Model 型号	LF160	Specification No. 规格书编号	RD-LF160-S01-LF	Version 版本	B

Product Specification
产品交付规格书

Prismatic LFP Cells

方形铝壳锂离子电池

Model: LF160

型号:LF160

Drafted by 编制	Product Design Checked by 产品设计审核	Quality Checked by 品质审核	Sales Checked by 销售审核	Approved by 批准
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Company: **公司名称:** **Approved by:** **批 准:** **Date:** **日 期:**

Jan, 2022

EVE Power Co., Ltd.

湖北亿纬动力有限公司

Model 型号	LF160	Specification No. 规格书编号	RD-LF160-S01-LF	Version 版本	B

Customer Requirements

EVE Power Co., Ltd. requires customer to provide specific requirements and communicates with EVE Power Co., Ltd. in advance. If special applications and operation conditions are inconsistent with the description of this specification, EVE Power Co., Ltd. may design and manufacture products according to customer's inputs.

客户要求

要求客户写出他们的需求信息并提前与湖北亿纬动力动力有限公司沟通。如果客户有一些特别的应用或者操作条件不同于此文件中所描述的，湖北亿纬动力动力有限公司可以根据客户的特别要求进行产品的设计和生产。

No. 序号	Special Requirements 特殊要求	Standards 标准
1	/	/
2	/	/
3	/	/

Customer Code 客户代码：_____ Signature 签字：_____ Date 日期：_____

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Revision History

变更履历

Version 版本	Date 日期	Contents 更改内容	Checked By 确认人
A	2021.07.12	First issue 新版发行	Hui Xu 徐辉
B	2022.01.26	1. Make a distinction between standard charge-discharge ratio and continuous charge-discharge ratio; 2. Add the term definition of normal capacity and AC resistance; 3. Add the center distance of cell poles; 4. Increase the cell cycles to 2000 at 45℃; 5. Complete the cautions of battery in use. 1、区分标准充放电倍率及持续充放电倍率; 2、增加额定容量和交流内阻术语定义; 3、增加极柱中心距尺寸; 4、电芯 45℃循环寿命增加至 2000 次; 5、完善电芯在使用时注意事项。	Hui Xu 徐辉
/	/	/	/
/	/	/	/

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Term Definition

术语定义

Product: Refers to 160 Ah rechargeable lithium-ion cell with Prismatic aluminum shell manufactured by EVE Power Co., Ltd. (EVE) in this specification.

产　　品：本规格书中的“产品”是指湖北亿纬动力有限公司（以下简称 EVE）生产的 160 Ah 可充电方形铝壳锂离子电池。

Customer: Refers to the buyer in the product sales contract signed with EVE.

客　　户：指与 EVE 签署产品销售合同中的买方。

Environment temperature: The ambient temperature where the cell is located.

环境温度：电池所处的周围环境温度。

Cell temperature: The temperature measured by temperature sensor installed at the center of cell surface.

电池温度：由接入电池表面中心的温度传感器测量的电池的温度。

Normal capacity: The minimum capacity that the cell can discharge under the specified discharge conditions which is indicated by the letter Q.

额定容量：电池在规定的放电条件下可以放出的最低容量，用字母 Q 表示。

Rate: The ratio of the charge-discharge current to the rated capacity of the cell is indicated by the letter C. For example, if the cell normal capacity is 160 Ah, when the charging or discharging current is 80 A, the charging or discharging rate is 0.5 C.

倍　　率：充放电电流与电池的额定容量值的比率，用字母 C 表示。例如，电池额定容量为 160 Ah，当充电或放电电流为 80 A 时，则充电或放电倍率为 0.5 C。

State of charge: Under unloaded conditions, the ratio of the cell capacity state to the rated capacity measured in ampere-hour or watt- hour. The abbreviation is expressed by SOC. For example, if the capacity is 230 Ah which considered as 100 % SOC, the capacity is 0 Ah, considered as 0 % SOC.

荷电状态：在无负载的情况下，以安培小时或者以瓦特小时为单位计量的电池容量状态与额定容量的比值，缩写用 SOC 表示。例如：若将容量为 160 Ah 的状态视为 100 % SOC，若容量为 0 Ah 时，SOC 为 0 %。

Cycle: The cell is charged and discharged in a cycle according to the prescribed charging and discharging standards. The cycle includes short-term normal charging or a combination of regenerative charging and discharging processes. In the charging process, sometimes there is only normal charging and no regenerative charging. The discharge can be formed by combining some partial discharges.

循　　环：电池按规定的充放标准充放一次为一个循环。循环包括短时的正常充电或者再生充电和放电过程的组合，在充电过程中有时只有正常充电而无再生充电的情况。放电可以由一些部分放电组合在一起形成。

Standard charge: The charging mode described in 3.5 of this specification.

标准充电：本规格书第 3.5 条所述的充电模式。

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Standard discharge: The discharge mode described in 3.6 of this specification.

标准放电：本规格书第 3.6 条所述的放电模式。

Open circuit voltage: Terminal voltage of the cell under open circuit conditions. The abbreviation is expressed by OCV.

开路电压：蓄电池在开路条件下的端电压，缩写用 OCV 表示。

AC resistance: Inject 1kHz sine wave current into the positive and negative poles of the cell, and the internal resistance obtained, which abbreviated as ACR, and the test method is as described in section 3.8.3.6 of this specification.

交流内阻：给电池正负极注入 1kHz 的正弦波电流，测试所得到的内阻值，缩写用 ACR 表示，测试方法如本规格书第 3.8.3.6 条所述。

DC resistance: The ratio of the voltage change to the corresponding current change under working conditions, the abbreviation is DCR, and the test method is as described in section 3.8.3.6 of this specification.

直流内阻：工作条件下电池的电压变化与相应的电流变化之比，缩写用 DCR 表示，测试方法如本规格书第 3.8.3.6 条所述。

Module: A combination in which more than one cell is combined in series, parallel or series parallel mixed connection and used as a power supply.

模　　组：将一个以上单体电池按照串联、并联或串并混连方式组合，并作为电源使用的组合体。

Pulse current: The current or voltage pulses that appear periodically are called pulse currents. The pulse currents appear either in the same direction or in alternating positive and negative directions.

脉冲电流：以周期重复出现的电流或电压脉冲称为脉冲电流，脉冲电流或是以同一方向出现，或是以正、负交替变换方向出现。

Compression force: When the module is assembled, the cell bears the force perpendicular to the cell stacking direction.

压 缩 力：模组组装时，电池可承受垂直于电池堆叠方向的力。

Units of measurement： Refer to following table

测量单位：见下表

Table 1 Units of measurement

表 1　测量单位

No. 序号	Unit 单位	Abbreviation 简写	Type of units 单位类型
1	伏特 (Volt)	V	Voltage 电压单位
2	安培 (Ampere)	A	Current 电流单位
3	安培-小时 (Ampere-Hour)	Ah	Capacity 容量单位
4	瓦特-小时 (Watt-Hour)	Wh	Energy 能量单位

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5	欧姆 (Ohm)	Ω	Resistance 电阻单位
6	毫欧姆 (Milliohm)	mΩ	Resistance 电阻单位
7	摄氏度 (Degree Celsius)	℃	Temperature 温度单位
8	毫米 (Millimeter)	mm	Length 长度单位
9	秒 (Second)	s	Time 时间单位
10	分 (Minute)	min	Time 时间单位
11	小时 (Hour)	h	Time 时间单位
12	赫兹 (Hertz)	Hz	Frequency 频率单位

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1. Fundamental Information 基本信息

1.1. Scope of Application 适用范围

This specification is applied to 160 Ah lithium-ion cell with prismatic aluminum shell manufactured by EVE Power Co., Ltd.

本产品规格书适用于 EVE 生产的 160 Ah 可充电方形铝壳锂离子电池。

1.2. Product Type 产品类型

Prismatic lithium-ion cell with aluminum shell 方形铝壳锂离子电池

1.3. Product Model 产品名称

LF230

2. Cell Specification 电池规格参数

2.1. Fundamental Parameters 电池基本参数

Table 2 Basic parameters of cell
表 2 电芯基本参数

Items 项目	Standards 标准	Remarks 备注
Min. Capacity 最小容量	160.0 Ah	0.5 C / 0.5 C，25 °C ± 2 °C，2.5 V ~ 3.65 V
Initial IR 初始内阻	≤ 0.5 mΩ	AC，1 kHz，30 % ~ 40 % SOC
Nominal Voltage 标称电压	3.22 V	0.5 C discharge, 25 °C ± 2 °C, 2.5 V ~ 3.65 V 0.5 C 放电，25 °C ± 2 °C，2.5 V ~ 3.65 V
Weight 重量	3000 g ± 100 g	/
Charging Cut-off Voltage 充电限制电压 (U_{max})	3.65 V	/
Discharging Cut-off Voltage 放电截止电压 (U_{min})	2.5 V（T > 0 °C） 2.0 V（T ≤ 0 °C）	/
Standard Charging Current 标准充电电流	80.0 A	0.5 C
Standard Discharging Current 标准放电电流	80.0 A	0.5 C

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Cycling Performance 循环性能	25 ℃ Cycle 25 ℃循环	4000 Cycles 4000 次	Under 300 kgf ±20 kgf initial compression force, 0.5 C / 0.5 C, 2.5 V ~ 3.65 V, Capacity retention≥80 %. Or follow the EVE recommended cycling method. 300 kgf ±20 kgf 初始压缩力下，0.5 C / 0.5 C 循环至容量保持率为 80%或者按照 EVE 提供的循环方式进行
	45 ℃ Cycle 45 ℃循环	2000 Cycles 2000 次	
Operation Temperature 工作温度	Charging Temperature 充电温度	0 ℃ ~ 65 ℃	/
	Discharging Temperature 放电温度	-35 ℃ ~ 65 ℃	/
Storage Temperature 存储温度	3 months 3 个月	0 ℃ ~ 35 ℃	Delivery SOC State 出货 SOC 状态
	1 month 1 个月	-20 ℃ ~ 45 ℃	
Welding Parameter of Al Busbar 铝巴焊接参数	Laser Welding Depth 激光焊接熔深	≤ 2.0 mm	/
	Max Pressure Force on Poles 极柱承受最大压力	700 N	Max force in longitudinal direction, no deformation. 极柱承受最大垂直力，不发生变形
	Max Torque Force on Poles 极柱承受最大扭矩	6 N m	Max torsion, non-loosen. 极柱承受最大扭曲，不松动
	Max Temperature Force on Poles 极柱承受最大温度	130 ℃	The maximum temperature that the pole bears when the plastic pad will not deform. 极柱承受最大温度，塑胶垫不发生变形

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2.2. Product Parameters 产品规格

2.2.1. Dimension and Weight 尺寸、重量指标

Table 3 Cell size and weight parameters
表 3 尺寸、重量指标

No. 序号	Item 项目		Standard 标准	Testing Methods 测试方法章节
1	Dimension 尺寸	Terminal Height 高度 1 (H)	153.50±0.50mm	3.8.1
		Can-top Height 高度 2 (h)	150.75±0.50mm	
		Length 宽度 (L)	173.90±0.50mm	
		Thickness 厚度 (T)	53.85 mm ±0.50 mm (300 kgf ±20 kgf compression force, 30 % ~ 40 % SOC) (300 kgf ±20 kgf 压缩力，30 % ~ 40 % SOC)	
		Center distance of pole 极柱中心距 (l)	123.00 mm ±0.30 mm	/
2	Weight 重量	Weight (Including external protective film, top insulator and bottom insulator) 重量（含外保护膜，顶、底贴片）	3000 g ±100 g	3.8.2

