5 次，当连续 3 次试验结果的极差小于额定容量的 3%，可提前结束试验，取最后 3 次试验结果平均值。	$1 I_1$ (A)放电容量 ≥ 180 Ah。
5	室温放电能量	1) 初始化放电; 2) 以 $0.5P_1$ (W) 恒功率充电至 3.65V，搁置 30min，记录充电能量; 3) 以 $0.5P_1$ (W) 恒功率放电至 2.5V，搁置 30min，记录放电能量; 4) 重复步骤 2) ~3) 2 次，以 3 次试验的均值作为结果。	$0.5P_1$ (W) 放电能量 ≥ 576 Wh; $0.5P_1$ (W) 充放电能量效率 $\geq 93\%$ 。
6	室温最大充、放电功率	室温最大充、放电功率: 1) 初始化放电; 2) 以 $0.5P_1$ (W) 恒功率充电至 3.65V，搁置 30min，记录充电能量 E1; 3) 以 $0.5P_1$ (W) 恒功率放电至 2.5V，搁置 30min，记录放电能量 E2; 4) 以 nP_1 (W) 恒功率充电至 3.65V，记录充电能量，搁置 30min; 再以 $0.5 P_1$ (W) 恒功率充电至 3.65V，搁置 30min; 5) 以 nP_1 (W) 恒功率放电至 2.5V，记录放电能量，搁置 30min; 再以 $0.5 P_1$ (W) 恒功率放电至 2.5V，搁置	表 3



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		30min; 能量效率: 1) 电池以 $0.5P_1$ (W) 恒功率放电至 2.5V, 搁置 30min; 2) 电池以 nP_1 (W) 恒功率充电至 3.65V, 记录充电能量, 搁置 30min; 3) 电池以 nP_1 (W) 恒功率放电至 2.5V, 记录放电能量, 搁置 30min; 计算 nP_1 (W) 恒功率充放电效率。	
7	循环寿命☆	1) 初始化放电; 2) 以 $1P_1$ (W) 恒功率充电至 3.65V, 搁置 30min; 3) 以 $1P_1$ (W) 恒功率放电至 2.5V, 搁置 30min; 4) 按照 2) ~3) 循环 5000 次; 5) 记录每次循环的放电能量, 计算每次放电能量相对于额定放电能量的能量保持率; 6) 电池在夹紧状态下进行测试, 夹具间隙恒定为 54mm。	循环 5000 次后电池放电能量 $\geq 80\%$ * 额定放电能量; 阶段性标准见表 4。
8	室温能量保持与能量恢复能力试验☆	1) 初始化充电; 2) 电池在 $25^\circ\text{C} \pm 2^\circ\text{C}$ 下储存 28 天; 3) 在 $25^\circ\text{C} \pm 2^\circ\text{C}$ 下, 以 $0.5P_1$ (W) 恒功率放电至 2.5V, 搁置 30min, 记录放电能量; 4) 在 $25^\circ\text{C} \pm 2^\circ\text{C}$ 下, 以 $0.5P_1$ (W) 恒功率充电至 3.65V, 搁置 30min, 记录充电能量; 5) 在 $25^\circ\text{C} \pm 2^\circ\text{C}$ 下, 以 $0.5P_1$ (W) 恒功率放电至 2.5V, 搁置 30min, 记录放电能量。	能量保持率 $\geq 92\%$ 充电能量恢复率 $\geq 95\%$ 放电能量恢复率 $\geq 95\%$
9	高温能量保持与能量恢复能力试验☆	1) 初始化充电; 2) 电池在 $45^\circ\text{C} \pm 2^\circ\text{C}$ 下储存 7 天; 3) 电池在 $25^\circ\text{C} \pm 2^\circ\text{C}$ 下搁置 5h; 4) 在 $25^\circ\text{C} \pm 2^\circ\text{C}$ 下, 以 $0.5P_1$ (W) 恒功率放电至 2.5V, 搁置 30min, 记录放电能量; 5) 在 $25^\circ\text{C} \pm 2^\circ\text{C}$ 下, 以 $0.5P_1$ (W) 恒功率充电至 3.65V, 搁置 30min, 记录充电能量; 6) 在 $25^\circ\text{C} \pm 2^\circ\text{C}$ 下, 以 $0.5P_1$ (W) 恒功率放电至 2.5V, 搁置 30min, 记录放电能量。	能量保持率 $\geq 92\%$ 充电能量恢复率 $\geq 95\%$ 放电能量恢复率 $\geq 95\%$
10	高温充放电性能	1) 初始化放电; 2) 电池在 $45^\circ\text{C} \pm 2^\circ\text{C}$ 下搁置 5h;	充电能量 $\geq$ 初始充电能量的 98%



