EVE 亿纬动力

型号 Product Model	4695E	规格书编号 Specification Number	PBRI-G16-V1.1-D06-10	版本 Version	A

产品交付规格书(非乘用车)

圆柱锂离子电池

型号：4695E

编制	产品设计审核	品质审核	销售审核	批准

客户接收栏
公司名称:
批　　准:
日　　期:

2024 年 06 月

湖北亿纬动力有限公司

EVE 亿纬动力

型号 Product Model	4695E	规格书编号 Specification Number	PBRI-G16-V1.1-D06-10	版本 Version	A

Product Delivery Specification (Non-Passenger Vehicles)

Power Cylindrical Lithium-ion Cell

Sample Type: 4695E

Preparation	Product Design Audit	Quality Audit	Sales Audit	Permission

Customer reception:
Company: **Approval:** **Date:**

2024-6

EVE Energy Co., Ltd

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客户要求

要求客户写出他们的需求信息并提前与亿纬动力沟通。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，亿纬动力可以根据客户的特别要求进行产品的设计和生产。

序号	特殊要求	标准
1		
2		
3		
4		
5		

客户代码： _____ **签字：** _____ **日期：** _____

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CUSTOMER'S REQUIREMENT

Customers are requested to write out their requirement information and communicate with EVE in advance. If the customer has some special applications or operating conditions different from those described in this document, EVE can design and manufacture the product according to the customer's special requirements

NO.	Special requirements	Standard
1		
2		
3		
4		
5		

Customer Code: _____ Sign: _____ Date: _____

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变更履历

版本	日期	更改内容	确认人
A	2024/6/18	新版发行	严景龙

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Change of Curriculum Vitae

Version	Date	Changed items	Responsible person
A	2024/6/18	1st Version	Yan Jinglong

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目录

术语定义

术语	定义
产品	本规格书中的“产品”是指湖北亿纬动力有限公司生产的可充电圆柱锂离子电池。
客户	指《湖北亿纬动力有限公司产品销售合同》中的买方。
环境温度	电池所处的周围环境温度。
电芯温度	由接入电池的温度传感器测量的电芯的温度。
倍率(C)	充/放电电流与电池的额定容量值的比率。
荷电状态(SOC)	在无负载的情况下，以 Ah 或 Wh 为单位计量的电池容量状态与额定容量的比值。满电状态视为 100%SOC，则容量为 0 Ah 时，SOC 为 0%。
循环(Cycle)	电池按规定的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。
标准充电	本规格书第 3.5 条所述的充电模式。
标准放电	本规格书第 3.6 条所述的放电模式。
开路电压(OCV)	没有接入任何负载和电路时测得的电池的电压。
直流电阻(DCR)	工作条件下电池电压变化与相应的电流变化之比，测试方法如规格书第 3.8.5.5 条所述。
电池管理系统(BMS)	客户用于检测和记录产品在整个服务期限内的运行参数的一种有效的追踪和控制系统。其追踪和记录的参数包括但不限于电压、电流、温度等，以控制产品的运行并确保产品运行环境及运行条件符合本规格书的规定。
模组	锂离子电芯经串并联方式组合，加装单体电池监控与管理装置后形成的电芯与 pack 的中间产品。
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。
压缩力	模组组装时，电池可承受压缩力的安全边界。
测量单位	“V”(Volt)伏特(V)，电压单位 “A”(Ampere)安培(A)，电流单位 “Ah”(Ampere-Hour)安培-小时(Ah)，负荷单位 “Wh”(Watt-Hour)瓦特-小时(Wh)，能量单位 “Ω”(Ohm)欧姆(Ω)，电阻单位 “mΩ”(Milliohm)毫欧姆(mΩ)，电阻单位 “°C”(degree Celsius)摄氏度(°C)，温度单位 “mm”(millimeter)毫米(mm)，长度单位 “s”(second)秒(s)，时间单位 “Hz”(Hertz)赫兹(Hz)，频率单位

DEFINITION OF TERMS

Terminology	Definition
Product	The 'product' in this specification refers to the power cylindrical lithium-ion cell produced by EVE.
Customer	Means the Purchaser in the 'Product Sales Contract of EVE'
Environment Temp	Ambient temperature around the Cell.
Cell Temp	The temperature of the cell measured by the temperature sensor plugged into the Cell.
Rate (C)	The ratio of the Ch/Dch current to the rated Capacity value of the Cell. For example, if the Cell Capacity is 32.5Ah, when the Ch or Dch current is 32.4A, then the Ch or Dch rate is 1C.
Charging state (SOC)	The ratio of the Cell Capacity state to the rated Capacity measured in ampere-hours or watt-hours with no load. For example, if the state of Capacity of 32.4Ah is considered as 100% SOC, then the SOC is 0% when Capacity is 0Ah
Cycle (Cycle)	The Cell is charged and discharged once as a cycle according to the specified charging and discharging standards. The cycle consists of a short period of normal Ch or a combination of regenerative Ch and Dch processes, and sometimes only normal Ch without regenerative Ch in the Ch process. Dch can be formed by combining some parts of Dch together.
Standard Ch	Ch mode as described in section 3.5 of this specification.
Standard Dch	Dch mode as described in section 3.6 of this specification.
Open Circuit Voltage (OCV)	Voltage of the Cell measured without any load or circuit connected.
DC resistance (DCR)	The ratio of the voltage changes of the Cell to the corresponding current change under operating conditions, tested as described in Article 3.8.3.8 of this specification.
Cell Management System (BMS)	An effective tracking and control system used by the customer to detect and record the operating parameters of the product throughout the service period. The parameters tracked and recorded include, but are not limited to, voltage, current, temperature, etc., to control the operation of the product and to ensure that the operating environment and operating conditions of the product are in accordance with the provisions of this specification.
Module	Lithium-ion cells are combined in series-parallel mode, and the intermediate products of cells and packs are formed after the addition of single cell monitoring and management devices.
Pulse current	Current or voltage pulses that recur in cycles are called pulse currents, which either appear in the same direction or alternate between positive and negative directions.
Compression force	A safe boundary where the cell can withstand compression forces during module assembly.
Measurement units	'V' (Volt) Volt (V), unit of voltage 'A' (Ampere) Ampere-A unit of current 'Ah' (Ampere-Hour) Ampere-hour (Ah), unit of load 'Wh' (Watt-Hour) Watt-hour (Wh), unit of Energy, 'Ω' (Ohm) unit of resistance in ohms 'mΩ' (MilliOhm) milliohm (mΩ), unit of resistance '°C' (degree Celsius) Celsius (°C), the unit of temperature 'mm' (millimeter) unit of length 's' (second) seconds (s), unit of time 'Hz' (Hertz) Hertz (Hz), unit of frequency

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1. 基本信息 BASIC INFORMATION

1.1. 适用范围 APPLICATION RANGE

本产品规格书适用于湖北亿纬动力电池有限公司生产的非乘用车用圆柱锂离子电池 4695E。
This product specification is applicable to the 4695E power cylindrical lithium-ion batteries produced by EVE.