2.2.2. Electrical Performance Parameters 电性能指标

Table 4 Cell electrical performance parameters
表 4 电性能指标

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No. 序号	Item 项目		Standards 标准	Testing Methods 测试方法章节
1	Capacity 容量	0.5 C / 0.5 C Capacity 0.5 C / 0.5 C 容量	≥ 160.0 Ah	3.8.3.1
2	Energy 能量	0.5 C / 0.5 C Energy 0.5 C / 0.5 C 能量	≥515.2Wh	3.8.3.1
3	Rate Discharge Performance 放电性能	-20 ℃ Capacity Retention Rate -20 ℃容量保持率	≥ 70 %	3.8.3.2
		0 ℃ Capacity Retention Rate 0 ℃容量保持率	≥ 85 %	3.8.3.3
		25 ℃ Capacity Retention Rate 25 ℃容量保持率	100 %	/
		45 ℃ Capacity Retention Rate 45 ℃容量保持率	≥ 97 %	3.8.3.4
		55 ℃ Capacity Retention Rate 55 ℃容量保持率	≥ 95 %	3.8.3.5
4	DCR	25 ℃，50 % SOC，1 C，10 s	≤ 1.2 mΩ	3.8.3.6

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5	Cycle 循环	With 300 kgf ±20 kgf initial compression force, 25 ℃ ± 2 ℃ @ 0.5 C / 0.5 C cycle, or follow the EVE recommended cycling method 300 kgf ±20 kgf 初始压缩力，25 ℃ ± 2 ℃ @ 0.5 C / 0.5 C，2.5 V ~ 3.65 V循环，或者按照EVE 提供的循环方式进行。	4000 cycles, Capacity Retention ≥ 80 % 4000 次，容量保持率 ≥ 80 %	3.8.3.7 & 3.8.3.9
		With 300 kgf ±20 kgf initial compression force, 45 ℃ ± 2 ℃ @ 0.5 C / 0.5 C cycle, or follow the EVE recommended cycling method 300 kgf ±20 kgf 初始压缩力，45 ℃ ± 2 ℃ @ 0.5 C / 0.5 C，2.5 V ~ 3.65 V循环，或者按照EVE 提供的循环方式进行。	2000 cycles, Capacity Retention ≥ 80 % 2000 次，容量保持率 ≥ 80 %	3.8.3.8 & 3.8.3.9
6	The capacity retention and recovery 荷电保持与恢复	25 ℃, 28 days 25 ℃，28 天	Capacity Retention ≥ 95 % 容量保持率 ≥ 95 %	3.8.3.10
			Capacity Recovery ≥ 96 % 容量恢复率 ≥ 96 %	
		45 ℃, 28 days 45 ℃，28 天	Capacity Retention ≥ 93 % 容量保持率 ≥ 93 %	3.8.3.11
			Capacity Recovery ≥ 95 % 容量恢复率 ≥ 95 %	
		55℃, 7 days 55℃，7 天	Capacity Retention ≥ 95 % 容量保持率 ≥ 95 %	3.8.3.12
			Capacity Recovery ≥ 96 % 容量恢复率 ≥ 96 %	

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2.2.3. Safety Performance parameters 安全性能指标

Table 5 Cell safety performance parameters
图 5 安全性能指标

No. 序号	Item 项目	Standard 标准	Testing Methods 测试方法章节
1	Over Discharge 过放电	No fire, No explosion 不起火、不爆炸	3.8.4.1
2	Over Charge 过充电	No fire, No explosion 不起火、不爆炸	3.8.4.2
3	External Short-circuit 外部短路	No fire, No explosion 不起火、不爆炸	3.8.4.3
4	Heating 加热	No fire, No explosion 不起火、不爆炸	3.8.4.4
5	Temperature Cycling 温度循环	No fire, No explosion 不起火、不爆炸	3.8.4.5
6	Extrusion Test 挤压	No fire, No explosion 不起火、不爆炸	3.8.4.6

2.3. Cell Drawing 电池图纸

See Fig.7. 见图 7。

2.4. Out Appearance 外观

The cell should have none of obvious scratches, cracks, rust stains, or electrolyte leakage, which have any defects that affect the commercial value of the cell.

电池应无明显擦伤、裂痕、锈渍或电解液泄漏这类对电池商用价值有影响的缺陷。

3. Testing Conditions 试验条件

3.1. Environmental Conditions 环境条件

Unless otherwise specified, the test should be carried out in an environmental temperature of 25 ℃ ± 2 ℃, relative humidity of 10 % ~ 90 %, and atmospheric pressure of 86 kPa to 106 kPa. The ambient temperature mentioned in this specification refers to 25 ℃ ± 2 ℃.

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除另有规定外，试验应在温度为 25 ℃ ± 2 ℃，相对湿度 10 % ~ 90 %，大气压力为 86 kPa ~ 106 kPa 的环境中进行。本规格书所提到的室温，是指 25 ℃ ± 2 ℃。

3.2. Measuring Instrument 测量设备

The minimum accuracy requirements of measuring instruments and meters are as follows:

测量仪器、仪表精确度最低要求如下：

A. Voltage measuring device 电压测量装置：± 0.1 %；

B. Current measuring device 电流测量装置：± 0.1 %；

C. Temperature measuring device 温度测量装置：± 0.5 ℃；

D. Dimension measuring device 尺寸测量装置：± 0.01 mm；

E. Weight measuring device 重量测量装置：± 0.1 g。

3.3. Testing Clamp Preparation 测试夹具准备

The single cell needs to be clamped with steel splints or aluminum alloy splints (thickness: greater than or equal to 8 mm). The splints need to cover the large surface of the cell. The splints are fixed with 6 M6 bolts. All sides of the splints need to be covered with insulating film. Fixtures as shown below:

单体电池需采用钢夹板或铝合金夹板（厚度：大于等于 8 mm）固定，夹板需要覆盖住电池大面，夹板之间采用 6 颗 M6 螺栓固定，且夹板各个面均需用绝缘膜包覆，夹具工装如下图所示：

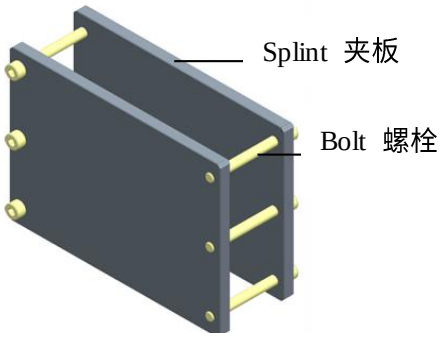

Fig. 1 Schematic diagram of cell clamp

图 1 电池夹具示意图

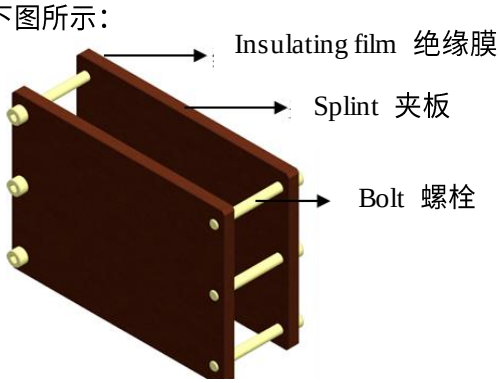

Fig. 2 Insulation film of cell clamp

图 2 电池夹具包绝缘膜图

3.4. Testing Clamp Installation 测试夹具安装

Place the cell (30 % ~ 40 % SOC) covered with external protective film (material: PET, thickness 0.11 mm) and top insulator (material: PC, thickness 0.3 mm) in the middle of the clamp, the gap difference between the left and right sides of the two splint should be ≤ 0.1 mm, and the initial compression force is 300 kgf ± 20 kgf.

将包覆有外保护膜（材质：PET，厚度 0.11 mm）和顶贴片（材质：PC，厚度 0.3 mm）的电池（30 % ~ 40 % SOC）置于夹具中间，两块夹板左右两边的间隙差应≤ 0.1 mm，初始压缩力为 300 kgf ± 20 kgf。

Model 型号	LF160	Specification No. 规格书编号	RD-LF160-S01-LF	Version 版本	B

Fig. 3 Schematic diagram of cell coating
图 3 电池贴膜示意图

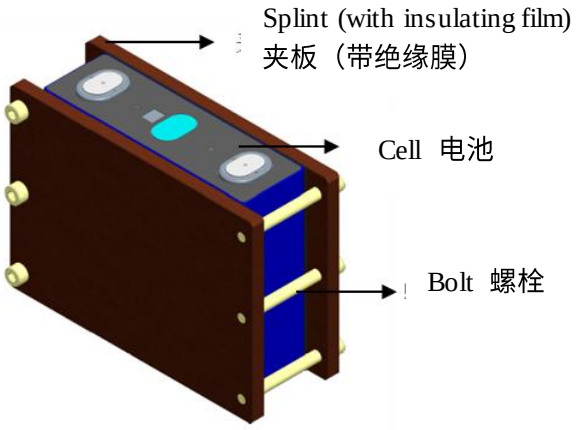

Fig. 4 Side view of cell shaft
图 4 电池轴侧图

3.5. Standard Charge 标准充电

At ambient temperature of 25 ℃ ± 2 ℃, the cell is charged to 3.65 V with constant current of 0.5 C, then charge at constant voltage of 3.65 V until the current decreases to 0.05 C, and rest the cell for 30 min.

在环境温度 25 ℃ ± 2 ℃的条件下，对电池以 0.5 C 的电流恒流充电至 3.65 V，然后在 3.65 V 下转恒压充电，直至充电电流至 0.05 C，搁置 30 min。

3.6. Standard Discharge 标准放电

At ambient temperature of 25 ℃ ± 2 ℃, the cell is discharged to 2.5 V with constant current of 0.5 C, and rest the cell for 30 min.

在环境温度 25 ℃ ± 2 ℃的条件下，电池以 0.5 C 的电流恒流放电，放电至电压达到 2.5 V 截止，搁置 30 min。

3.7. 1 C Capacity Calibration 1 C 容量标定

At ambient temperature of 25 ℃ ± 2 ℃ (constant temperature without air convection), the cell is charged to 3.65 V with constant current of 1 C. Then charge at constant voltage of 3.65 V until the current decreases to 0.05 C, rest the cell for 30 min. After that, discharging the cell to 2.5 V with constant current of 1 C, lastly rest for 30 min. Repeat the above steps 5 times, and the average discharge capacity of the last 3 times is the 1 C discharge capacity, which is recorded as C_0.