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		3) 在 $45^{\circ}\text{C} \pm 2^{\circ}\text{C}$ 下, 以 $0.5P_1$ (W) 恒功率充电至 3.65V, 搁置 30min, 记录充电能量; 4) 在 $45^{\circ}\text{C} \pm 2^{\circ}\text{C}$ 下, 以 $0.5P_1$ (W) 恒功率放电至 2.5V, 搁置 30min, 记录放电能量。	放电能量 $\geq$ 初始放电能量的 98% 能量效率 $\geq 93\%$
11	低温充放电性能	1) 初始化放电; 2) 电池在 $5^{\circ}\text{C} \pm 2^{\circ}\text{C}$ 下搁置 20h; 3) 在 $5^{\circ}\text{C} \pm 2^{\circ}\text{C}$ 下, 以 $0.5P_1$ (W) 恒功率充电至 3.65V, 搁置 30min, 记录充电能量; 4) 在 $5^{\circ}\text{C} \pm 2^{\circ}\text{C}$ 下, 以 $0.5P_1$ (W) 恒功率放电至 2.5V, 搁置 30min, 记录放电能量。	充电能量 $\geq$ 初始充电能量的 85% 放电能量 $\geq$ 初始放电能量的 80% 能量效率 $\geq 80\%$
12	短路试验★	1) 初始化充电; 2) 将电池单体正、负极经外部短路 10min, 外部线路电阻应小于 $5\text{m}\Omega$; 3) 观察 1h。	电池不起火, 不爆炸
13	过充试验★	1) 初始化充电; 2) 电池以 $1 I_1$ (A) 恒流充电至电池终止电压的 1.5 倍 (5.475V) 或时间达到 1h 时停止充电; 3) 观察 1h。	电池不起火, 不爆炸
14	过放试验★	1) 初始化充电; 2) 电池以 $1 I_1$ (A) 恒流放电至时间达到 90min 或者电压到 0V 时停止放电; 3) 观察 1h。	电池不起火, 不爆炸 不漏液
15	加热试验★	1) 初始化充电; 2) 电池放入加热试验箱, 以 $5^{\circ}\text{C}/\text{min}$ 的速率由环境温度升至 $130^{\circ}\text{C} \pm 2^{\circ}\text{C}$, 并保持此温度 30min 后停止加热; 3) 观察 1h。	电池不起火, 不爆炸
16	挤压试验★	1) 初始化充电; 2) 按下列条件试验: ——挤压方向: 垂直于电池单体极板方向施压; ——挤压板形式: 半径为 75mm 的半圆柱体, 半圆柱体的长度大于被挤压电池的尺寸; ——挤压速度: $(5 \pm 1) \text{mm/s}$; ——挤压程度: 电压达到 0V 或变形量达到 30% 或挤压力达到 $(13 \pm 0.78) \text{kN}$ 时停止挤压;	电池不起火, 不爆炸



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		——保持 10min。 3) 观察 1h。	
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表 3 室温最大充、放电功率试验标准

充放电功率 (W)	n=0.5	n=1	n=2
充电能量 (Wh)	E1	$\geq 97\% * E1$	$\geq 92\% * E1$
放电能量 (Wh)	E2	$\geq 97\% * E1$	$\geq 92\% * E1$
能量效率	$\geq 93\%$	$\geq 87\%$	$\geq 83\%$

表 4 室温循环试验标准

循环次数	500 次	1000 次	2000 次	3000 次	4000 次	5000 次
放电能量 (Wh)	≥ 547	≥ 530	≥ 501	≥ 484	≥ 472	≥ 461
能量保持率 (相对于 额定放电能量)	$\geq 95\%$	$\geq 92\%$	$\geq 87\%$	$\geq 84\%$	$\geq 82\%$	$\geq 80\%$

5 注意事项

5.1 充电

- a) 严禁过充，充电电压不得高于 3.65V。
- b) 严禁反向充电。
- c) 充电温度范围为 0℃~55℃。
- d) 建议最佳充电温度为 15℃~35℃。