1.2. 产品类型 PRODUCT TYPE

圆柱锂离子电池 Power cylindrical lithium-ion Cell

1.3. 产品型号 PRODUCT MODEL

4695E

2. 电池规格参数 CELL SPECIFICATION PARAMETERS

2.1. 电池基本参数 BASIC PARAMETERS

项目 Items		标准 Standard	备注 Remark
额定容量 Normal Capacity		30.0 Ah	1/3C，25±2°C，2.8~4.2 V
额定能量 Normal Energy		110.0Wh	1/3C，25±2°C，2.8~4.2 V
初始 ACR AC Internal Resistance of BOL Status		≤1.8 mΩ	1 kHz，出货 SOC Shipment SOC Status
初始 DCR DC Internal Resistance of BOL Status		≤4.0 mΩ	25°C，50%SOC，2C，10 s
标称电压 Nominal Voltage		3.67 V	1/3C
电池重量(包膜) Cell Weight(With Insulating Film)		415±10 g	/
电池尺寸 Cell Dimension	直径(包膜) Diameter(with Insulating Film)	φ1：46.16±0.15 mm	参考 3.8.1 Refer 3.8.1
		φ2：46.16±0.1/-0.25mm	
		φ3：46.16±0.15 mm	
	直径(未包膜) Diameter(without Insulating Film)	φ1：46.00±0.15 mm	
		φ2：46.00±0.1/-0.25 mm	
		φ3：46.00±0.15 mm	
	肩高 h1(w/o Terminal (h1))	95.00±0.20 mm	
	总高 h2(w/ Terminal (h2))	96.50±0.35 mm	
	极柱直径 (Terminal Diameter)	18.50±0.20 mm	
充电限制电压 Ch Limited Voltage (U_{max})		4.2 V	/
放电截止电压 Dch Cut-off Voltage (U_{min})		2.8 V(0＜T≤55°C) 2.5 V(-20≤T≤0°C)	/
标准充电电流 Standard Ch Current		10.0A	1/3C
标准放电电流 Standard Dch Current		10.0 A	1/3C
最大持续充电电流 Maximum Continuous Charging Current		1C	(0%，90%]SOC
最大放电电流 Maximum Discharging		4C	(50%，100%]SOC,10 s

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Current		2C	(20%，50%]SOC,10 s
		1C	[0%，20%]SOC, 10 s
循环寿命 Cycle Life		25℃，3.0~4.15 V，0.5C/0.5C，1000 周/1000 cycles	SOH≥80%
环境温度 Environmental Temp.	充电温度 Ch Temp	0~45℃	/
	放电温度 Dch Temp	-20~45℃	
电芯工作温度 Operation Temp.	充电温度 Ch Temp.	0~55℃	指电芯表面温度，参考 4.2.3 Cell Surface Temp., Refer 4.2.3
	放电温度 Dch Temp.	-20~55℃	
存储温度 Storage Temp.	1 年/1 Year	0~25℃	出货 SOC 状态 Shipment SOC Status
	3 个月/3 Month	0~45℃	
	1 个月/1 Month	-20~55℃	
自放电率@25℃ Self discharge rate@25℃		首月 First month 0.05 V/month，后续 followed by 0.03V/month	出货 SOC 状态 Shipment SOC Status
出货电压范围 Shipping voltage range		3.5~3.8V	/
出货电压分档 Voltage Grading during shipment		10mV /档 10mV/gear	默认不分档，有配组分档需求时，请出货前单独提出。Default is no grading; please specify if grading is needed before shipment.

2.2. 产品规格 PRODUCT SPECIFICATIONS

2.2.1. 基础性能指标 BASIC PERFORMANCE

序号 No.	项目 Items		标准 Standard	测试方法章节 Testing Chapter
1	外观 Appearance	外观 Appearance	外观不得有裂痕、明显擦伤、锈渍、表面无毛刺、无污物，且应有清晰正确的标识 No Cracks, No Obvious Abrasions, No Rust Stains, No Burrs on The Surface, No Dirt, with Clear and Correct Markings.	3.8.1
2	尺寸 Cell Dimension	直径(包膜) Diameter(with Insulating Film)	φ1：46.16±0.15 mm	3.8.2
			φ2：46.16±0.1/-0.25 mm	
			φ3：46.16±0.15 mm	
		直径(未包膜) Diameter(without Insulating Film)	φ1：46.00±0.15 mm	
			φ2：46.00±0.1/-0.25 mm	
			φ3：46.00±0.15 mm	
		肩高 h1(without Terminal (h1))	95.00±0.20 mm	
		总高 h2(with Terminal (h2))	96.50±0.35 mm	

		极柱直径 (Terminal Diameter)	18.50±0.20 mm	
3	重量 Cell Weight	重量(包膜) Cell Weight(with Insulating Film)	415±10 g	3.8.3
4	初始 ACR AC Internal Resistance of BOL Status	1 kHz，出货 SOC Shipment SOC Status	≤1.8 mΩ	3.8.4

2.2.2. 电性能指标 ELECTRICAL PERFORMANCE

序号 No.	项目 Items		标准 Standard	测试方法章节 Testing Chapter
1	放电容量 Discharge Capacity	25°C，1/3C，2.8~4.2V	≥30.0 Ah	3.8.5.1
2	放电能量 Discharge Energy	25°C，1/3C，2.8~4.2V	≥110.0 Wh	
3	初始 DCR DC Internal Resistance of BOL Status	25°C，50%SOC，2C，10 s	≤4.0mΩ	3.8.5.2
4	倍率放电性能 Multiple Rate Discharge	25°C，3C	≥1C 初始容量 90% ≥90% Of 1C Discharge Capacity	3.8.5.3
5	高低温放电性能 High and Low Temperature Dch	-20°C，1C	容量保持率≥80% Capacity Retention Rate ≥80 %	3.8.5.4
		55°C，1C	容量保持率≥90% Capacity Retention Rate ≥90 %	
6	常温荷电保持与容量恢复率 Room Temperature Charge Retention and Capacity Recovery	25±2°C，100%SOC，28 天 28 days	容量保持率≥90% Capacity Retention Rate ≥90 % 容量恢复率≥95% Capacity Recovery Rate ≥95 %	3.8.5.5
7	高温荷电保持与容量恢复 High Temperature Charge Retention and Capacity Recovery	55±2°C，100%SOC，7 天 7 days	容量保持率≥90% Capacity Retention Rate ≥90 % 容量恢复率≥95% Capacity Recovery Rate ≥95 %	3.8.5.6
8	循环寿命 Cycle Life	25°C，3.0~4.15V，0.5C/0.5C，1000 周 1000 cycles	SOH≥80%	3.8.5.7

2.2.3. 安全性能指标 SAFETY PERFORMANCE

序号 No.	项目 Items	标准 Standard	测试方法章节 Testing Chapter
1	高温外部短路 External Short Circuit at High Temperature	GB31241-2022	3.8.6.1
2	过充电测试 Overcharge	GB38031-2020	3.8.6.2
3	强制放电 Forced Discharge	GB31241-2022	3.8.6.3
4	低气压 Low Pressure	GB31241-2022	3.8.6.4
5	温度循环测试 Temperature Cycle	GB31241-2022	3.8.6.5
6	振动 Vibration	UN38.3	3.8.6.6
7	挤压测试 Squeeze	GB31241-2022	3.8.6.7
8	机械冲击 Mechanical Impact	UN38.3	3.8.6.8
9	热滥用 Thermal Abuse	GB31241-2022	3.8.6.9

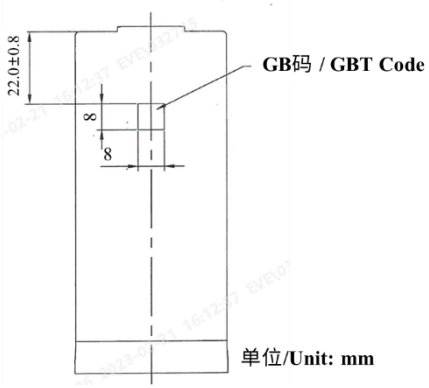
备注：外部短路测试需要带夹具进行测试，进行其他测试或者参考其他标准测试前需与 EVE 确认具体测试流程和注意事项。

Note: External short circuit test needs to be carried out with a fixture, other tests or reference to other standard tests need to be confirmed with EVE before the specific test procedures and precautions.