在环境温度 25 ℃ ± 2 ℃（恒温无空气对流）的条件下，电池以 1 C 的电流恒流充电至 3.65 V 后，转恒压充电至充电电流为 0.05 C 截止，搁置 30 min，然后 1 C 放电至 2.5 V，搁置 30 min。按照以上充放电方式重复 5 次，

最后 3 次的平均放电容量即为 1 C 放电容量，记录放电容量为标定容量 C_0。

3.8. Testing Methods 测试方法

3.8.1. Dimension 尺寸

Testing Instrument: Automatic wrapping machine;

试验设备：自动包膜机；

Testing Method:

试验方法：

a) Thickness, length and height of the delivery cell are measured by automatic wrapping machine;
使用包膜机自动测试出货态电池高度，厚度和宽度；

b) Test conditions: 300 kgf ± 20 kgf.
测试条件：300 kgf ± 20 kgf 下测试。

3.8.2. Weight 重量

Test Instrument: electronic scale;

试验设备：电子秤；

Test Method: weight of the cell is measured by electronic scale.

试验方法：使用电子秤测量电池的重量。

3.8.3. Electrical Performance 电性能

3.8.3.1. 0.5 C Discharge Capacity and Energy 0.5 C 放电容量和能量

At ambient temperature of 25 ℃ ± 2 ℃, the cell is charged to 3.65 V with constant current of 0.5 C, then charge at constant voltage of 3.65 V until the current decreases to 0.05 C, and rest for 30 min. After that, discharge to 2.5 V with constant current of 0.5 C and rest for 30 min. Record the discharge capacity and discharge energy. Repeat the charging method and 0.5 C discharging method 5 times. The average discharge capacity of the last 3 times is the 0.5 C discharge capacity, and the last 3 times average discharge energy is 0.5 C discharge energy.

在环境温度 25 ℃ ± 2 ℃的条件下，电池以 0.5 C 的电流恒流充电至 3.65 V 后，转恒压充电至充电电流为 0.05 C 截止，搁置 30 min，然后 0.5 C 放电至 2.5 V，搁置 30 min。记录放电容量和放电能量。按照以上充放电方式重复 5 次，取最后 3 次的平均放电容量即为 0.5 C 放电容量，最后 3 次的平均放电能量即为 0.5 C 放电能量。

3.8.3.2. -20 ℃ Capacity Retention Rate -20 ℃容量保持率

Capacity calibration is carried out according to 3.7. At ambient temperature of 25 ℃ ± 2 ℃, the cell is charged to 3.65 V with constant current of 1 C, and then charge at constant voltage of 3.65 V until the current decreases to 0.05 C.

After that, rest the cell at -20 ℃ ± 2 ℃ for 24 h, and discharge it to 2.0 V with constant current of 1 C under the environment of -20 ℃ ± 2 ℃. Discharge capacity is recorded as C_1, and C_1 / C_0 is the capacity retention rate at -20 ℃.

对电池按照 3.7 的方法进行容量标定。在环境温度 25 ℃ ± 2 ℃的条件下，电池以 1 C 的电流恒流充电至 3.65 V 后，转恒压充电至充电电流为 0.05 C 截止。然后在-20 ℃ ± 2 ℃的环境下搁置 24 h，在-20 ℃ ± 2 ℃的环境下用 1 C 的电流恒流放电至 2.0 V，记录放电容量 C_1，C_1 / C_0 即为-20 ℃容量保持率。

3.8.3.3. 0 ℃ Capacity Retention Rate 0 ℃容量保持率

Capacity calibration is carried out according to 3.7. At ambient temperature of 25 ℃ ± 2 ℃, the cell is charged to 3.65 V with constant current of 1 C, and then charge at constant voltage of 3.65 V until the current decreases to 0.05 C. After that, rest the cell at -0 ℃ ± 2 ℃ for 24 h, and discharge it to 2.0 V with constant current of 1 C under the environment of -20 ℃ ± 2 ℃. Discharge capacity is recorded as C_2, and C_2 / C_0 is the capacity retention rate at 0 ℃.

对电池按照 3.7 的方法进行容量标定。在环境温度 25 ℃ ± 2 ℃的条件下，电池以 1 C 的电流恒流充电至 3.65 V 后，转恒压充电至充电电流为 0.05 C 截止。然后在 0 ℃ ± 2 ℃的环境下搁置 24 h，在 0 ℃ ± 2 ℃的环境下用 1 C 的电流恒流放电至 2.0 V，记录放电容量 C_2，C_2 / C_0 即为 0 ℃容量保持率。

3.8.3.4. 45 ℃ Capacity Retention Rate 45 ℃容量保持率

Capacity calibration is carried out according to 3.7. At ambient temperature of 25 ℃ ± 2 ℃, the cell is charged to 3.65 V with constant current of 1 C, and then charge at constant voltage of 3.65 V until the current decreases to 0.05 C. After that, rest the cell at 45 ℃ ± 2 ℃ for 5 h, and discharge it to 2.5 V with constant current of 1 C under the environment of 45 ℃ ± 2 ℃. Discharge capacity is recorded as C_3, and C_3 / C_0 is the capacity retention rate at 45 ℃.

对电池按照 3.7 的方法进行容量标定。在环境温度 25 ℃ ± 2 ℃的条件下，电池以 1 C 的电流恒流充电至 3.65 V 后，转恒压充电至充电电流为 0.05 C 截止。然后在 45 ℃ ± 2 ℃的环境下搁置 5 h，在 45 ℃ ± 2 ℃的环境下用 1 C 的电流恒流放电至 2.5 V，记录放电容量 C_3，C_3 / C_0 即为 45 ℃容量保持率。

3.8.3.5. 55 ℃ Capacity Retention Rate 55 ℃容量保持率

Capacity calibration is carried out according to 3.7. At ambient temperature of 25 ℃ ± 2 ℃, the cell is charged to 3.65 V with constant current of 1 C, and then charge at constant voltage of 3.65 V until the current decreases to 0.05 C. After that, rest the cell at 55 ℃ ± 2 ℃ for 5 h, and discharge it to 2.5 V with constant current of 1 C under the environment of 55 ℃ ± 2 ℃. Discharge capacity is recorded as C_4, and C_4 / C_0 is the capacity retention rate at 55 ℃.

对电池按照 3.7 的方法进行容量标定。在环境温度 25 ℃ ± 2 ℃的条件下，电池以 1 C 的电流恒流充电至 3.65 V 后，转恒压充电至充电电流为 0.05 C 截止。然后在 55 ℃ ± 2 ℃ 的环境下搁置 5 h，在 55 ℃ ± 2 ℃的环境下用 1 C 的电流恒流放电至 2.5 V，记录放电容量 C_4，C_4 / C_0 即为 55 ℃容量保持率。

3.8.3.6. Internal Resistance 内阻

a. ACR: When the SOC is 30 %~40 % at ambient temperature, test the cell with a frequency of AC 1 kHz.

b. DCR: Capacity calibration is carried out according to 3.7. The cell is charged to 3.65 V with constant current of 1 C, and then charge at constant voltage of 3.65 V until the current decreases to 0.05 C. Rest for 30 min, and discharge with constant current of 1/3 C_0 for 90 min afterwards (adjust the SOC to 50 %). Then rest for 2 h, and record the voltage V_1 at the end of the period. Put a 10 s discharge pulse current of 1 C and record the voltage V_2 at the end of the pulse, and calculate the DCR. DCR= $(V_1 - V_2) \times 1000 / 160.0$ (mΩ).

a. 交流内阻（ACR）：在环境温度 25 ℃ ± 2 ℃的条件下，30 % ~ 40 % SOC 的电池采用 1 kHz 的频率进行测试。

b. 直流内阻（DCR）：对电池按照 3.7 的方法进行容量标定，电池以 1 C 的电流恒流充电至 3.65 V 后，转恒压充电至充电电流为 0.05 C 截止，搁置 30 min，然后以 1/3 C_0 的电流恒流放电 90 min（调整 SOC 为 50 %）搁置 2 h，记录搁置末期电压 V_1，用 1 C 的电流恒流放电 10 s，记录放电末期电压 V_2，计算 DCR，DCR= $(V_1 - V_2) \times 1000 / 160.0$ (mΩ)。

3.8.3.7. 25 ℃ 0.5 C / 0.5 C Cycle 25 ℃ 0.5 C / 0.5 C 循环

Before the test, prepare the fixture according to 3.3. When the SOC is 30 %~40 % at ambient temperature, install the test fixture according to the method of 3.4.

测试前按照 3.3 进行夹具准备，在常温下 30 % ~ 40 % SOC 时，按照 3.4 的方法安装测试夹具。

Pre-cycle initial capacity test: test the cell capacity (3.8.3.1). and record the initial capacity as C_5.

循环前初始容量测试：对电池按照 3.8.3.1 的方法进行容量测试，记录初始容量 C_5。

Cycle test: ambient temperature 25 ℃ ± 2 ℃;

循环测试：环境温度 25 ℃ ± 2 ℃；

a. The cell is charged to 3.65 V with constant current of 0.5 C, and then charge at constant voltage of 3.65 V until the current decreases to 0.05 C;

b. Discharge to 2.5 V with constant current of 0.5 C and rest for 30 min;

c. Repeat a ~ b and cycle 4000 times.

Capacity test after cycle: at ambient temperature of 25 ℃ ± 2 ℃, discharge the cell to 2.5 V with constant current of 0.5 C. Rest for 30 min, then charging it to 3.65 V with constant current of 0.5 C, and switch to constant voltage charging when the cut-off current is 0.05 C. Rest for 30 min, then discharging to 2.5 V with constant current of 0.5 C, and record the discharge capacity C_6. The capacity retention rate = $C_6 / C_5 \times 100$ %.

a. 对电池以 0.5 C 的电流恒流充电至 3.65 V 后转恒压充电至 0.05 C 截止，搁置 30 min；

b. 以 0.5 C 的电流恒流放电至 2.5 V，搁置 30 min；

c. 重复 a ~ b 循环 4000 次时终止。

循环后容量测试：在 25 ℃ ± 2 ℃的环境温度下对电池以 0.5 C 的电流恒流放电至 2.5 V，搁置 30 min，然后以 0.5 C 的电流恒流充电至 3.65 V 后，转恒压充电至充电电流为 0.05 C 截止，搁置 30 min，然后 0.5 C 放电至 2.5 V，记录放电容量 C_6，容量保持率=C_6 / C_5 × 100 %。

3.8.3.8. 45 ℃ 0.5 C / 0.5 C Cycle 45 ℃ 0.5 C / 0.5 C 循环

Before the test, prepare the fixture according to 3.3. When the SOC is 30 % ~ 40 % at ambient temperature, install the test fixture according to the method of 3.4.

测试前按照 3.3 进行夹具准备，在常温下 30 % ~ 40 % SOC 时，按照 3.4 的方法安装测试夹具。

Pre-cycle initial capacity test: test the cell capacity (3.8.3.1), and record the initial capacity as C_7.

循环前初始容量测试：对电池按照 3.8.3.1 的方法进行容量测试，记录初始容量 C_7。

Cycle test: ambient temperature 45 ℃ ± 2 ℃;

循环测试：环境温度 45 ℃ ± 2 ℃；

a. Charge the cell to 3.65 V with constant current of 0.5 C, then switching to constant voltage charging to 0.05 C to cut off, and rest for 30 min;

b. Discharge to 2.5 V with constant current of 0.5 C and rest for 30 min;

c. Repeat a ~ b and cycle 2000 times.

a. 对电池以 0.5 C 的电流恒流充电至 3.65 V 后转恒压充电至 0.05 C 截止，搁置 30 min；

b. 以 0.5 C 的电流恒流放电至 2.5 V，搁置 30 min；

c. 重复 a ~ b 循环 2000 次时终止。

Capacity test after cycle: at ambient temperature of 25 ℃ ± 2 ℃, discharge the cell to 2.5 V with constant current of 0.5 C. Rest for 30 min, then charging it to 3.65 V with constant current of 0.5 C, and switch to constant voltage charging when the cut-off current is 0.05 C. Rest for 30 min, then discharging to 2.5 V with constant current of 0.5 C, and record the discharge capacity C_8. The capacity retention rate = C_8 / C_7 × 100 %.