5.2 放电

- a) 严禁短路。
- b) 放电电压不得低于 2.0 V。
- c) 放电温度范围为 -30℃~55℃。
- d) 建议最佳放电温度为 15℃~35℃。

5.3 将电芯放置在远离儿童的地方。

5.4 储存



短时储存（1 个月内）要将电池放置于清洁、湿度低于 65%RH、温度-40℃~45℃的环境中，电池荷电 20~40% SOC 状态。

长期储存（6 个月内）要将电池放置于清洁、湿度低于 65%RH、温度-20℃~35℃的环境中，电池荷电 20~40% SOC 状态。

5.5 使用中电池的容量小于等于标称容量的 65%（25℃），应停止使用。如果违反此条，力神不承担产品质量保证责任。

6 警示

6.1 在使用之前，应详细阅读规格书并对其中警示内容和注意事项有足够深刻的理解。

6.2 严禁电池过热；严禁改装、拆解电池；这些行为非常危险，可能会引起电池起火、漏液、爆炸。

6.3 严禁将电芯暴露在极热环境或投入火中，不要将电池放置在太阳直射的地方。

6.4 严禁将电池正负极柱用金属或其他导线直接连在一起形成通路，这样将导致电池短路，可能引起电池起火甚至爆炸。

6.5 严禁将正负极柱颠倒使用。

6.6 严禁将电芯浸入水中或者其它导电性液体中，或者使其吸湿。

6.7 严禁使电芯承受过重的机械冲击。

6.8 严禁直接焊接电池，过热可能会引起电池零部件（如垫片）变形，这将导致电池鼓胀、漏液、起火甚至爆炸。

6.9 严禁使用运输中发生挤压、跌落、短路、漏液及其他不正常问题的电池。

6.10 电池壳体带正电，在使用过程中严禁将电池负极柱与电池壳体直接连在一起形成通路，这样将导致电池短路，可能引起电池起火甚至爆炸。

6.11 电池应该在远离静电的场所进行储存、使用。

6.12 禁止把电池同其他一次电池或二次电池一起使用，也不要同不同包装、不同型号或其他品牌的电池一起使用。

6.13 在使用、充放电或者存储过程中发现电池急剧变热、散发气味、变色、变形或者其他反应，应立即停止使用，并进行相应的处理。

6.14 如电池漏液到皮肤或衣物上，请立即用清水冲洗，以免造成皮肤不适等。

7 运输

运输过程中应防止剧烈振动、冲击、日晒雨淋。

运输过程中电池应处于荷电 10~50%SOC 状态。

8 其它

如果客户需要将电芯在该文件之外的条件下操作或应用，请先咨询力神公司相关事宜。
在该文件说明的条件之外使用该电芯而产生的事故，公司不承担任何责任。

对单体电池与电路，电池组，充电器搭配使用不当所产生的问题公司不承担任何责任。

出货后客户在电芯组装过程中，因加工产生的不良电芯不在质量保证的范围之列。

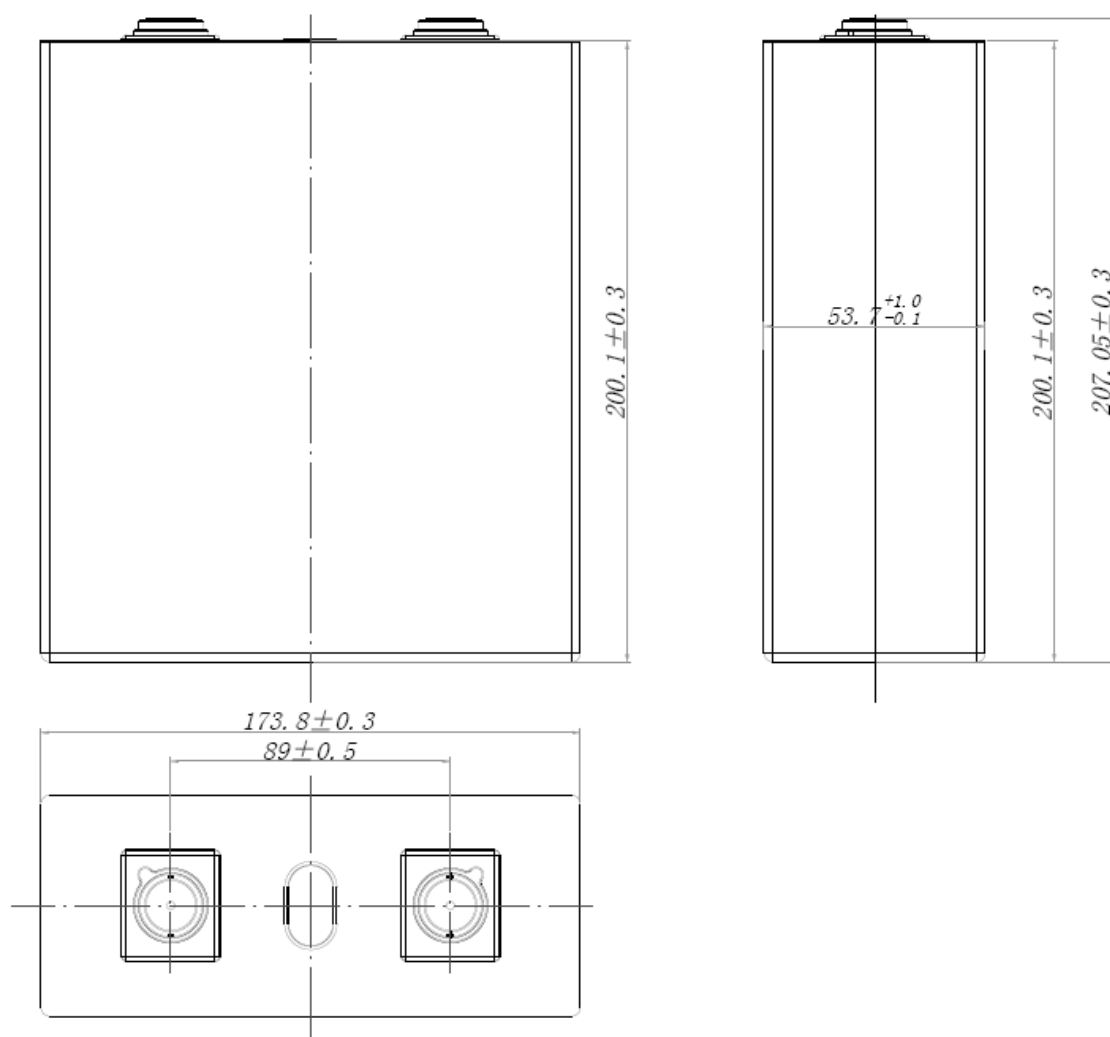


图 1 电池简易外形图



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Lithium Iron Phosphate Battery of LP54173207-180Ah

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1. Scope

The product specification describes the requirement of the Prismatic Lithium Iron Phosphate Battery to be supplied to the customer by Lishen Power Battery System Co.,Ltd. If there is any additional information required by the customer, customers are advised to contact Lishen Power Battery System Co.,Ltd.

2. General Specifications

2.1 Abbreviation Definitions

C_1 —— the rated capacity (Ah) of the cell for a one-hour discharge.

I_1 —— a current(A) corresponding to the one-hour discharge capacity(Ah), which is equal to, in numeral, the C_1 ; In this specification, 1 $I_1 = 180$ A.