2.3. 外观 APPEARANCE

电池外观不得有裂痕、明显擦伤、锈渍、表面无毛刺、无污物，且应有清晰正确的标识。电池表面需要有可追溯的喷码。喷码清晰、喷码尺寸及样式应满足下图要求：

The appearance of the battery should not have cracks, obvious abrasions, rust stains, no burrs on the surface, no dirt, and should be clearly and correctly labeled. The battery surface needs to have traceable spray code. The spray code should be clear, and the size and style of the code should meet the requirements of the following figure:



图一 电芯喷码位置尺寸示意图

Fig. 1 Schematic diagram of the cell dimensions

3. 试验条件 TEST CONDITION

3.1. 环境条件 ENVIRONMENTAL CONDITION

除另有规定外，试验应在温度为 25±2°C，湿度低于 60%RH，大气压力为 86~106 kPa 的环境中进行。本规格书所提到的室温，是指 25±2°C。

Unless otherwise specified, the test shall be conducted in an environment with a temperature of 25±2°C, a humidity of less than 60% RH, and an atmospheric pressure of 86~106 kPa. References to room temperature in this specification are to 25±2°C.

3.2. 测量设备 TEST EQUIPMENT

测量仪器、仪表准确度应满足以下要求：

(1) 电压测量装置：±0.1%；
(2) 电流测量装置：±0.1%；
(3) 温度测量装置：±0.5°C；
(4) 尺寸测量装置：±0.01 mm；
(5) 重量测量装置：±0.01 g；
(6) 内阻 ACR 测试仪：0.001 mΩ。

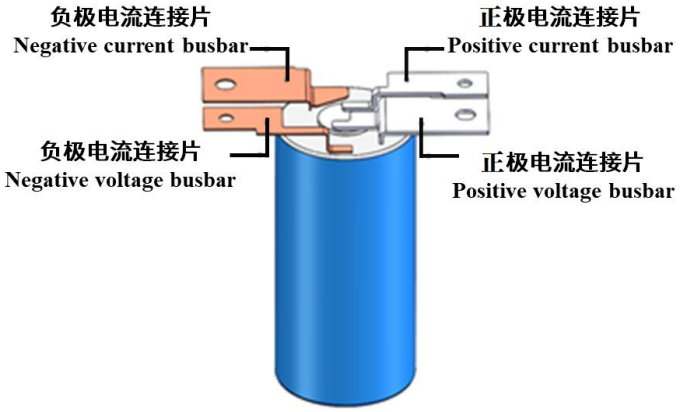
The accuracy of measuring instruments and meters shall meet the following requirements:

(1) Voltage measuring device: ± 0.1%;
(2) Current measuring device: ± 0.1%;
(3) Temperature measuring device: ±0.5°C;
(4) Dimension measuring device: ±0.01 mm;
(5) Weight measurement device: ±0.01 g;
(6) Internal resistance ACR tester: 0.001 mΩ.

3.3. 测试夹具安装 TEST FIXTURE MOUNTING

电池进行电性能测试和寿命测试时，为了满足接触内阻小于 0.2 mΩ，如无特殊要求，需要对电芯进行 bar 片焊接，实现与测试柜之间的电压连接和电流连接，焊接 bar 片后示意图如下：

In order to meet the contact resistance of less than 0.2 mΩ during the electrical performance test and life test of the cell, if there is no special requirement, it is necessary to weld the bar tabs on the cells to realize the voltage connection and current connection with the test cabinet, the diagram after welding the bar tabs is as follows:



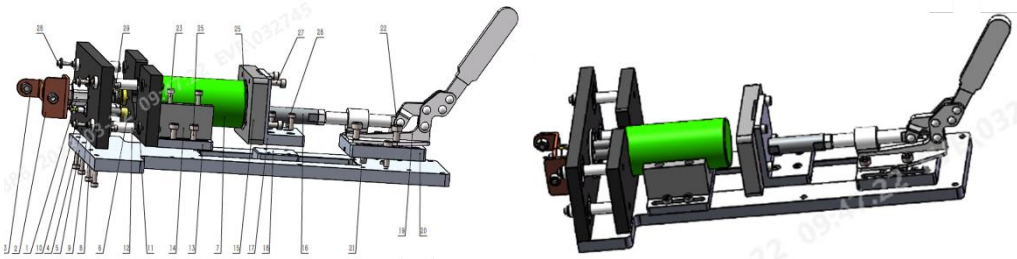
图二 电池测试焊接示意图

Fig. 2 Cell Welding Schematic

3.3.1 夹具类型 A FIXTURE TYPE A

如无特殊要求，电池进行安全性能测试时，采用夹具类型 A(Type A)进行预处理。单体电池放入测试固定支架中，电池与测试柜之间的连接方式为顶针式接触。如下图所示：

If there is no special requirement, when the cell is tested for safety performance, fixture type A is used for pre-treatment. The single cell is placed in the test mounting bracket, and the connection between the cell and the test cabinet is a thimble-type contact, as shown in the figure below:



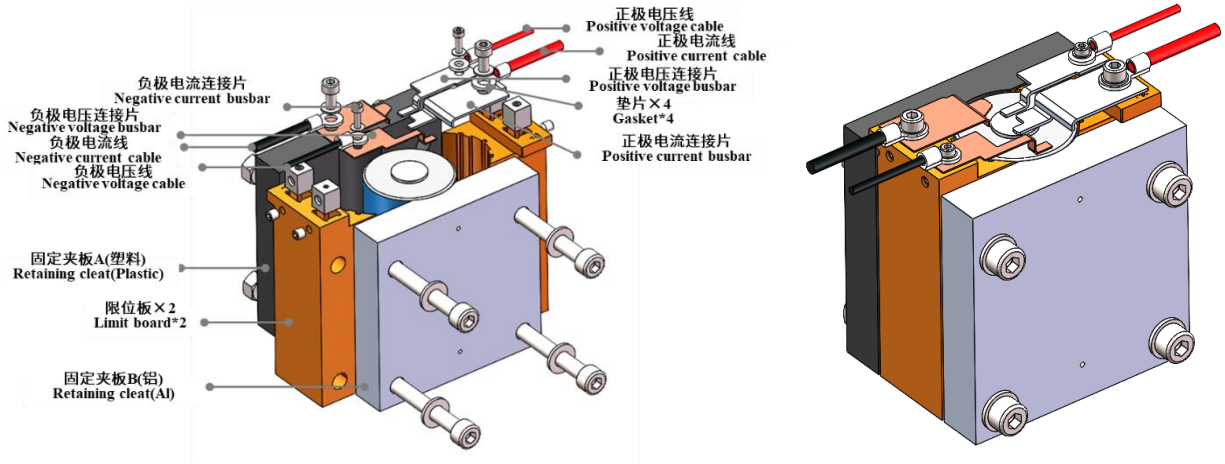
图三 电池测试夹具示意图(Type A)

Fig. 3 Cell Test Fixture Schematic (Type A)

3.3.2 夹具类型 B FIXTURE TYPE B

如无特殊要求，电池进行电性能测试时，需要用固定夹具(单面铝板)进行测试。单体电池放入测试固定支架中，用内六角螺丝将电池和测试夹具装配到一起，装配时保证装配的一致性，需要覆盖住整个电池的表面，测试柜电压监测线连接电压 bar 片，电流监测线连接电流 bar 片，如下图所示：

If there is no special requirement, the cell needs to be tested with a fixed fixture (single-sided aluminum plate) for electrical performance testing. Single cell into the test mounting bracket, using hexagonal screws to assemble the cell and test fixture together, assembly to ensure consistency of assembly, need to cover the entire surface of the cell, the test cabinet voltage monitoring line connected to the voltage bar tabs, current monitoring line connected to the current bar tabs, as shown in the figure below:



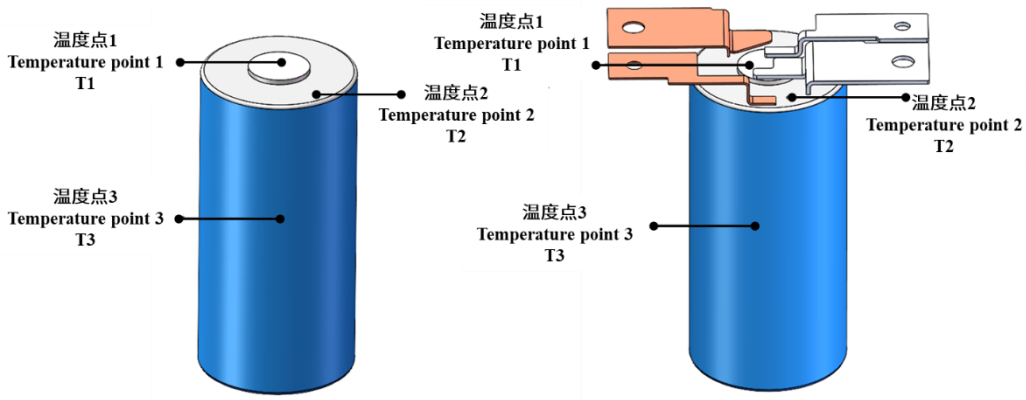
图四 电池测试夹具组装示意图

Fig. 4 Cell Test Fixture Schematic (Type B)

3.4. 电池测试温度采集 CELL TEMPERATURE COLLECT

如无特殊要求，电池测试时将按照如下描述进行温度采集。对电池表面进行温度采集时，建议温度采集点布置在正极端子(温度点 T1)、负极端子(温度点 T2)、圆柱面中间位置(温度点 T3)，如下图所示：

If there is no special requirement, the temperature will be collected according to the following description during the cell test. When collecting temperature on the surface of the cell, it is recommended that the temperature collection points are arranged at the positive terminal (temperature point T1), the negative terminal (temperature point T2), and the middle of the cylindrical surface (temperature point T3), as shown in the figure below:



图五 电池温度采集点示意图

Fig. 5 Schematic diagram of battery temperature collection point

3.5. 标准充电方式 STANDARD CHARGE

标准充电是在环境温度 25±2°C 的条件下，对电池以 1/3C 的电流恒流充电至 4.2 V，然后转为恒压充电，至充电电流小于等于 1/50C 结束，搁置 30 min。

Standard charging was performed at an ambient temperature of 25±2°C. The cell was charged at a constant current of 1/3C to 4.2 V, then switched to constant voltage charging until the charging current was less than or equal to 1/50C, and then set aside for 30 min.

3.6. 标准放电方式 STANDARD DISCHARGE

标准放电是在环境温度 25±2°C 的条件下，电池以 1/3C 的电流恒流放电，放电至电压达到 2.8 V 截止，搁置 30 min。

The standard discharge is at an ambient temperature of 25±2°C, the cell is discharged at a constant current of 1/3C until the voltage reaches a cut-off of 2.8 V, and then set aside for 30 min.

3.7. 容量标定和能量标定 CAPACITY AND ENERGY CALIBRATION

3.7.1. 容量标定和能量标定 CAPACITY AND ENERGY CALIBRATION

容量标定是在环境温度 25±2°C 的条件下，对电池按照 3.5 标准充电方式进行充电，然后按照 3.6 标准放电进行放电。将标准充电方式和标准放电方式重复 3 次，3 次的平均放电容量即为 1/3C 放电容量，记录放电容量为标定容量 C_0；3 次的平均放电能量即为 1/3C 放电能量，记录放电能量为标定能量 E_0。

Capacity calibration is to charge the cell according to 3.5 standard charging method and discharge it according to 3.6 standard discharging method under the condition of ambient temperature 25±2°C. The average discharging capacity of 3 times is 1/3C discharging capacity, and the discharging capacity is recorded as the calibrated capacity C_0. Repeat the standard charging method and standard discharging method for 3 times, the average discharging capacity of the 3 times is 1/3C discharging capacity, and the discharging capacity is recorded as the calibration capacity C_0; the average discharging energy of the 3 times is 1/3C discharging energy, and the discharging energy is recorded as the calibration energy E_0.

3.7.2. SOC 调节方式 SOC ADJUSTMENT METHOD

步骤 No.	状态 Status	环境温度 Environment Temp.	内容 Content
1	搁置 Rest	25±2°C	设置温箱温度为 25°C，搁置 30 min Set the temperature of the temperature tank to 25°C and rest for 30 minutes
2	标准放电 Standard Dch		1/3C 恒流放电至 2.8 V，搁置 30 min 1/3C CC Dch to 2.8 V, rest 30 min
3	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C，搁置 30 min 1/3C CCCV Ch to 4.2 V, 1/50C cut off, rest 30 min
4	标准放电 Standard Dch		1/3C 恒流放电至 2.8 V，搁置 30 min 1/3C CC Dch to 2.8 V, Rest 30 min
5	循环 Cycle		重复步骤 3 和步骤 4 共三次，将第三圈放电容量标记为 C_0，放电能量标记为 E_0。 Repeat 3,4 for 3 times, the discharge capacity of the third circle is marked as C0, and the discharge capacity and energy of the third circle are recorded
6	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C，搁置 30 min 1/3C CCCV Ch to 4.2 V, 1/50C cut off, rest 30 min
7	恒流放电 CC Dch		1/3C 恒流放电，放电容量为(1-N%)*C_0 截止，即调整到 N%SOC 1/3C CC Dch, discharge capacity cut off at (1-N%)*C0, i.e. adjusted to N% SOC

3.8. 测试方法 MEASUREMENT METHOD

3.8.1. 外观 APPEARANCE

待检物受检面与检验者约成 45°角，距离约 300 mm，亮度 700 LUXmin 接受检验。不得在反光情况下检验，导致强光掩盖表面可能出现的瑕疵，眼睛和产品平面呈 90°角，产品可以在与人眼睛垂直的方向摆动 45±10°，时间不超过 10 s。

The product to be inspected shall be inspected at an angle of approximately 45° to the inspector, at a distance of approximately 300 mm, with a brightness of 700 LUXmin. Must not be examined in a reflective situation, resulting in glare masking the surface of possible defects, the eyes and the product plane at an angle of 90 °, the product can be in the direction perpendicular to the human eye swing 45 ± 10 °, time does not exceed 10 s.

3.8.2. 尺寸 DIMENSION

尺寸的测量一般采用卡尺、高度规测试。如尺寸出现争议，以三坐标（CMM）测试结果为准。

The measurement of dimensions is carried out using calipers and height gauges. In case of any disputes over the dimensions, the results of the Coordinate Measuring Machine (CMM) test shall prevail.

3.8.2.1. 总高和肩高 TOTAL AND SHOULDER HEIGHT

1) 试验设备：高度规。

试验方法：

① 测试准备：电池需在温度 18~22°C，湿度 40~60%环境下放置 3 h；高度规设备检查，仪表归零。

② 将电芯正极柱朝上放置在高度规大理石平台面上，如图所示。

③ 在电池 A 面φ35±1mm 的直径开始取 4 点，每个点以 90°间隔采点，记录四个位置数值，取四个值的最大值，则为肩高 h1；

④ 在端子φ10±1mm 的直径取 4 点，每点以 90°间隔采点，记录四个位置数值，取四个值的最大值，则为总高 h2。

1）Test equipment: height gauge.

Test method:

① Preparation before testing: The battery needs to be placed in an environment with a temperature of 18-22 ° C and a humidity of 40-60% for 3 hours; Check the height gauge equipment and reset the instrument to zero.

② Place the positive pole of the battery cell facing upwards on the height gauge marble platform surface, as shown in the figure.

③ Starting from a diameter of 35 ± 1mm on surface A of the battery, 4 points are taken at 90 ° intervals, and the values of the four positions are recorded. The maximum value of the four values is taken, which is the shoulder height h1;

④ Take 4 points with a diameter of 10 ± 1mm at the terminal, and take points at 90 ° intervals at each point. Record the values of the four positions, and take the maximum value of the four values to obtain the total height h2.