循环后容量测试：在 25 ℃ ± 2 ℃的环境温度下对电池以 0.5 C 的电流恒流放电至 2.5 V，搁置 30 min，然后以 0.5 C 的电流恒流充电至 3.65 V 后，转恒压充电至充电电流为 0.05 C 截止，搁置 30 min，然后 0.5 C 放电至 2.5 V，记录放电容量 C_8，容量保持率=C_8 / C_7 × 100 %。

3.8.3.9. Recommend EVE Cycling Method EVE 推荐循环方式

Before the test, prepare the fixture according to 3.3. When the SOC is 30 % ~ 40 %, install the test fixture according to the method of 3.4.

测试前按照 3.3 进行夹具准备，在 30 % ~ 40 % SOC 时，按照 3.4 的方法安装测试夹具。

Pre-cycle capacity test: Calibrate the cell capacity (3.7), and record the calibrated capacity as C_0.

循环前容量标定：对电池进行容量标定（3.7），记录标定容量 C_0。

Steps of 25 ℃ Staged Charging Cycle 25 ℃ 阶梯充电循环工步：

a. Ambient temperature at 25 ℃ ± 2 ℃, staged charge cycle at 300 kgf ±20 kgf;

b. With 1 C constant current charging capacity as 80 % C_0;

c. 0.8 C constant current charging to 3.5 V;

d. 0.5 C constant current charging to 3.6 V;

e. 0.1 C constant current charging to 3.65 V;

f. Rest for 30 min in an open circuit state, discharge to 2.5 V with constant current of 1 C, and rest for 30 min;

g. Repeat steps from b to f. When the cycle capacity retention rate decreases by 5 %, the current value of 1 C is adjusted to 1 C × (1 – 5 % × n), n=1, 2, 3, 4, ...; ensure that every decay 5 % of the charging time remains the same, and the specific steps are shown in the corresponding charging and discharging ammeter of the staged charging cycle;

h. Cycle steps b ~ g and cycle 4000 times.

a. 环境温度25 ℃ ± 2 ℃，300 kgf ± 20 kgf下阶梯充电循环；

b. 1 C 恒流充电至 80 % C_0；

c. 0.8 C 恒流充电至 3.5 V；

d. 0.5 C 恒流充电至 3.6 V；

e. 0.1 C 恒流充电至 3.65 V；

f. 在开路状态静置30 min，以1 C恒流放电至2.5 V，搁置30 min；

g. 重复 b 到 f 步骤，循环容量保持率每衰减 5 %时，此时 1 C 电流值调整为 1 C ×(1 – 5 % × n)，n=1，2，3，4，...；确保每衰减 5 %的充电时长保持一致，具体步骤见阶梯充电循环对应充放电电流表；

h. 按步骤 b ~ g 循环 4000 次时终止。

Steps of 45 ℃ Staged Charging Cycle 45 ℃ 阶梯充电循环工步：

a. Ambient temperature 45 ℃ ± 2 ℃, staged charge cycle at 300 kgf ±20 kgf;

b. With 1 C constant current charging capacity as 80 % C_0;

c. 0.8 C constant current charging to 3.5 V;

d. 0.5 C constant current charging to 3.6 V;

e. 0.1 C constant current charging to 3.65 V;

f. Rest for 30 min in an open circuit state, discharge to 2.5 V with constant current of 1 C, and rest for 30 min;

g. Repeat steps from b to f. When the cycle capacity retention rate decreases by 5 %, the current value of 1 C is adjusted to 1 C × (1 – 5 % × n), n=1, 2, 3, 4, ...; ensure that every decay 5 % of the charging time remains the same, and the specific steps are shown in the corresponding charging and discharging ammeter of the staged charging cycle;

h. Cycle steps b ~ g and cycle 2000 times.

a. 环境温度45 ℃ ± 2 ℃，300 kgf ± 20 kgf下阶梯充电循环；

b. 1 C 恒流充电至 80 % C_0；

c. 0.8 C 恒流充电至 3.5 V；

d. 0.5 C 恒流充电至 3.6 V;

e. 0.1 C 恒流充电至 3.65 V;

f. 在开路状态静置30 min，以1 C恒流放电至2.5 V，搁置30 min;

g. 重复 b 到 f 步骤，循环容量保持率每衰减 5 %时，此时 1 C 电流值调整为 1 C ×(1 – 5 % × n)，n=1，2，3，4，...；确保每衰减 5 %的充电时长保持一致，具体步骤见阶梯充电循环对应充放电电流表;

h. 按步骤 b ~ g 循环 2000 次时终止。

Corresponding Charging Current Table for Staged Charging Cycle:

阶梯充电循环对应充电电流表:

Table 6 Corresponding charging current meter for stepped charging cycle

表 6 阶梯充电循环对应充电电流表

Item 项目	Current /Capacity 电流/容量	Current capacity / calibrated capacity × 100 % 当前容量 / 标定容量 ×100 %			
		> 95 %	[95 % ~ 90 %)	[90 % ~ 85 %)	[85 % ~ 80 %)
Charging Current (A) 充电电流（A）	1 C	160.0	152.0	144.0	136.0
	0.8 C	128.0	121.6	115.2	108.8
	0.5 C	80.0	76.0	72.0	68.0
	0.1 C	16.0	15.2	14.4	13.6
Discharging Current (A) 放电电流（A）	1 C	160.0	160.0	160.0	160.0
1 C constant Current Charge to 80 % C_0; 1 C 恒流充电至容量 80 % C_0		80 % C_0	76 % C_0	72 % C_0	68 % C_0

Remarks: When the cycle capacity retention rate decreases by 5 %, the charging current 1 C / 0.8 C / 0.5 C / 0.1 C current value is adjusted to 1 C / 0.8 C / 0.5 C / 0.1 C × (1 – 5 % × n) at this time, n=0, 1, 2, 3, 4, …; set the current according to the charging and discharging ammeter corresponding to the stepped charging.

备注：循环容量保持率每衰减 5 %时，此时充电电流 1 C / 0.8 C / 0.5 C / 0.1 C 电流值调整为 1 C / 0.8 C / 0.5 C / 0.1 C ×(1 – 5 % × n)，n=0，1，2，3，4，…；按阶梯充电对应充放电电流表设置电流。

3.8.3.10. 25 ℃ Capacity Retention and Recovery 25 ℃荷电保持与恢复

Capacity calibration is carried out according 3.7. The cell is charged to 3.65 V with constant current of 1 C, then switching to constant voltage charging at 3.65 V until the charging current reaches 0.05 C, and rest for 28 days

afterwards at ambient temperature of 25 ℃ ± 2 ℃. At ambient temperature of 25 ℃ ± 2 ℃, discharging the cell to 2.5 V with constant current of 1 C (record the discharge capacity as C_9), rest for 30 min. Then charge it to 3.65 V with constant current of 1 C, switching to constant voltage charging When the cut-off current is 0.05 C, and rest for 30 min. Then discharge to 2.5 V with constant current of 1 C (record the discharge capacity C_{10}). Capacity retention rate=C_9 / C_0 × 100 %, capacity recovery rate=C_{10} / C_0 ×100 %.

对电池进行容量标定（3.7），电池以 1 C 的电流恒流充电至 3.65 V，在 3.65 V 下转恒压充电，直至充电电流为 0.05 C，然后在环境温度 25 ℃ ± 2 ℃的条件下搁置 28 天，然后在环境温度 25 ℃ ± 2 ℃的条件下按照 1 C 放电至 2.5 V（记录放电容量 C_9），搁置 30 min，然后按照 1 C 的电流恒流充电至 3.65 V，在 3.65 V 下转恒压充电，直至充电电流为 0.05 C，搁置 30 min，用 1 C 放电至 2.5 V（记录放电容量 C_{10}）。容量保持率=C_9 / C_0 × 100 %，容量恢复率=C_{10} / C_0 × 100 %。

3.8.3.11. 45 ℃ Capacity Retention and Recovery 45 ℃荷电保持与恢复

Capacity calibration is carried out according 3.7. The cell is charged to 3.65 V with constant current of 1 C, then switching to constant voltage charging at 3.65 V until the charging current decreases to 0.05 C, and rest for 28 days afterwards at ambient temperature of 45 ℃ ± 2 ℃. At ambient temperature of 25 ℃ ± 2 ℃ rest for 5 h , and the cell discharge to 2.5 V with constant current of 1 C (record the discharge capacity C_{11}). Rest for 30 min, charging it to 3.65 V with constant current of 1 C, and switch to constant voltage charging When the cut-off current is 0.05 C. Rest for 30 min, and then discharge to 2.5 V with constant current of 1 C (record the discharge capacity C_{12}). Capacity retention rate= C_{11} / C_0 × 100 %, capacity recovery rate= C_{12} / C_0 × 100 %.

对电池进行容量标定（3.7），电池以 1 C 的电流恒流充电至 3.65 V，在 3.65 V 下转恒压充电，直至充电电流为 0.05 C，然后在环境温度 45 ℃ ± 2 ℃的条件下搁置 28 天，然后在环境温度 25 ℃ ± 2 ℃的条件下搁置 5 h，然后按照 1 C 放电至 2.5 V（记录放电容量 C_{11}），搁置 30 min，然后按照 1 C 的电流恒流充电至 3.65 V，在 3.65 V 下转恒压充电，直至充电电流为 0.05 C，搁置 30 min，用 1 C 放电至 2.5 V（记录放电容量 C_{12}）。容量保持率=C_{11} / C_0 × 100 %，容量恢复率=C_{12} / C_0 × 100 %。

3.8.3.12. 55 ℃ Capacity Retention and Recovery 55 ℃荷电保持与恢复

Capacity calibration is carried out according 3.7. The cell is charged to 3.65 V with constant current of 1 C, then switching to constant voltage charging at 3.65 V until the charging current decreases to 0.05 C, and rest for 7 days at ambient temperature of 55 ℃ ± 2 ℃. At ambient temperature of 25 ℃ ± 2 ℃ rest for 5 h, and the cell discharge to 2.5 V with constant current of 1 C (record the discharge capacity C_{13}). Rest for 30 min, then charging it to 3.65 V with constant current of 1 C, and switch to constant voltage charging When the cut-off current is 0.05 C. Rest for 30 min, and then discharge to 2.5 V with constant current of 1 C (record the discharge capacity C_{14}). Capacity retention rate=C_{13} / C_0 × 100 %, capacity recovery rate=C_{14} / C_0 ×100 %.