P_1 —— a power(W) corresponding to the one-hour discharge energy(Wh). In this specification, 1 $P_1 = 576$ W; $nP_1 = n * P_1$ (W), for example, $0.5P_1 = 288$ W.

SOC —— State of charge.

2.2 General Specifications

Table 1

No.	Item		Condition	Specification
1	Cell Model		N.A.	LP54173207
2	Minimum Capacity		$(25 \pm 2) ^\circ\text{C}$, 1 I_1 , 2.5V~3.65V	180Ah
3	Minimum Energy		$(25 \pm 2) ^\circ\text{C}$, 1 P_1 , 2.5V~3.65V	576Wh
4	Nominal Voltage		$(25 \pm 2) ^\circ\text{C}$, 1 I_1 , 2.5V~3.65V	3.2 V
5	AC-Impedance		$(25 \pm 2) ^\circ\text{C}$, 1KHz, 30%SOC, BOL	$\leq 0.3\text{m}\Omega$
6	Weight		N.A.	$4.0 \pm 0.1\text{kg}$
7	Rated power at room temperature	Charge	$(25 \pm 2) ^\circ\text{C}$, 3.65V	$0.5P_1$ (288W)
		Discharge	$(25 \pm 2) ^\circ\text{C}$, 2.5V	$0.5P_1$ (288W)
8	Maximum power at room temperature	Charge	$(25 \pm 2) ^\circ\text{C}$, 0%SOC	$2P_1$ (1152W)
		Discharge	$(25 \pm 2) ^\circ\text{C}$, 100%SOC	$2P_1$ (1152W)
9	Charge cut-off voltage	Charge	N.A.	3.65 V
		Discharge	$0^\circ\text{C} < \text{Temperature} < 55^\circ\text{C}$	2.5V
			$-30^\circ\text{C} \leq \text{Temperature} \leq 0^\circ\text{C}$	2.0V
10	Maximum operating	Charge	N.A.	$0^\circ\text{C} \sim 55^\circ\text{C}$



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	temperature range	Discharge		-30℃ ~ 55℃
11	Optimum operating temperature rang	Charge	N.A.	15℃ ~ 35℃
		Discharge		15℃ ~ 35℃
12	Storage temperature	1 month	Cells should be stored at the state of 20%~40%SOC or the voltage is between 3.275V and 3.304V.	-40℃ ~ 45℃
		6 months		-20℃ ~ 35℃

Note: The temperature shown in the above table is the cell temperature. That is, the temperature of the cell measured by the temperature sensor connected to the battery. No matter what charging and discharging mode the battery is in, the battery will be stopped when the temperature exceeds the maximum operating temperature range.