2) 试验设备：三坐标(CMM)。

试验方法：

① 采用 CMM 测量项目，电池需在温度 18~22°C，湿度 40~60%环境下放置 3 h；

② 电池卧置在 V 形块上，如下图所示；

③ CMM 采用直径 φ1 mm 探针，在电芯 B 面 φ42.5 mm 处，间隔 90°取 4 个点，拟合形成基准平面；

④ 在电池 A 面 φ35 mm 处，间隔 90°取 4 个点，拟合肩高平面；

⑤ 在电池 A 面 φ10 mm 出，间隔 90°取 4 个点，拟合总高平面；

⑥ CMM 计算出基准平面与肩高平面距离即为肩高 h1；

⑦ CMM 计算出基准平面与总高平面距离即为总高 h2。

2) Test equipment: Coordinate Measuring Machine (CMM).

Test method:

(1) Using CMM measurement item, the cell should be placed in the environment of temperature 18~22°C and humidity 40~60% for 3 h. The cell should be placed on the V-block as shown in the figure below;

(2) The cell is lying on the V-shaped block, as shown in the figure below;

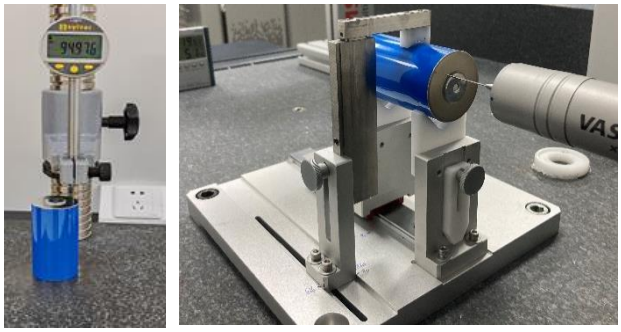
(3) CMM adopts φ1 mm diameter probe, at φ42.5 mm on the B side of the cells, take 4 points at 90° intervals, and fit to form a reference plane;

(4) At φ35 mm on cell A surface, take 4 points at 90° intervals to fit the shoulder height plane;

(5) Take 4 points at 90° intervals at φ10 mm on the cell A surface to fit the total height plane;

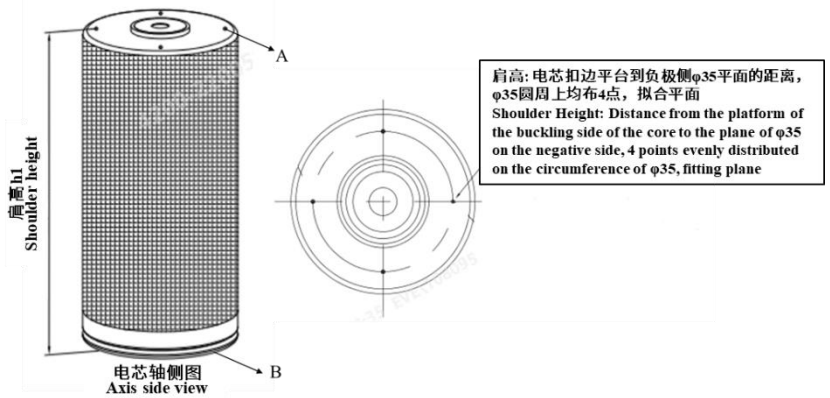
(6) CMM calculates the distance between the reference plane and the shoulder height plane as the shoulder height h1

(7) CMM calculates the distance between the reference plane and the total height plane as the total height h2



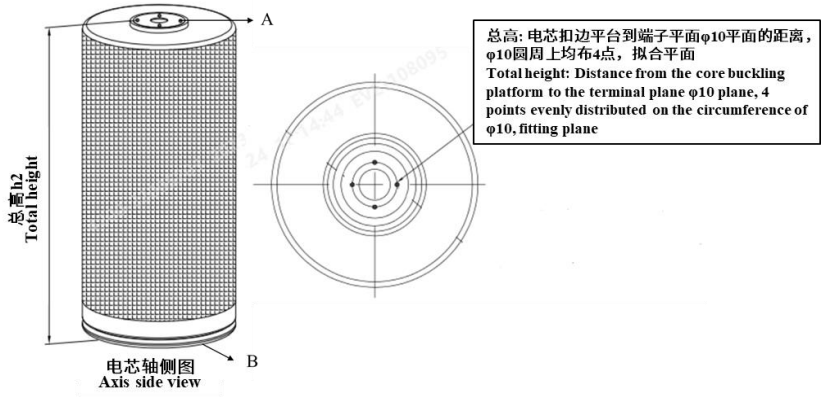
图六 高度规及高度 CMM 测量夹具示意图

Fig. 6 Height gauge and CMM measurement fixture



图七 电池肩高测量示意图

Fig. 7 Shoulder height measurement



图八 电池总高测量示意图

Fig. 8 Total height measurement

3.8.2.2. 直径 DIAMETER

1) 试验设备：卡尺或数显卡尺。

试验方法：

① 测试前准备：电池需在温度 18~22°C，湿度 40~60%环境下放置 3 h；卡尺设备检查，仪表归零。

② 测量时， 一手拿着卡尺，一手稳住电芯，测量电芯距离封口位置(5±1)mm、电芯中部(47.5±1)mm 和正极柱侧(5±1)mm 位置处的电芯直径，卡尺卡住电芯测量位置旋转一周，读取旋转一周后最大直径，最大值为电芯测量位置电芯直径。

1）Test Equipment: Coordinate Measuring Machine (CMM)

Test method:

① The cell should be placed in the environment of temperature 18~22°C, humidity 40~60% for 3 h;

② Start the test: During the measurement, hold the caliper in one hand and hold the cell with the other hand to measure the diameter of the cell at the sealing position (5±1)mm, the center of the cell (47.5±1)mm) and the positive column side (5±1)mm). Rotate the measuring position of the cell when the caliper is stuck for one week and read the maximum diameter after one week of rotation. The maximum value is the diameter of the cell at the measuring position of the cell.

2）试验设备：三坐标(CMM)

试验方法：

① 采用 CMM 测量项目，电池需在温度 18~22°C，湿度 40~60%环境下放置 3 h；

② 电池 A 面朝上，放置在 CMM 测量台面上，如下图所示；

③ CMM 采用直径 φ8 mm 探针，分别在电芯 B 面距底部 5±0.5 mm 处、47.0±0.5 mm 处、距顶部 5±0.5 mm 处，3 个位置高度，每个位置高度分别间隔 60°取 6 个点，包膜电池需要测量位置避开蓝膜重叠区；

④ CMM 计算出 φ1、φ2、φ3，3 个位置的直径。

Test Equipment: Coordinate Measuring Machine (CMM)

Test method:

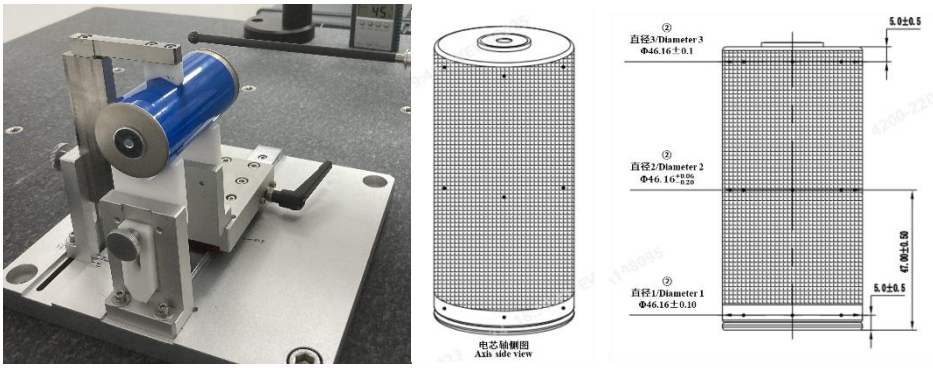
① Adopt CMM measurement item, the cell should be placed in the environment of temperature 18~22°C, humidity 40~60% for 3 h;

② Cell A side up, placed in the CMM measurement table, as shown in the figure below;

③ CMM adopts φ8 mm diameter probe, respectively in the B side of the cells from the bottom 5 ± 0.5 mm,

47.0 ± 0.5 mm, from the top 5 ± 0.5 mm, 3 position height, each position height was spaced 60 ° to take 6 points, film batteries need to measure the position to avoid overlapping areas of the blue film;

④ CMM calculates the diameters of φ1, φ2 and φ3 at three positions.