对电池进行容量标定（3.7），电池以 1 C 的电流恒流充电至 3.65 V，在 3.65 V 下转恒压充电，直至充电电流

为 0.05 C，然后在环境温度 55 ℃ ± 2 ℃的条件下搁置 7 天，然后在环境温度 25 ℃ ± 2 ℃的条件下搁置 5 h，然后按照 1 C 放电至 2.5 V（记录放电容量 C_{13}），搁置 30 min，然后按照 1 C 的电流恒流充电至 3.65 V，在 3.65 V 下转恒压充电，直至充电电流为 0.05 C，搁置 30 min，用 1 C 放电至 2.5 V（记录放电容量 C_{14}）。容量保持率= C_{13} / C_0 × 100 %，容量恢复率= C_{14} / C_0 × 100 %。

3.8.4. Safety Performance 安全性能

3.8.4.1. Over Discharge 过放电

At ambient temperature of 25 ℃ ± 2 ℃, the cell is charged to 3.65 V with constant current of 1 C, and then switch to constant voltage charging at 3.65 V, until the charging current decreases to 0.05 C. The cell is discharged with constant current of 1 C for 90 min at the ambient temperature of the safety test. Observe for 1 h. (Refer to GB 38031-2020 electric vehicles traction battery safety requirements)

在环境温度 25 ℃ ± 2 ℃条件下，对电池以 1 C 的电流恒流充电至 3.65 V，在 3.65 V 下转恒压充电，至 0.05 C 截止。在安全试验环境温度 25 ℃ ± 2 ℃下电池以 1 C 恒流放电 90 min。观察 1 h。（参考 GB 38031-2020 电动汽车用动力蓄电池安全要求）

3.8.4.2. Over Charge 过充电

At ambient temperature of 25 ℃ ± 2 ℃, the cell is charged to 3.65 V with constant current of 1 C, and switch to constant voltage charging at 3.65 V until the charging current reaches 0.05 C, then installing the test fixture according to 3.4. After the cell is charged to 1.1 times the termination voltage, or 115 % SOC with constant current of not less than 1/3 C at the ambient temperature of the safety test, stop charging. Observe for 1 h. (Refer to GB 38031-2020 electric vehicles traction battery safety requirements)

在环境温度 25 ℃ ± 2 ℃条件下，对电池以 1 C 的电流恒流充电至 3.65 V，在 3.65 V 下转恒压充电，至 0.05 C 截止，然后按照 3.4 的方法安装测试夹具。在安全试验环境温度下电池以不小于 1/3 C 恒流充电至终止电压的 1.1 倍或 115 % SOC 后，停止充电。观察 1 h。（参考 GB 38031-2020 电动汽车用动力蓄电池安全要求）

3.8.4.3. External Short-circuit 外部短路

At ambient temperature of 25 ℃ ± 2 ℃, the cell is charged to 3.65 V with constant current of 1 C, and then switch to constant voltage charging at 3.65 V until the charging current reaches 0.05 C. The positive and negative terminals of the cell are short-circuited externally for 10 min under the environmental temperature of the safety test, and the resistance of the external circuit should be less than 5 mΩ. Observe for 1 h. (Refer to GB 38031-2020 electric vehicles traction battery safety requirements)

在环境温度 25 ℃ ± 2 ℃条件下，对电池以 1 C 的电流恒流充电至 3.65 V，在 3.65 V 下转恒压充电，至 0.05 C 截止。在安全试验环境温度下将电池正、负极经外部短路 10 min，外部线路电阻值应小于 5 mΩ。观察 1 h。（参考 GB 38031-2020 电动汽车用动力蓄电池安全要求）

3.8.4.4. Heating 加热（130 ℃）

At ambient temperature of 25 ℃ ± 2 ℃, the cell is charged to 3.65 V with constant current of 1 C, and then switch to constant voltage charging at 3.65 V until the charging current reaches 0.05 C. Put the cell into the temperature chamber, and the temperature chamber will rise from room temperature to 130 ℃ ± 2 ℃ at a rate of 5 ℃/min, and keep this temperature for 30 min before stopping heating. Observe for 1 h. (Refer to GB 38031-2020 electric vehicles traction battery safety requirements)

在环境温度 25 ℃ ± 2 ℃条件下，对电池以 1 C 的电流恒流充电至 3.65 V，在 3.65 V 下转恒压充电，至 0.05 C 截止。将电池放入温度箱，温度箱按照 5 ℃/min 的速率由室温升至 130 ℃ ± 2 ℃，并保持此温度 30 min 后停止加热。观察 1 h。（参考 GB 38031-2020 电动汽车用动力蓄电池安全要求）

3.8.4.5. Temperature Cycling 温度循环

At ambient temperature of 25 ℃ ± 2 ℃, the cell is charged to 3.65 V with constant current of 1 C, and then switch to constant voltage charging at 3.65 V, until the charging current reaches 0.05 C. Put the cell into the temperature chamber, and adjust the temperature chamber according to the following table and figure, and cycles for 5 times. (Refer to GB 38031-2020 electric vehicles traction battery safety requirements)

在环境温度 25 ℃ ± 2 ℃条件下，对电池以 1 C 的电流恒流充电至 3.65 V，在 3.65 V 下转恒压充电，至 0.05 C 截止。将电池放入温度箱中，温度箱按照下表进行调节，循环次数 5 次。（参考 GB 38031-2020 电动汽车用动力蓄电池安全要求）

Table 7 Temperature cycle corresponding parameter table

表 7 温度循环对应参数

Temperature 温度（℃）	Time Increment 时间增量（min）	Time Accumulation 累计时间（min）	Temperature Change Rate 温度变化率（℃/min）
25	0	0	0
-40	60	60	13/12
-40	90	150	0
25	60	210	13/12
85	90	300	2/3
85	110	410	0
25	70	480	6/7

3.8.4.6. Extrusion 挤压

At ambient temperature of 25 ℃ ± 2 ℃, the cell is charged to 3.65 V with constant current of 1 C, and then switch to constant voltage charging at 3.65 V until the charging current reaches 0.05 C. Test under the following conditions at a safety test environment temperature of 25 ℃ ± 2 ℃:

a) Extrusion direction: apply pressure perpendicular to the direction of the cell plate, or the same direction that the cell is most susceptible to extrude in the layout of the whole vehicle;

b) The form of the extruded plate: a semi-cylinder with a radius of 75 mm, the length (L) of the semi-cylinder is greater than the size of the cell being extruded (refer to the figure below);

c) Extrusion speed: not more than 2 mm/s;

d) Extrusion degree: stop extruding after the voltage reaches 0 V or the deformation reaches 15 % or the extruding force reaches 100 kN or 1000 times the weight of the test object;

e) Keep it for 10 min. Observe for 1 h. (Refer to GB 38031-2020 electric vehicles traction battery safety requirements).

在环境温度 25 ℃ ± 2 ℃条件下，对电池以 1 C 的电流恒流充电至 3.65 V，在 3.65 V 下转恒压充电，至 0.05 C 截止。在安全试验环境温度下按照如下条件进行试验：

a) 挤压方向：垂直于电池单体极板方向施压，或与电池单体在整车布局上最容易受到挤压的方向相同；

b) 挤压板形式：半径 75 mm 的半圆柱体，半圆柱体的长度（L）大于被挤压电池单体的尺寸；

c) 挤压速度：不大于 2 mm/s；

d) 挤压程度：电压达到 0 V 或变形量达到 15 %或挤压力达到 100 kN 或 1000 倍试验对象重量后停止挤压；

e) 保持 10 min。观察 1 h。（参考 GB 38031-2020 电动汽车用动力蓄电池安全要求）

4. Charge and Discharge Parameters 充放电参数

The following data is the reference performance data of LF230 cell for reference during BMS design. Actual use is subject to the use mode and conditions agreed by both parties.

以下数据为 LF230 电池参考性能数据，供 BMS 设计时参考，实际使用以双方约定的使用方式和条件为准。

4.1. Charge Mode 充电模式

Table 8 Charging mode parameter table

表 8 充电模式参数表

Parameters 参数	Product specifications 产品规格	Remarks 备注
Standard charging current 标准充电电流	0.5 C	25 ℃ ± 2 ℃

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Maximum continuous charging current 最大充电可持续电流	1 C	
Standard charging cut-off voltage 标准充电截止电压	Single cell ≤ 3.65 V 单体电池 ≤ 3.65 V	
Standard charging mode 标准充电模式	Refer to section 3.5 参考 3.5 节	
Standard charging temperature 标准充电温度	25 ℃ ± 2 ℃	
Absolute charging temperature (cell temperature) 绝对充电温度（电池温度）	0 ℃ ~ 65 ℃	No matter what charging mode the cell is in, once the cell temperature exceeds the absolute charging temperature range, charging will stop 无论电池处于何种充电模式，电池温度一旦超出绝对充电温度范围，即停止充电
Absolute charging voltage 绝对充电电压	Max 3.65 V 最大 3.65 V	No matter what charging mode the cell is in, once the cell voltage exceeds the absolute charging voltage, the charging will stop 无论电池处于何种充电模式，电池电压一旦超出绝对充电电压，即停止充电

4.2. Other Charging Mode 其他充电模式

Table 9 Continuous charging modes / C-cell level (unit: C-Rate)

表 9 持续充电模式 / C-电芯级别（单位：C-Rate）

T / SOC	0 %	5 %	10 %	20 %	30 %	40 %	50 %	60 %	70 %	80 %	90 %	95 %	100 %
0 ℃	0	0	0	0	0	0	0	0	0	0	0	0	0
2 ℃	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.06	0.06	0
5 ℃	0.4	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.12	0.12	0
7 ℃	0.4	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.12	0.12	0
10 ℃	0.8	0.8	0.6	0.6	0.6	0.6	0.4	0.4	0.4	0.2	0.2	0.12	0
25 ℃	1	1	1	1	1	1	1	1	1	1	0.8	0.4	0
45 ℃	1	1	1	1	1	1	1	1	1	1	0.8	0.4	0
55 ℃	1	1	1	1	1	1	1	1	1	1	0.8	0.4	0
60 ℃	1	1	1	1	1	1	1	1	1	1	0.8	0.4	0
65 ℃	0	0	0	0	0	0	0	0	0	0	0	0	0

4.3. Discharge Mode 放电模式

Table 10 Discharge mode parameter table

表 10 放电模式参数表

Parameters 参数	Product specifications 产品规格	Remarks 备注
Standard discharge current 标准放电电流	0.5 C	25 ℃ ± 2 ℃
Maximum continuous discharge current 最大放电可持续电流	1 C	
Discharge cut-off voltage 放电截止电压	2.5 V	Temperature T > 0 ℃ 温度 T > 0 ℃
	2.0 V	Temperature T ≤ 0 ℃ 温度 T ≤ 0 ℃
Standard discharge mode 标准放电模式	Refer to section of 3.6 参考 3.6 节	
Standard discharge temperature 标准放电温度	25 ℃ ± 2 ℃	
Absolute discharge temperature (cell temperature) 绝对放电温度（电池温度）	-35℃ ~ 65 ℃	No matter what discharge mode the cell is in, once the cell temperature exceeds the absolute discharge temperature range, the discharge will stop 无论电池处于何种放电模式，电池温度一旦超出绝对放电温度范围，即停止放电
Absolute discharge voltage 绝对放电电压	Min 2.5 V (T > 0 ℃) Min 2.0 V (T ≤ 0 ℃) 最小 2.5 V（T > 0 ℃） 最小 2.0V（T ≤ 0 ℃）	No matter what kind of discharge mode the cell is in, once the cell voltage is less than the absolute discharge voltage, it stops discharging 无论电池处于何种放电模式，电池电压一旦小于绝对放电电压，即停止放电