3. Appearance and Dimension

Appearance and Dimension refer to the attached drawing 1. Battery thickness is measured without applying pressure. The thickness of the cell is the thickness after the insulation film is coated, and the thickness of the insulation film is 0.1mm.

4. Characteristics

4.1 Test Condition

Cells should be tested within a month after purchase and the charge-discharge times of the test cells should be less than 5. Unless noted otherwise, all tests will be conducted at standard temperature which is $(25 \pm 2)^\circ\text{C}$ and standard humidity which is 15% ~ 90%. The room temperature mentioned in this specification means $(25 \pm 2)^\circ\text{C}$.

4.2 Test Equipment

- a) Voltmeter Inner impedance > 1000Ω per volt.
- b) Slide caliper Slide caliper should have a minimum scale of 0.02mm.
- c) Impedance meter Impedance meter should be operated at AC 1 kHz.
- d) Electronic Scale The electronic scale should have a minimum scale of 0.001g.

4.3 Test Process and Specification

4.3.1 Initial Charge

Cells rest for 5 hours at room temperature. Discharge cells at constant power $0.5 P_1(W)$ to



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2.5V, and rest for 30 min. Charge cells at constant power $0.5P_1(W)$ to 3.65V, and rest for 30 min.

4.3.2 Initial Discharge

Cells rest for 5 hours at room temperature. Charge cells at constant power $0.5 P_1(W)$ to 3.65V, and rest for 30 min. Discharge cells at constant power $0.5P_1(W)$ to 2.5V, and rest for 30 min.

4.3.3 Test Item and Specification

Test item and specification should refer to table 2.

Table 2

No.	Item	Test profile	Specification
1	Appearance	The appearance of a cell is examined by visual inspection under good light conditions.	Appearance without deformation and crack, surface drying, flat surface without burr, no trauma, no dirt, and clearly marked and correct marked.
2	Dimension	Vernier caliper measurement	Dimensions according to drawing 1.
3	Weight	Electronic scale measurement	$4.0 \pm 0.1\text{kg}$
4	Discharge capacity at room temperature	1) Charge cells with constant current and constant voltage (CCCV) method. The current is $1 I_1 (A)$. The cut-off voltage is 3.65V and the cut-off current is $0.05 I_1 (A)$. Rest for 30min. 2) Discharge cells to 2.5V at $1 I_1 (A)$ current. Record discharge capacity. Rest for 30min. 3) Repeat step 1)~2) 5 times. The test can be terminated when the capacity range of 3 times test is less than 3% of the minimum capacity (180Ah). Take the average of last 3 discharge capacity.	Capacity at $1 I_1 (A) \geq 180\text{Ah}$.



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5	Discharge energy at room temperature	1) Initial discharge per 4.3.2. 2) Charge cells at constant power $0.5P_1(W)$ to 3.65V. Record charge energy. Rest for 30 min. 3) Discharge cells at constant power $0.5P_1(W)$ to 2.5V. Record discharge energy. Rest for 30 min. 4) Repeat step 2)~3) twice. Take the average discharge energy of 3 times. Calculate the charge and discharge energy efficiency.	1) Discharge energy $\geq 576Wh$; 2) Energy efficiency $\geq 93\%$.
6	Maximum charge and discharge power at room temperature	Power Test: 1) Initial discharge per 4.3.2; 2) Charge cells at constant power $0.5P_1(W)$ to 3.65V. Record charge energy as E1. Rest for 30 min. 3) Discharge cells at constant power $0.5P_1(W)$ to 2.5V. Record discharge energy as E2. Rest for 30 min. 4) Charge cells at constant power $nP_1(W)$ to 3.65V. Record charge energy. Rest for 30 min. And then charge cells at constant power $0.5P_1(W)$ to 3.65V. 5) Discharge cells at constant power $nP_1(W)$ to 2.5V. Record discharge energy. Rest for 30 min. And then discharge cells at constant power $0.5P_1(W)$ to 2.5V. Energy Test: 1) Discharge cells at constant power $0.5P_1(W)$ to 2.5V. Rest for 30 min. 2) Charge cells at constant power $nP_1(W)$ to 3.65V. Record charge energy. Rest for 30 min. 3) Discharge cells at constant power $nP_1(W)$ to 2.5V. Record discharge energy. Rest for 30 min. Calculate energy efficiency.	Table 3