图九 电池直径测量示意图

Figure 9 Cell diameter measurement

3.8.3. 重量 WEIGHT

测试设备：电子秤，满足 0.01 g 精度；

测试方法：使用电子秤测量电池的重量。

Test equipment: Electronic scale, meets 0.01 g accuracy;

Test method: Measurement of the weight of the cell using electronic scales.

3.8.4. 初始 ACR AC INTERNAL RESISTANCE OF BOL STATUS

测试设备：电压内阻测试仪，满足 0~100 mΩ 范围和 0.001 mΩ 精度；

测试方法：在环境温度 25±2°C，将电池用频率为 1 kHz 的电压内阻测试仪的正、负极分别接触电池的正、负极，读取电池的交流内阻读数。

Test equipment: Voltage internal resistance tester, meet the 0~100 mΩ range and 0.001 mΩ accuracy;

Test Method: At ambient temperature of 25±2°C, contact the positive and negative terminals of the cell with the positive and negative terminals of the voltage internal resistance tester with a frequency of 1 kHz, and read the AC internal resistance of the cell.

3.8.5. 电性能 ELECTRICAL PERFORMANCE

3.8.5.1. 放电容量和能量 DISCHARGE CAPACITY AND ENERGY

测试设备：充放电柜：电流量程 0~200 A，电压量程 0~5 V；

温度箱：可以提供-40~60°C 范围内恒定温度的恒温箱；

测试方法：在环境温度 25±2°C 的条件下，电池按照 3.3 安装测试夹具，并参照下表进行测试：

Test equipment: Charge and Discharge Cabinet: Current range 0~200 A, Voltage range 0~5 V;

Thermostatic chamber: a chamber that can provide a constant temperature and humility within the range of -40~60°C;

Test method: Under the condition of ambient temperature 25±2°C, the cell should be installed with the test fixture according to 3.3, and the test should be conducted according to the following table:

步骤 No.	状态 Status	环境温度 Environment Temp.	内容 Content
1	标准放电 Standard Dch	25±2°C	1/3C 恒流放电至 2.8 V，搁置 30 min。 1/3C CC Dch to 2.8 V, rest 30 min.
2	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C。搁置 30 min。 1/3C CCCV Ch to 4.2 V, 1/50C cut off, rest 30 min.
3	标准放电 Standard Dch		1/3C 恒流放电至 2.8 V，搁置 30 min。 1/3C CC Dch to 2.8 V, rest 30 min.
4	循环 1 Cycle 1		重复步骤 2~3，共计三次。第 3 圈放电容量，作为 1/3C 初始放电容量；第 3 圈放电能量，作为 1/3C 初始放电能量 Repeat 2~3 for 3 times. Discharge capacity of the 3rd turn is taken as 1/3C initial discharge capacity; Discharge energy of the 3rd turn is taken as 1/3C initial discharge energy.
5	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C。搁置 30 min。 1/3C CCCV Ch to 4.2 V, 1/50C cut off, rest 30 min.
6	恒流放电 CC Dch		1C 恒流放电至 2.8 V，搁置 30 min。 1C CC Dch to 2.8 V, rest 30 min.
7	循环 2 Cycle 2		重复步骤 5~6，共计 3 次。第 3 圈放电容量，作为 1C 初始放电容量；第 3 圈放电能量，作为 1C 初始放电能量 Repeat 5~6 for 3 times. Discharge capacity of the 3rd turn is taken as 1C initial discharge capacity; Discharge energy of the 3rd turn is taken as 1C initial discharge energy
备注：①1C 对应电流为 29.6 A Remarks: ①1C corresponds to a current of 29.6 A.			

3.8.5.2. 初始 DCR DC INTERNAL RESISTANCE OF BOL STATUS

测试设备：试验设备：充放电柜：电流量程 0~200 A，电压量程 0~5 V；
温度箱：可以提供-40~60°C 范围内恒定温度的恒温箱。
测试方法：在环境温度 25±2°C 的条件下，对电池按照 3.3 的方法安装测试夹具，并参照下表进行测试：
Test Equipment: Charge and Discharge Cabinet: Current range 0~200 A, Voltage range 0~5 V;
Thermostatic chamber: a chamber that can provide a constant temperature and humility within the range of -40~60°C.

Test Methods: Under the condition of ambient temperature 25±2°C, install the test fixture on the cell according to the method of 3.3, and refer to the following table for testing:

步骤 No.	状态 Status	环境温度 Environment Temp.	内容 Content
1	标准放电 Standard Dch	25±2°C	1/3C 恒流放电至 2.8 V，搁置 30 min 1/3C CC Dch to 2.8 V, rest 30 min
2	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C，搁置 30 min 1/3C CCCV Ch to 4.2 V, 1/50C cut off, rest 30 min
3	标准放电 Standard Dch		1/3C 恒流放电至 2.8 V，搁置 30 min，记录放电容量，标记为 C_0 1/3C CC Dch to 2.8 V, rest 30 min, record the discharge capacity as C_0.
4	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C，搁置 30 min 1/3C CCCV Ch to 4.2 V, 1/50C cut off, rest 30 min
5	调整 SOC Adjust SOC		1/3C 恒流放电，放电容量 50%C_0 截止，搁置 30 min，记录搁置结束电压 V_1 1/3C CC Dch, discharge capacity 50% C0 cut-off, rest 30 min, record rest end voltage V_1
6	恒流放电 CC Dch		$2C_0$ 恒流放电 10 s，搁置 30 min，记录第 10 s 放电的电压 V_2 $2C_0$ CC Dch10 s, rest 30 min, record the voltage V2 of the 10^{th} s discharge.
Remarks:①1C 对应电流为 29.6A; 1C corresponds to a current of 29.6A. ②DCR：$DCR=(V_1-V_2)*1000/2*C_0$ mΩ			

3.8.5.3. 倍率放电性能 MULTIPLE RATE DISCHARGE

测试设备：充放电柜：电流量程 0~200 A，电压量程 0~5 V；

温度箱：可以提供-40~60°C 范围内恒定温度的恒温箱。

测试方法：在环境温度 25±2°C 的条件下，对电池按照 3.3 的方法安装测试夹具，并参照下表进行测试：

Test Equipment: Charge and Discharge Cabinet: Current range 0~200 A, Voltage range 0~5 V;

Thermostatic chamber: a chamber that can provide a constant temperature and humility within the range of -40~60°C.