4.4. Other Discharging Mode 其他放电模式

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Table 11 Continuous discharge rate / C-cell level (unit: C-Rate)

表 11 持续放电倍率 / C-电芯级别（单位：C-Rate）

T / SOC	100 %	95 %	90 %	80 %	70 %	60 %	50 %	40 %	30 %	20 %	10 %	5 %	0 %
-35 ℃	0	0	0	0	0	0	0	0	0	0	0	0	0
-30 ℃	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.12	0.06	0.03	0
-20 ℃	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.25	0.12	0.06	0
-10 ℃	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.3	0.15	0
0 ℃	1	1	1	1	1	1	1	1	1	1	0.5	0.3	0
10 ℃	1	1	1	1	1	1	1	1	1	1	0.5	0.3	0
25 ℃	1	1	1	1	1	1	1	1	1	1	0.8	0.4	0
45 ℃	1	1	1	1	1	1	1	1	1	1	0.8	0.4	0
55 ℃	1	1	1	1	1	1	1	1	1	1	0.8	0.4	0
60 ℃	1	1	1	1	1	1	1	1	1	1	0.8	0.4	0
65 ℃	0	0	0	0	0	0	0	0	0	0	0	0	0

4.5. Pulsing Mode 脉冲模式

4.5.1. Pulsing Discharging Mode 脉冲放电模式

Table 12 30 s pulse discharge rate / C-cell level (unit: C-Rate)

表 12 30 s 脉冲放电倍率 / C-电芯级别（单位：C-Rate）

T\SOC	100 %	95 %	90 %	80 %	70 %	60 %	50 %	40 %	30 %	20 %	10 %	5 %	0 %
< -35 ℃	0	0	0	0	0	0	0	0	0	0	0	0	0
-35 ℃	0.8	0.8	0.8	0.8	0.8	0.8	0.4	0.4	0.2	0.1	0.1	0.05	0
-30 ℃	1.6	1.6	1.6	1.6	1.6	1.6	0.8	0.8	0.4	0.25	0.25	0.15	0
-20 ℃	2	2	2	2	2	2	2	1.6	0.4	0.25	0.25	0.15	0
-15 ℃	2	2	2	2	2	2	2	1.6	0.4	0.25	0.25	0.15	0
-10 ℃	2	2	2	2	2	2	2	2	2	0.8	0.25	0.15	0
-5 ℃	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	1	0.5	0.25	0
0 ℃	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	1.1	0.6	0.3	0
5 ℃	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	1.15	0.7	0.35	0
10 ℃	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	1.2	0.8	0.4	0
15 ℃	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	1.3	0.9	0.45	0
20 ℃	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	1.4	1	0.5	0

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25 ℃	3	3	3	3	3	3	3	3	3	2	2	1	0
30 ℃	3	3	3	3	3	3	3	3	3	2	2	1	0
35 ℃	3	3	3	3	3	3	3	3	3	2	2	1	0
40 ℃	3	3	3	3	3	3	3	3	3	2	2	1	0
45 ℃	3	3	3	3	3	3	3	3	3	2	2	1	0
50 ℃	3	3	3	3	3	3	3	3	3	2	2	1	0
55 ℃	3	3	3	3	3	3	3	3	3	2	2	1	0
60 ℃	3	3	3	3	3	3	3	3	3	2	2	1	0
65 ℃	0	0	0	0	0	0	0	0	0	0	0	0	0

4.5.2. Pulsing Feedback Mode 脉冲回馈模式

Table 13 30 s pulse feedback rate / C-cell level (unit: C-Rate)

表 13 30 s 脉冲回馈倍率 / C-电芯级别（单位：C-Rate）

T\SOC	0 %	5 %	10 %	20 %	30 %	40 %	50 %	60 %	70 %	80 %	90 %	95 %	100 %
-10 ℃	0	0	0	0	0	0	0	0	0	0	0	0	0
-5 ℃	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.05	0.05	0
0 ℃	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0
5 ℃	0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.25	0.25	0
10 ℃	1.6	1.6	1.2	1.2	1.2	1.2	0.8	0.8	0.8	0.4	0.4	0.25	0
15 ℃	1.8	1.8	1.6	1.6	1.4	1.4	1.2	1.2	1.2	1.2	0.6	0.4	0
20 ℃	2	2	2	2	1.6	1.6	1.6	1.6	1.6	1.6	0.8	0.4	0
25 ℃	2	2	2	2	2	2	2	2	2	2	1.6	0.8	0
30 ℃	2	2	2	2	2	2	2	2	2	2	1.6	0.8	0
35 ℃	2	2	2	2	2	2	2	2	2	2	1.6	0.8	0
40 ℃	2	2	2	2	2	2	2	2	2	2	1.6	0.8	0
45 ℃	2	2	2	2	2	2	2	2	2	2	1.6	0.8	0
50 ℃	2	2	2	2	2	2	2	2	2	2	1.6	0.8	0
55 ℃	2	2	2	2	2	2	2	2	2	2	1.6	0.8	0
60 ℃	2	2	2	2	2	2	2	2	2	2	1.6	0.8	0
65 ℃	0	0	0	0	0	0	0	0	0	0	0	0	0

Model 型号	LF160	Specification No. 规格书编号	RD-LF160-S01-LF	Version 版本	B

5. Safety Limits 安全限制

5.1. Application Conditions 应用条件

The customer shall ensure strict compliance with the following battery application conditions.
客户应当确保严格遵守以下与电池相关的应用条件：

a) The customer shall configure a battery management system to strictly monitor, manage and protect each battery.

a) 客户应配置电池管理系统，严密监控、管理与保护每个电池。

b) The customer shall provide EVE with detailed design scheme, system characteristics, framework, system data, format and other relevant information of the battery management system, so that EVE can conduct design evaluation of the system and establish battery management archives.

b) 客户应向 EVE 提供电池管理系统详细的设计方案、系统特点、框架、系统数据、格式等相关信息，以供 EVE 对该系统进行设计评估，并建立电池管理档案。

c) Without EVE's consent, the customer is not allowed to modify or change the design and framework of the battery management system, so as not to affect the performance of the battery.

c) 未经 EVE 同意，客户不可擅自修改或改变电池管理系统的设计和框架，以免影响电池的使用性能。

d) The customer shall keep complete monitoring data of battery operation for reference of product quality responsibility division. **EVE is not responsible for product quality assurance if it does not have complete monitoring data of the battery system during its service life.**

d) 客户应保存完整的电池运转的监测数据，用做产品质量责任划分的参考。**不具备完整的电池系统使用期限内的监测数据的，EVE 不承担产品质量保证责任。**

e) The waterproof and dustproof problems of the battery shall be fully considered in the design of the battery pack, and the battery pack must meet the waterproof and dustproof grade stipulated by relevant national standards. EVE is not responsible for the damage (such as corrosion, rust, etc.) of the battery caused by waterproof and dustproof problems.

e) 电池包设计中应充分考虑电芯的防水、防尘问题，电池包必须满足国家有关标准规定的防水、防尘等级。由于防水、防尘问题而导致的电芯或电池的损坏（如腐蚀、生锈等），EVE 不承担质量保证责任。

f) It is forbidden to mix different types of cells in the same battery system (or vehicle), otherwise, EVE will not be responsible for quality assurance.

f) **禁止不同型号电芯在同一电池系统（或整车）中混用，否则，EVE 不承担质量保证责任。**

5.2. Voltage Limits 电压限制

Table 14 Safety limit voltage parameters

表 14 安全限制电压参数

Model 型号	LF160	Specification No. 规格书编号	RD-LF160-S01-LF	Version 版本	B

Item 项目	Category 类别	Parameters 参数	Protective Action 保护动作
Charging Voltage 充电电压	Charging Ends 充电终止	3.85 V	Forcibly stop and lock the battery management systemuntil the technician solves the problem. 强制停止，并锁定电池管理系统，直至技术人员解决问题。
	First Over-Charging Protection 第一级过充电保护	3.70 V	Pre-alarm 预报警
	Second Over-Charging Protection 第二级过充电保护	3.80 V	Decrease current or power 降电流或降功率
Discharging Voltage 放电电压	Discharging Ends 放电终止	1.85 V	Temperature T > 0 ℃, forcibly stop and lock the battery management systemuntil the technician solves the problem. 温度 T > 0 ℃，强制停止，并锁定电池管理系统，直至技术人员解决问题。
		1.75 V	Temperature T ≤ 0 ℃, forcibly stop and lock the battery management systemuntil the technician solves the problem. 温度 T ≤ 0 ℃，强制停止，并锁定电池管理系统，直至技术人员解决问题。
	First Over-Discharging Protection	2.00 V	Temperature T > 0 ℃, Pre-alarm 温度 T > 0 ℃，预报警

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	第一级过放电保护	1.90 V	Temperature T ≤ 0 ℃, Pre-alarm 温度 T ≤ 0 ℃，预报警
	Second Over-Discharging Protection 第二级过放电保护	1.90 V	Temperature T > 0 ℃, decrease current or power 温度 T > 0 ℃，降电流或降功率
		1.80 V	Temperature T ≤ 0 ℃, decrease current or power 温度 T ≤ 0 ℃，降电流或降功率
BMS protection BMS 保护	Short circuit protection 短路保护	Short circuit is not allowed 不允许短路	When a short circuit occurs, the cell is disconnected by the overcurrent device 发生短路时，由过流器断开电池
	Long charging time Protection 充电时间过长保护	Charging time within 8 h 充电时间在 8 小时内	If the charging time is longer than 8 h, the charging will be terminated 充电时间长于8小时，则终止充电

Remarks 备注：

a) Charge protection and discharge protection are warning clauses, please note: when the battery reaches indicators and parameters status of any described terms, it means that the battery has already beyond the conditions of use of the provisions in this specification. The customer shall take protective measures for the battery according to the "Protective Action" and other relevant provisions in this specification. At the same time, EVE disclaims any warranty liability for the quality of the batteries in the above states of use, and EVE will not compensate customers and the third parties for any loss caused by this situation.

a) 充电保护和放电保护为警示条款，提请客户注意：当电池达到上述任何一项条款描述的指标和参数状态时，意味着电池已超出本规格书规定的使用条件，客户依据"保护动作"及本规格书其他相关规定对电池采取保护措施，同时，EVE 声明对上述使用状态的电池质量不承担任何保证责任，并对因此而导致的客户及第三方的任何损失不予赔偿。

b) Avoid over discharge of the battery. When the battery voltage falls below 1.8 V, permanent damage to the battery interior may occur, at this time, EVE's product quality assurance responsibility becomes invalid. When the cut-off voltage of discharge is below 2.5 V, the internal energy consumption of system is minimized and the sleep time is extended before recharging. The customer needs to train the user to recharge the battery in the shortest time ，and prevent the battery from entering the over-discharge state.

b) 应避免电池到达过放状态。电池电压低于 1.8 V 时，电池内部可能会遭到永久性的损坏，此时 EVE 的产品质量保证责任失效。当放电截止电压低于 2.5 V 时，系统内部能耗降到最小，并在重新充电之前延长休眠时间。客户需要培训使用者在最短的时间内重新充电，防止电池进入过放状态。