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7	Cycle life ☆	1) Initial discharge per 4.3.2. 2) Charge cells at constant power $1P_1(W)$ to 3.65V. Rest for 30 min. 3) Discharge cells at constant power $1P_1(W)$ to 2.5V. Rest for 30 min. 4) Repeat step 2)~3) and cycle 5000 times. 5) Record discharge energy every cycle. Calculate energy retention ratio. Energy retention ratio = Discharge energy / Rated energy(576Wh) * 100% 6) Cells are clamping during test. Fixture clearance is constant at 54mm.	The energy retention ratio of 5000 th cycle $\geq$ 80%.
8	Energy retention and recovery at room temperature ☆	1) Initial charge per 4.3.1. 2) Cells stored at $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for 28 days; 3) Discharge cells at constant power $0.5P_1(W)$ to 2.5V. Record discharge energy. Rest for 30 min. Calculate energy retention ratio. 4) Charge cells at constant power $0.5P_1(W)$ to 3.65V. Record charge energy. Rest for 30 min. Calculate charge energy recovery ratio. 5) Discharge cells at constant power $0.5P_1(W)$ to 2.5V. Record discharge energy. Rest for 30 min. Calculate discharge energy recovery ratio.	1) Energy retention ratio $\geq$ 92%; 2) Charge energy recovery ratio $\geq$ 95%; 3) Discharge energy recovery ratio $\geq$ 95%.
9	Energy retention and recovery at high temperature ☆	1) Initial charge per 4.3.1. 2) Cells stored at $45^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for 7 days; 3) Discharge cells at constant power $0.5P_1(W)$ to 2.5V. Record discharge energy. Rest for 30 min. Calculate energy retention ratio. 4) Charge cells at constant power $0.5P_1(W)$ to 3.65V. Record charge energy. Rest for 30 min. Calculate charge energy recovery ratio. 5) Discharge cells at constant power $0.5P_1(W)$ to 2.5V. Record discharge energy. Rest for 30 min. Calculate discharge energy recovery ratio.	1) Energy retention ratio $\geq$ 92%; 2) Charge energy recovery ratio $\geq$ 95%; 3) Discharge energy recovery ratio $\geq$ 95%.



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10	Charge and discharge performance at high temperature	1) Initial discharge per 4.3.2. 2) Cells rest 5 hours at $45^{\circ}\text{C} \pm 2^{\circ}\text{C}$. 3) Charge cells in constant power $0.5P_1(\text{W})$ to 3.65V at $45^{\circ}\text{C} \pm 2^{\circ}\text{C}$. Record charge energy. Rest for 30 min. 4) Discharge cells in constant power $0.5P_1(\text{W})$ to 2.5V at $45^{\circ}\text{C} \pm 2^{\circ}\text{C}$. Record discharge energy. Rest for 30 min.	1) Charge energy at $45^{\circ}\text{C} \geq 98\%*$ Initial charge energy at 25°C; 2) Discharge energy at $45^{\circ}\text{C} \geq 98\%*$ Initial discharge energy at 25°C; 3) Energy efficiency $\geq 93\%$.
11	Charge and discharge performance at low temperature	1) Initial discharge per 4.3.2. 2) Cells rest 5 hours at $5^{\circ}\text{C} \pm 2^{\circ}\text{C}$. 3) Charge cells in constant power $0.5P_1(\text{W})$ to 3.65V at $5^{\circ}\text{C} \pm 2^{\circ}\text{C}$. Record charge energy. Rest for 30 min. 4) Discharge cells in constant power $0.5P_1(\text{W})$ to 2.5V at $5^{\circ}\text{C} \pm 2^{\circ}\text{C}$. Record discharge energy. Rest for 30 min.	1) Charge energy at $5^{\circ}\text{C} \geq 85\%*$ Initial charge energy at 25°C; 2) Discharge energy at $5^{\circ}\text{C} \geq 80\%*$ Initial discharge energy at 25°C; 3) Energy efficiency $\geq 80\%$.
12	Short circuit★	1) Initial charge per 4.3.1. 2) Cells should be short circuit 10 minutes by connecting the positive and negative terminals through the external wires. And the resistance of external wires will be less than $5\text{m}\Omega$. 3) Observe 1h.	No Explosion, No Fire.
13	Over charge★	1) Initial charge per 4.3.1. 2) Charge cells at $1 I_1 (\text{A})$ to 1.5 times of cut-off voltage(5.48V) or charge cells at $1 I_1 (\text{A})$ for 1h. 3) Observe 1h.	No Explosion, No Fire.
14	Over discharge★	1) Initial charge per 4.3.1. 2) Discharge cells at $1 I_1 (\text{A})$ to 0V or discharge cells for 90min. 3) Observe 1h.	No Explosion, No Fire, No Leakage.
15	Thermal test★	1) Initial charge per 4.3.1. 2) Put cells into the oven. The oven temperature shall be raised to $130^{\circ}\text{C} \pm 2^{\circ}\text{C}$ at a rate of $5^{\circ}\text{C}/\text{min}$. the temperature of oven should be remained at $130^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for 30min.	No Explosion, No Fire.