Test Methods: Under the condition of ambient temperature 25±2°C, install the test fixture on the cell according to the method of 3.3, and refer to the following table for testing:

步骤 No.	状态 Status	环境温度 Environment Temp.	内容
1	标准放电 Standard Dch	25±2°C	1/3C 恒流放电至 2.8 V，搁置 30 min。 1/3C CC Dch to 2.8 V, rest 30 min
2	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C。搁置 30 min。 1/3C CCCV Ch to 4.2 V, 1/50C cut off, rest 30 min
3	标准放电 Standard Dch		1/3C 恒流放电至 2.8 V，搁置 30 min.。记录放电容量，标记为 C_0 1/3C CC Dch to 2.8 V, rest 30 min, record the discharge capacity as C_0.
4	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C。搁置 30 min。 1/3C CCCV Ch to 4.2 V, 1/50C cut off, rest 30 min
5	恒流放电 CC Dch		1C 恒流放电至 2.8 V，搁置 30 min。记录放电容量，标记为 C_1 1C CC Dch to 2.8 V, rest 30 min, record the discharge capacity as C_1.
6	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C。搁置 30 min。 1/3C CCCV Ch to 4.2 V, 1/50C cut off, rest 30 min
7	恒流放电 CC Dch		3C 恒流放电至 2.8 V，搁置 30 min。记录放电容量，标记为 C_2 3C CC Dch to 2.8 V, rest 30 min, record the discharge capacity as C_2.
备注：①1C 对应电流为 29.6 A ②计算倍率放电性能：C_1/C_0(1C/0.33C)，C_2/C_1*100% (3C/1C) Remarks: ①1C corresponds to a current of 29.6A. ②multiple rate discharge performance calculation: C_1/C_0(1C/0.33C)，C_2/C_1*100% (3C/1C)			

3.8.5.4. 高低温放电 HIGH AND LOW TEMPERATURE DISCHARGE

测试设备：充放电柜：电流量程 0~200 A，电压量程 0~5 V；

温度箱：可以提供-40~60°C 范围内恒定温度的恒温箱。

测试方法：在环境温度 25±2°C 的条件下，对电池按照 3.3 的方法安装测试夹具，并参照下表进行测试：

Test Equipment: Charge and Discharge Cabinet: Current range 0~200 A, Voltage range 0~5 V;

Thermostatic chamber: a chamber that can provide a constant temperature and humility within the range of -40~60°C.

Test Methods: Under the condition of ambient temperature 25±2°C, install the test fixture on the cell according to the method of 3.3, and refer to the following table for testing:

步骤 No.	状态 Status	环境温度 Environment Temp.	内容 Content
1	标准放电 Standard Dch	25±2°C	1/3C 恒流放电至 2.8 V，搁置 30 min。 1/3C CC Dch to 2.8 V, rest 30 min
2	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C。搁置 30 min。 1/3C CCCV Ch to 4.2 V, 1/50C cut off, rest 30 min
3	恒流放电 CC Dch		1C 恒流放电至 2.8 V，搁置 30 min。记录放电容量(能量)，标记为 C_1 1C CC Dch to 2.8 V, rest 30 min, record the discharge capacity as C_1.
4	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C。搁置 30 min。 1/3C CCCV Ch to 4.2 V, 1/50C cut off, rest 30 min
5	温度调节 Adjust Temp.	目标温度	将温箱温度设置为指定温度，搁置指定的时间。T≤0°C，搁置 5h。T > 0°C，搁置 3h。 Set the temperature of the incubator to the specified temperature, Rest for the specified time. T≤0°C, rest5 h.T＞0°C, Rest3 h.
6	恒流放电 CC Dch		1C 恒流放电至指定截止电压，搁置 30min。记录放电容量(能量)。 T≤0°C，放电截止电压为 2.5 V。T＞0°C，放电截止电压为 2.8 V。 1C CC Dch to the specified cut-off voltage, Rest 30 min to record the discharge capacity (energy). For T≤0°C, the discharge cut-off voltage is 2.5 V. For T>0°C, the discharge cut-off voltage is 2.8 V.
7	温度调节 Adjust Temp.	25±2°C	搁置 3 h。 Rest3 h.
8	循环 Cycle	/	重复步骤 4~8，完成所有目标温度。 Repeat No.4~8, finish all the target temperature.
备注：①1C 对应电流为 29.6A ②目标温度为 55°C、-20°C，将 55°C 下，1C 放电容量标记为 C_3；将-20°C 下，1C 放电容量标记为 C_4。 ③计算放电容量保持率：55°C 容量保持率：C_3/C_1*100%；-20°C 容量保持率：C_4/C_1*100%。 Remark: ①1C corresponds to a current of 29.6A. ②Target temperature: 55°C、-20°C, Label the 1C discharge capacity at 55°C as C_3 and the 1C discharge capacity at -20°C as C_4.. ③Calculated discharge capacity retention: 55°C capacity retention: C_3/C_1*100; -20°C capacity retention: C_4/C_1*100.			

3.8.5.5. 常温荷电保持与容量恢复 ROOM TEMPERATURE CHARGE RETENTION AND CAPACITY RECOVERY

测试设备：充放电柜：电流量程 0~200 A，电压量程 0~5 V；

温度箱：可以提供-40~60°C 范围内恒定温度的恒温箱。

测试方法：在环境温度 25±2°C 的条件下，对电池按照 3.3 的方法安装测试夹具，并参照下表进行测试：

Test Equipment: Charge and Discharge Cabinet: Current range 0~200 A, Voltage range 0~5 V;

Thermostatic chamber: a chamber that can provide a constant temperature and humility within the range of -40~60°C.

Test Methods: Under the condition of ambient temperature 25±2°C, install the test fixture on the cell according to the method of 3.3, and refer to the following table for testing:

步骤 No.	状态 Status	环境温度 Environment Temp.	内容 Content
1	标准放电 Standard Dch	25±2°C	1/3C 恒流放电至 2.8 V，搁置 30 min 1/3C CC Dch to 2.8 V, rest 30 min
2	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C，搁置 30 min 1/3C CCCV Ch to 4.2 V, 1/50C cut off, rest 30 min
3	恒流放电 CC Dch		1C 恒流放电至 2.8 V，搁置 30 min 1C CC Dch to 2.8 V, rest 30 min
4	循环 1 Cycle 1		重复步骤 2~3，共计三次，计算三次放电容量平均值，标记为初始容量 C_0 Repeat No.2~3 for 3 times, record the third-round discharge capacity and mark it as the initial capacity C_0.
5	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2V，截止电流为 1/50C，搁置 30 min 1/3C CCCV Ch to 4.2 V, 1/50C cut off, rest 30 min
6	存储 Storage		存储 28 天 Storage 28 days
7	恒流放电 CC Dch		1C 恒流放电至 2.8 V，搁置 30 min。记录放电容量，标记为剩余容量 C_1 1C CC Dch to 2.8 V, rest 30 min. record the discharge capacity as C_1.
8	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C，搁置 30 min 1/3C CCCV Ch to 4.2 V, 1/50C cut off, rest 30 min
9	循环 2 Cycle 2		重复步骤 7~8，共计三次，计算三次放电容量平均值，标记为恢复容量 C_2 Repeat No.7~8 for 3 times, record the third-round discharge capacity and mark it as the initial capacity C_2.
备注：①1C 对应电流为 29.6 A ②容量保持率=C_1/C_0*100%，容量恢复率=C_2/C_0*100% Remark: ①1C corresponds to a current of 29.6 A. ②Capacity retention rate = C_1/C_0*100%, Capacity recovery rate = C_2/C_0*100%			

3.8.5.6. 高温荷电保持与容量恢复 HIGH TEMPERATURE CHARGE RETENTION AND CAPACITY RECOVERY

测试设备：充放电柜：电流量程 0~200 A，电压量程 0~5 V；

温度箱：可以提供-40~60°C 范围内恒定温度的恒温箱。

测试方法：在环境温度 25±2°C 的条件下，对电池按照 3.3 的方法安装测试夹具，并参照下表进行测试：

Test Equipment: Charge and Discharge Cabinet: Current range 0~200 A, Voltage range 0~5 V;

Thermostatic chamber: a chamber that can provide a constant temperature and humility within the range of -40~60°C.