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5.3. Temperature Limits 温度限制

Table 15 Safety limit temperature parameters

表 15 安全限制温度参数

Item 项目	Value 数值	Remarks 备注
Recommended Operating Temperature Range 推荐操作温度范围	10 ℃ ~ 35 ℃	Recommend cell usage temperature range. 推荐使用电池的温度范围。
Maximum operating temperature 最高操作温度	60 ℃	If the cell temperature exceeds the maximum operating temperature, the power needs to be reduced to 0. 如果电池使用温度超过最高操作温度，功率需要降为 0。
Minimum operating temperature 最低操作温度	-35 °C	If the cell temperature exceeds the minimum operating temperature, the power needs to be reduced to 0. 如果电池使用温度超过最低操作温度，功率需要降为 0。
Maximum safe temperature 最高安全温度	65 ℃	If the cell temperature exceeds the maximum safe temperature, it will cause irreversible and permanent damage to the cell, and the user should not use it higher than the maximum safe temperature. 如果电池使用温度超过最高安全温度，将会造成电池不可逆的永久性损坏，用户使用时不得高于最高安全温度。
Minimum safe temperature 最低安全温度	-35 ℃	If the cell temperature exceeds the minimum safe temperature, it will cause irreversible and permanent damage to the cell, and the user should not lower the minimum safe temperature when using it. 如果电池使用温度超过最低安全温度，将会造成电池不可逆的永久性损坏，用户使用时不得低于最低安全温度。

Remarks 备注：

a) Avoid charging the battery at low temperatures (including but not limited to standard charge, quick

charge, emergency charge and regenerative charge) prohibited by this specification, otherwise unexpected capacity reduction may occur. The battery management system should be controlled according to minimum charging and regenerative charging temperatures. Charging at temperatures lower than specified in this specification is prohibited, otherwise, EVE will not bear all relevant responsibilities such as quality assurance liability and loss compensation caused thereby.

a) 电池避免在本规格书禁止的低温条件下充电（包括但不限于标准充电，快充，紧急情况充电和再生充电等），否则可能出现意外的容量降低现象。电池管理系统应依照最小的充电和再生充电温度进行控制。禁止在低于本规格书规定的温度条件下充电，否则，EVE 不承担质量保证责任及由此引起的损失赔偿等一切相关责任。

b) The heat dissipation of battery should be fully considered in the design of battery pack, EVE is not responsible for the quality assurance caused by overheating due to the heat dissipation design of battery pack.

b) 电池包设计中应充分考虑电芯的散热问题，由于电池包散热设计问题导致的电芯或电池过热损坏，EVE 不承担质量保证责任。

6. Parameters Recommendation for Module Design 模组设计参数建议

6.1. Cell Directions 电池方向

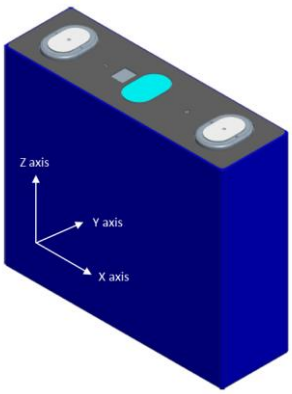

Fig.5 Schematic diagram of LF160 cell direction
图 5 LF160 电池方向示意图

6.2. Cell Compression Force 电池压缩力

Test Conditions 测试条件：

-Compression area 压缩面积：173.90mm×150.75mm (L×h)

-Compression speed 压缩速度：0.02 mm/s

-Compression direction 压缩方向：Y direction Y 方向

-Cell SOC 电池 SOC：30 % ~ 40 % SOC

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Table 16 Cell compression force limit parameters

表 16 电池压缩力限制参数

Observation 现象	Compression Force 压缩力
Compression force 推荐压缩力	3 kN ~ 5 kN
Normal bearing maximum compression force 正常承受最大压缩力	7 kN
Internal defects 内部产生缺陷	9 kN
Leakage 漏液	15 kN

It can be seen from the above table, that the compression force of the cell cannot exceed 9 kN, otherwise the cell may be damaged.

从上表可知，电池承受的压缩力不能超过 9 kN，否则可能电池会受到损害。

6.3. Cell Expansion Force 电池膨胀力

6.3.1. Testing Conditions 测试条件

Before the test, prepare the expansion force clamp, place the cell in the middle of the clamp at 30 % ~40 % SOC, and the initial compression force is 300 kgf ±20 kgf.

测试前准备膨胀力夹具，在 30 % ~ 40 % SOC 时，将电池置于夹具中间，初始压缩力为 300 kgf ±20 kgf。

6.3.1.1. 0.5 C / 0.5 C Cycle 0.5 C / 0.5 C 循环

At ambient temperature:

-Charge: 0.5 C constant current charge to 3.65 V, then constant voltage charge to cut-off current 0.05 C, rest for 30 min.

-Discharge: discharge at 0.5 C constant current to 2.5 V, and rest for 30 min.

室温条件下：

-充电：0.5 C 恒流恒压充电至 3.65 V，截止电流 0.05 C，搁置 30 min。

-放电：0.5 C 恒流放电至 2.5 V，搁置 30 min。

6.3.1.2. Recommend EVE Cycling Method EVE 推荐循环方式

a. Ambient temperature at 25 ℃ ± 2 ℃, staged charge cycle at 300 kgf ±20 kgf;

b. With 1 C constant current charging capacity as 80 % C_0;

c. 0.8 C constant current charging to 3.5 V;

d. 0.5 C constant current charging to 3.6 V;

e. 0.1 C constant current charging to 3.65 V;

f. Rest for 30 min in an open circuit state, discharge to 2.5 V with constant current of 1 C, and rest for 30 min;

g. Repeat steps from b to f. When the cycle capacity retention rate decreases by 5 %, the current value of 1 C is adjusted to 1 C × (1 – 5 % × n), n=1, 2, 3, 4, ...; ensure that every decay 5 % of the charging time remains the same, the specific steps are shown in the table 6;

a. 环境温度25 ℃ ± 2 ℃，300 kgf ± 20 kgf下阶梯充电循环；

b. 1 C 恒流充电至 80 % C_0；

c. 0.8 C 恒流充电至 3.5 V；

d. 0.5 C 恒流充电至 3.6 V；

e. 0.1 C 恒流充电至 3.65 V；

f. 在开路状态静置30 min，以1 C恒流放电至2.5 V，搁置30 min；

g. 重复 b 到 f 步骤，循环容量保持率每衰减 5 %时，此时 1 C 电流值调整为 1 C ×(1 – 5 % × n)，n=1，2，3，4，...；确保每衰减 5 %的充电时长保持一致，具体步骤见表 6；

Record the cell expansion force before and after the cycles.

记录循环前后的电池膨胀力。

6.3.2. Testing Results 测试结果

Table 17 Cell expansion force parameter

表 17 电池膨胀力参数

Expansion Force 膨胀力	BOL	≤3 kN
	EOL	≤30 kN

6.4. Thermodynamic Parameters 热力学参数

Test method: 测试方法：

Reference standards: GB/T 10295-2008、ASTM E1269-2011

参考标准：GB/T 10295-2008、ASTM E1269-2011

Table 18 Cell thermal conductivity parameter

表 18 电池导热系数参数

Mean thermal conductivity	Thermal Conductivity W/(m·K) 导热系数 W/(m·K)

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导热系数均值	X/Z direction X/Z 方向	Y direction Y方向
	18~20 W/(m·K)	1~2 W/(m·K)
Mean heat capacity 热容均值	Heat Capacity kJ/(kg·K) 热容 kJ/(kg·K)	
	0.9~1.2 kJ/(kg·K)	

6.5. Recommend Temperature Collection Points 推荐温度采集点

When collecting temperature on the cell surface, it is recommended that the temperature collection points to be arranged at the center of the poles and the surface, as shown in the figure below.

对电池表面进行温度采集时，建议温度采集点布置在极柱及大面中心处，如下图。

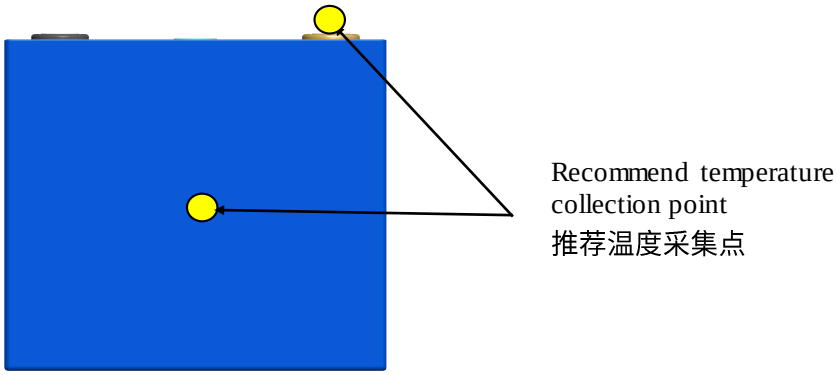

Fig.6 Schematic diagram of LF160 cell temperature collection point
图 6 LF160 电池温度采集点示意图

7. Cell Operation Instructions and Precautions 电池操作说明及注意事项

7.1. Product End-life Management 产品寿命终止管理

The cell life is limited. Customers should establish an effective tracking system to monitor and record the internal resistance and capacity of each cell during its life. The measurement method and calculation method of internal resistance and capacity need to be discussed and agreed between the customer and EVE. When the internal resistance of the cell in use exceeds 150 % of the initial internal resistance of the cell, or the capacity is less than 70 % of the nominal capacity, the cell should not to be operated. **Violation of this requirement will exempt EVE from its responsibility for product quality assurance in accordance with the product sales agreement and this specification and all related liabilities such as loss compensation caused thereby.**

电池使用期限是有限的，客户应建立有效的跟踪系统监测并记录每个使用期限内电池的内阻和容量。内阻及容量的测量方法和计算方法需要客户和 EVE 共同讨论和双方同意。当使用中电池的内阻超过这个电池最初内阻的 150 %或容量小于标称容量的 70 %，应停止使用电池。**违反该项要求，将免除 EVE 依据产品销售协议以及**

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本规格书所应承担的产品质量保证责任及由此引起的损失赔偿等一切相关责任。

7.2. Long-term Storage 长期存储

After charge, the cell should be used as soon as possible to avoid loss of usable capacity due to self-discharge. If storage is required, the cell needs to be stored in a low SOC state. The recommended storage conditions are: 30 % ~ 50 % SOC, 0 ℃ ~ 35 ℃, relative humidity ≤ 60 %.

电池进行充电后，需尽快使用，以免因自放电而造成可用容量损失。若预计将电池存放 30 天以上，应将 SOC 调整为 30 % ~ 40 % SOC。推荐的存储条件为： 0 ℃ ~ 45 ℃，相对湿度≤ 60 %。

7.3. Transportation 运输

Cell for shipping should be packed in boxes with the SOC of 30 % ~ 40 % SOC. The severe vibration, impact, extrusion, sun and rain should be prevented during shipping. Applicable methods of transportation include truck, train, ship, airplane, etc.