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		3) Observe 1h.	
16	Crush★	1) Initial charge per 4.3.1. 2) Crush the cells vertically at the speed of (5 ± 1) mm/s until cells deformation reach to 30% or the voltage tapered to 0V, or the press reach to (13 ± 0.78) kN. Stay 10min. 3) Observe 1h.	No Explosion, No Fire.

Table 3

Power (W)	n=0.5	n=1	n=2
Charge energy (Wh)	E1	$\geq 97\% * E1$	$\geq 92\% * E1$
Discharge energy (Wh)	E2	$\geq 97\% * E1$	$\geq 92\% * E1$
Energy efficiency	$\geq 93\%$	$\geq 87\%$	$\geq 83\%$

5. Caution

5.1 Charge

- a) No over-charge, the charge voltage should not be over 3.65V.
- b) No reverse charging.
- c) The charge temperature range is $0^{\circ}\text{C} \sim 55^{\circ}\text{C}$.
- d) Optimal charge temperature range is $15^{\circ}\text{C} \sim 35^{\circ}\text{C}$.

5.2 Discharge

- a) No short circuit.
- b) The end of discharge voltage must be over 2.0V.
- c) The discharge temperature range is $-30^{\circ}\text{C} \sim 55^{\circ}\text{C}$.
- d) Optimal discharge temperature range is $15^{\circ}\text{C} \sim 35^{\circ}\text{C}$.

5.3 Put cells away from children.

5.4 Storage

- a) For any short time storage (in one month), cell should be in a clean and dry area (humidity $\leq 65\% \text{ RH}$) and at $-40^{\circ}\text{C} \sim +45^{\circ}\text{C}$ at 20~40% SOC charged stage.



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b) For any long time storage (in 6 month), cell should be in a clean and dry area (humidity $\leq$ 65% RH) and at $-20^{\circ}\text{C} \sim +35^{\circ}\text{C}$ at 20~40% SOC charged stage.

5.5 If the capacity of the battery in use is less than or equal to 65% (25°C) of the minimum capacity, it should be discontinued. In case of violation of this clause, Lishen shall not assume the responsibility of product quality assurance.

6. Warning

6.1 Read the specification carefully before application. Be have profound understanding with the warnings and announcements.

6.2 Avoid overheat in any circumstances. Don't modify or disassemble the battery. It will be dangerous, and may cause ignition, heating, leakage or explosion.

6.3 Don't put cells in overheat circumstances or disposed in fire, don't put cells under the sunshine.

6.4 Don't short-circuit positive(+) and negative(-) terminals. Keep away from metal or other conductive materials. Jumbling the batteries of direct contact with positive(+) and negative(-) terminals or other conductive materials may cause short-circuit and may even cause fire and explosion.

6.5 Don't reverse the positive (+) and negative (-) terminals.

6.6 Don't put cells in water or other conductive liquids or let cells absorb moisture.

6.7 Don't impact cells excessively.

6.8 Don't weld the battery directly. Excessive heating may cause deformation of the battery components such as the gasket, which may lead to the battery swelling, leakage, explosion, or ignition.

6.9 Don't use abnormal cell which has damages by shipping stress, drop, short or something else, and which gives off electrolyte odor.

6.10 Cell cans were connected with positive (+) terminals. Don't contact cans with negative (-) terminals or other cell cans during the using process. It will be dangerous, and may cause ignition or explosion.

6.11 Keep away from static circumstances during storage and using.

6.12 Don't use cells together with other one-shot batteries and secondary batteries. Don't use cells



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together with different packages, types and brands.

6.13 Stop using and process the cells accordingly when the following circumstances happened: getting hot sharply, smelling, changing colors, deformation or others.

6.14 If there is leaked electrolyte from batteries, please scrub it away with fresh water to avoid any skin discomfort.

7. Shipping

7.1 During transportation, keep the battery from acutely vibration, impacting, insolation, drenching.

7.2 The delivery battery should be at 10%~50%SOC charged state.

8. Others

If customers need to use or operating cells beyond the specified range of this file, please contact Tianjin Lishen Battery Joint-Stock Co., Ltd. Manufacturer will not be responsible for trouble caused by using cells beyond the specified range of this file.

Manufacturer will not be responsible for trouble occurred by matching electric circuit, cell pack and charger.

Manufacturer will be exempt from warrantee any defect cells during assembling after acceptance.



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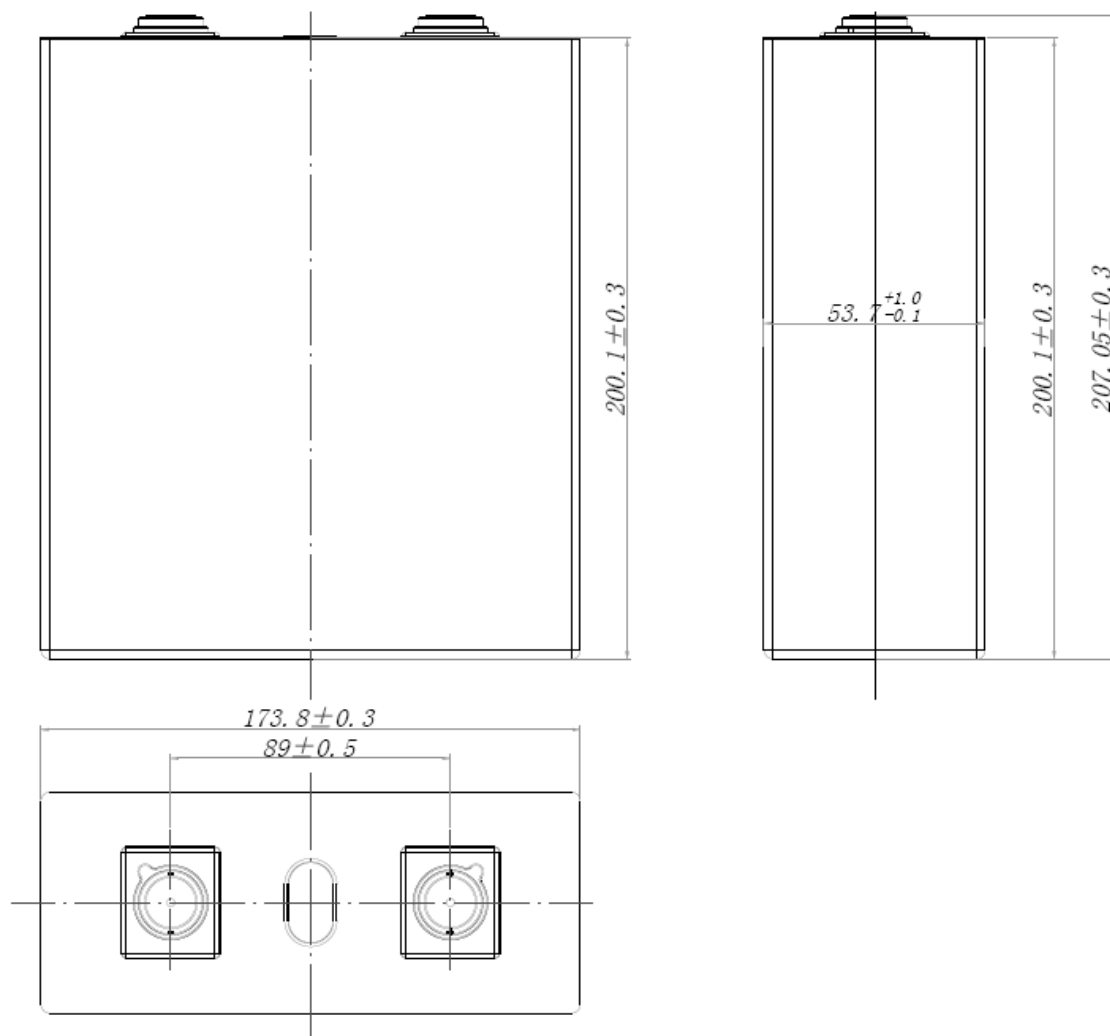
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Drawing 1