产品的运输应在 30 % ~ 40 % SOC 下包装成箱进行。在运输过程中应防止剧烈振动、冲击或挤压，避免日晒雨淋。适用于汽车、火车、轮船、飞机等交通工具运输。

7.4. Operation Precautions 操作说明

- It is strictly forbidden to immerse the cell in water. When it is not in use, it should be placed in a cool and dry environment.
- 严禁将电池浸入水中，保存不用时，应放置于阴凉干燥的环境中。
- It is forbidden to use and place the cell next to a hot and high temperature source, such as fire or heater. The temperature of the battery cannot exceed 65 ℃ in any normal use, otherwise the battery management system must shut down the battery and stop running the battery.
- 禁止将电池放在热高温源旁或投入热高温源，如火、加热器等使用和留置，在任何正常的使用情况下，电芯温度不能超过 65 ℃，如果电池中电芯温度超过 65 ℃，电池管理系统需关闭电池，停止电池运行。
- Please use a special charger for lithium-ion batteries when charging.
- 充电时请选用锂离子电池专用充电器。
- Do not overcharge the cell. Otherwise, cell overheating and fire may occur. During cell installation and use, hardware and software must be protected against multiple overcharge failures. See 5.2 of this specification for the minimum requirements of protection.
- 禁止电池过充，否则，可能引起电池过热和火灾事故的发生。在电池安装和使用中，硬件和软件需实行多重过充失效安全保护。最低保护要求见本规格书 5.2 条。
- During use please connect the positive and the negative of the cell strictly according to the labels and instructions, and forbid reverse charging.

- 在使用过程中，严格按照标示和说明连接电池正负极，禁止反向充电。
- It is forbidden to use metal to directly connect the positive and the negative of the cell to short-circuit, Otherwise, strong current and high temperature may cause personal injury or fire.
- 禁止用金属直接连接电池正负极短路，否则强电流和高温可能导致人身伤害或者火灾。
- It is forbidden to transport or store the cell with metal, such as hairpins, necklaces, etc.
- 禁止将电池与金属，如发夹、项链等一起运输或贮存。
- It is forbidden to knock or throw, step on, or bend the cell.
- 禁止敲击或抛掷、踩踏和弯折电池等。
- It is forbidden to directly weld the cell or pierce the cell with nails or other sharp objects
- 禁止直接焊接电池和用钉子或其他利器刺穿电池。
- Try to protect the battery from mechanical shock, collision and pressure impact. Otherwise, the battery may be short-circuited internally, resulting in high temperature and fire.
- 尽力保护电池，使其免受机械震动、碰撞及压力冲击，否则电池内部可能短路，产生高温和火灾。
- It is forbidden to use or place the battery at a high temperature (under the hot sun). Otherwise, the battery may overheat, fail to function, and its service life may be shortened.
- 禁止在高温下 (炙热的阳光下)使用或放置电池，否则可能会引起电池过热或功能失效、寿命减短。
- It is forbidden to use it in places with strong static electricity and strong magnetic fields; otherwise it will easily damage the protection device of cell safety and bring potential for insecurity.
- 禁止在强静电和强磁场的地方使用，否则易破坏电池安全保护装置，带来不安全的隐患。
- Normal charging should be terminated when charging exceeds 8 hours. When charging for longer than a reasonable time limit, the battery occurs overheat, potentially causing thermal runaway and fire. A timer should be installed for protection. Once the charging current reaches a certain overcharge state that cannot be terminated, the timer will kick in and terminate the charge.
- 在充电超过 8 小时时，应结束正常充电。当持续充电时间超过合理的时间限制，电池会出现过热现象，可能会引起热失控和火灾。应安装一个定时器加以保护。一旦充电电流达到某种过充状态而不能终止，定时器将会起作用从而终止充电。
- Improper charging termination may occur during battery charging. Such as: charging beyond the allowed charging time, when charging voltage is too high or charging current is too strong, the charge is terminated. This phenomenon is defined as “inappropriate termination of charging”. When this happens, it can mean that the battery system is leaking electricity or some components are faulty. Continuing to charge the battery before the root cause is identified and resolved may cause the battery to overheat or catch fire. When the above phenomenon occurs, the battery management system should prohibit subsequent charging through the automatic lock function and remind the user to return the product with the battery to the dealer for system maintenance. The battery can be recharged

only after a thorough inspection by a qualified technician to determine the root cause, solve it thoroughly and improve it.

- 电池充电过程中可能发生不适当的终止充电现象。如：超出允许的充电时间充电，充电电压过高而终止充电或充电电流过强而终止充电。上述现象被定义为“不适当的终止充电”。当发生以上现象时，可能意味着电池系统出现漏电或某些部件出现故障。在没有找到根本原因并彻底解决之前继续对该电池充电可能会引起电池过热或发生火灾。当发生以上现象时，电池管理系统应该通过自动锁定功能，禁止后续的充电，并提醒使用者将装载有该电池的产品退回到经销商处进行系统维护。该电池只有经过有认证资格的技术人员全面检查，确定根本原因并彻底解决、改善后方可恢复充电。
- The customer shall securely secure the battery to a solid surface and securely bind the power cord in place to avoid arcing and sparks caused by friction.
- 客户应将电池安全地固定在固体平面上，并将电源线安全地束缚在合适的位置，以避免摩擦而引起电弧和火花。
- Do not use plastic to encapsulate batteries or use plastic for electrical connection. Improper electrical connection may cause overheating during battery use.
- 严禁用塑料封装电池或用塑料进行电气连接。不正确的电气连接方式可能会造成电池使用过程中发生过热现象。
- If the battery leaks and the electrolyte spills onto the skin or clothes, immediately wash the affected area with running water. If the battery leaks and the electrolyte enters the eyes, mouth, nose and other open parts of the human body, immediately wash the eyes with plenty of water and seek medical treatment immediately, otherwise serious injuries will be caused to the human body. No person or animal is allowed to swallow any part of the battery or any substance contained in the battery.
- 如果电池漏液，电解液溅到皮肤或衣服上，应立即用流动的水清洗受影响区域，如果电池发生泄露，电解液进入眼睛、口、鼻等人体开放部位，应立即用大量清水冲洗眼睛，并马上送医治疗，否则会对人体造成严重伤害。禁止任何人或动物吞食电池的任何部位或电池所含物质。
- If the cell emits peculiar smell, heat, discoloration, deformation, or any abnormality during use, storage, or charging, immediately remove the cell from the device or charger and stop using it
- 如果电池发出异味、发热、变色、变形或使用、贮存、充电过程中出现任何异常，立即将电池从装置或充电器中移离并停用。
- It is prohibited to disassemble the product without the written consent of EVE.
- 未经 EVE 书面同意，禁止私自拆解产品。

7.5. Disclaimer 免责声明

If the product demand unit or user does not use the product in accordance with the provisions of this manual,

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EVE will no longer bear all relevant responsibilities such as product quality assurance liability and loss compensation caused thereby. In case of any negative impact on EVE's reputation due to the above-mentioned acts, EVE reserves the right to investigate the legal liability of the product demand unit.

如果由于产品需求单位或使用者不按本说明书中的规定进行使用，EVE 不再承担产品质量保证责任及由此引起的损失赔偿等一切相关责任。因前述行为，对 EVE 的声誉造成负面影响的，EVE 保留追究产品需求单位法律责任权利。

7.6. Other 其他

Any matters not mentioned in this specification must be negotiated and determined by both parties.

任何本规格书中未提及的事项，须经双方协商确定。

8. Risk Warning 风险警告

8.1. Warning Declaration 警示声明

Warning 警告

The battery has potential hazards, and take proper precautions when operating and maintaining the battery!

The battery must be operated with proper tools and protective equipment.

Battery maintenance must be performed by professional with battery expertise and safety training.

Failure to comply with these warnings could result in multiple disasters.

电池存在潜在的危险，在操作和维护时必须采取适当的防护措施！

必须使用正确的工具和防护装备操作电池。

电池的维护必须由具有电池专业知识并经过安全培训的人士执行。

不遵守上述警告可能造成多种灾难。

8.2. Types of Dangerous 危险类型

The customer is aware of the following potential hazards in the use and operation of batteries:

客户知悉在电芯使用和操作过程中存在以下潜在的危险：

a) The operator may be injured by chemicals, electric shocks, or electric arcs during operation. Although the human body reacts differently to direct current and alternating current, DC voltage higher than 50 V is just as serious as alternating current. Therefore, the customer must adopt a conservative posture during operation to avoid the injury of current.

a) 操作者在操作时可能会受到化学品、电击或者电弧的伤害。尽管人体对遭受直流电与交流电的反应不同，但是高于 50 V 的直流电压与交流电对人体的伤害是同样严重的，因此客户必须在操作中采取保守的姿势以避免电流的伤害。

b) There is a chemical risk from the electrolyte in the battery.

b) 存在来自电池中的电解液的化学风险。

c) When operating batteries and selecting personal protective equipment, customers and their employees must take these potential risks into account to prevent accidental short circuits, arcing, explosions or thermal runaway.

d) 在操作电池和选择个人防护装备时，客户及其雇员必须考虑到以上潜在的风险，防止发生意外短路，造成电弧、爆炸或热失控。

9. Contact Information 联系方式

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Tel：86-0724-6079688

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10. Cell Drawing of LF160 LF160 电池图纸

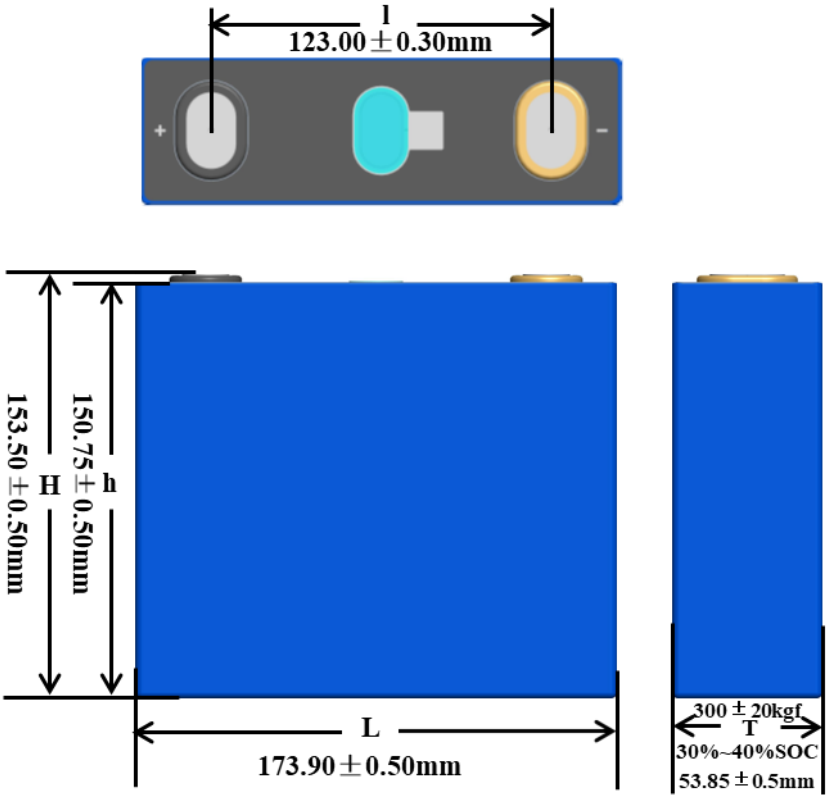

Fig.7 Cell Drawing of LF160

图 7 LF160 电池图纸