Test Methods: Under the condition of ambient temperature 25±2°C, install the test fixture on the cell according to the method of 3.3, and refer to the following table for testing:

步骤 No.	状态 Status	环境温度 Environment Temp.	内容 Content
1	标准放电 Standard Dch	25±2°C	1/3C 恒流放电至 2.8 V，搁置 30 min 1/3C CC Dch to 2.8 V, rest 30 min
2	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C，搁置 30 min 1/3C CCCV Ch to 4.2 V, 1/50C cut off, rest 30 min
3	恒流放电 CC Dch		1C 恒流放电至 2.8 V，搁置 30 min 1C CC Dch to 2.8 V, rest 30 min
4	循环 1 Cycle 1		重复步骤 2~3，共计三次，记录第三次放电容量，标记为初始容量 C_0 Repeat No.2~3 for 3 times, record the third-round discharge capacity and mark it as the initial capacity C_0.
5	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C，搁置 30 min 1/3C CCCV Ch to 4.2 V, 1/50C cut off, rest 30 min
6	存储 Storage	55±2°C	存储 7 天 Storage 7 days
7	搁置 Rest	25±2°C	5 h
8	恒流放电 CC Dch		1C 恒流放电至 2.8 V，搁置 30 min。记录放电容量，标记为剩余容量 C_1 1C CC Dch to 2.8 V, rest 30 min. record the discharge capacity as C_1.
9	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C，搁置 30 min 1/3C CCCV Ch to 4.2 V, 1/50C cut off, rest 30 min
10	循环 2 Cycle 2		重复步骤 8~9，共计三次，计算三次放电容量平均值，标记为恢复容量 C_2 Repeat No.8~9 for 3 times, record the third-round discharge capacity and mark it as the initial capacity C_2.
备注：①1C 对应电流为 29.6 A ②容量保持率=C_1/C_0*100%，容量恢复率=C_2/C_0*100% Remark: ①1C corresponds to a current of 29.6 ②Capacity retention rate = C_1/C_0*100%, Capacity recovery rate = C_2/C_0*100%			

3.8.5.7. 循环寿命 CYCLE LIFE

测试设备：充放电柜：电流量程 0~200 A，电压量程 0~5 V；

温度箱：可以提供-40~60°C 范围内恒定温度的恒温箱。

测试方法：在环境温度 25±2°C 的条件下，对电池按照 3.3 的方法安装测试夹具，并参照下表进行测试：

Test Equipment: Charge and Discharge Cabinet: Current range 0~200 A, Voltage range 0~5 V;

Thermostatic chamber: a chamber that can provide a constant temperature and humility within the range of -40~60°C.

Test Methods: Under the condition of ambient temperature 25±2°C, install the test fixture on the cell according to the method of 3.3, and refer to the following table for testing:

步骤 No.	状态 Status	环境温度 Environment Temp	内容 Content
1	搁置 Rest	25±2°C	调整温箱温度至 25°C，搁置 30 min Adjust the chamber temperature to 25°C, rest 30 min
2	标准放电 Standard Dch		1/3C 恒流放电至 2.8 V，搁置 30 min 1/3C CC Dch to 2.8 V, rest 30 min
3	标准充电 Standard Ch		1/3C 恒流充电至 4.2 V，转恒压充电，截止电流为 1/50C，搁置 30 min 1/3C CCCV Ch to 4.2 V, 1/50C cut off, rest 30 min
4	标准放电 Standard Dch		1/3C 恒流放电至 2.8 V，搁置 30 min 1/3C CC Dch to 2.8 V, rest 30 min
5	循环 Cycle 1		重复步骤 3~4，共计三次，记录第三次放电容量和能量，标记为初始容量 C_0 和初始能量 E_0 Repeat No.3~4 for 3 times, record the third-round discharge capacity and energy, and mark it as the initial capacity C_0 and initial energy E_0.
6	标准充电 Standard Ch		1/3C 恒流充电至 4.2 V，转恒压充电，截止电流为 1/50C，搁置 30 min 1/3C CCCV Ch to 4.2 V, 1/50C cut off, rest 30 min
7	调整 SOC Adjust SOC		1/3C 恒流放电，放电容量 0.5C_0 截止，静置 60 min，记录搁置后电压，标记为 V_1 1/3C CC Dch, discharge capacity 0.5C_0 cut-off, rest for 60 min, record voltage after Rest, labelled V_1
8	恒流放电 CC Dch		2C_0 恒流放电 10 s，搁置 30 min，记录放电第 10 s 的电压，标记为 V_2 2C_0 CC Dch 10 s, rest 30 min, record the voltage at 10 s of discharge, labelled as V_2
9	标准放电 Standard Dch		1/3C 恒流放电至 2.8 V，搁置 30 min 1/3C CC Dch to 2.8 V, rest 30 min
10	恒流充电 CC Ch		0.5C 恒流充电至 4.15 V，搁置 30 min 0.5C CC Ch to 4.15 V, rest 30 min
11	恒流放电 CC Dch		0.5C 恒流恒压放电至 3.0V，搁置 30 min 0.5C CC Ch to 3.0V, rest 30 min
12	循环 2 Cycle 2		重复步骤 10~11，共循环 100 次 Repeat No.10~11 for 100 times
13	循环 3 Cycle 3		重复步骤 2-12，共循环 10 次，记录步骤 5 的容量 C_i，i=100,200,300..... Repeat No.2~12 for 10 times, Record the capacity C_i of step 5, i=100、200、300.....

备注：①1C 对应电流为 29.6A
②目标 SOC 为 10%，目标 SOC 下的 DCR 计算，=(V_2-V_1)/1C。
③目标 SOC 为 90%、50%，目标 SOC 下的 DCR 计算，=(V_2-V_1)/2C。
④步骤 8 记录间隔 0.1 s，其余步骤记录间隔 60 s
⑤SOH=C_i/C_0*100%

Remark: ①1C corresponds to a current of 29.6A
②10% SOC, DCR calculation: =(V_2-V_1)/1C.
③90% and 50% SOC, DCR calculation: =(V_2-V_1)/2C.
④No.8 recording interval is 0.1 s, the rest of the steps recording interval is 60 s
⑤SOH=C_i/C_0*100%

3.8.6. 安全性能 SAFETY

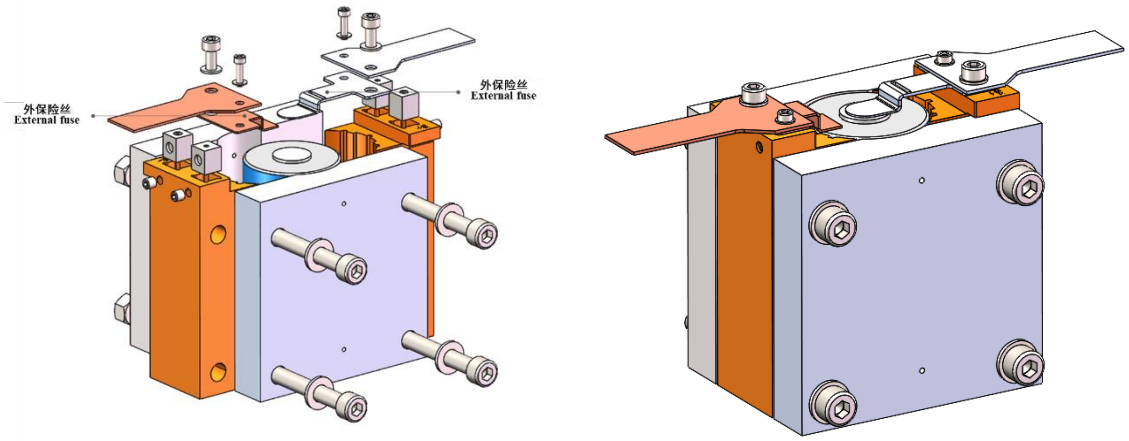
3.8.6.1. 高温外部短路 EXTERNAL SHORT CIRCUIT AT HIGH TEMPERATURE

在环境温度 25±2°C 的条件下，对电池按照图十的方法进行焊接、安装测试夹具，并参照下表进行测试：

At an ambient temperature of 25±2°C, weld the cell according to the method in Fig. 10, install the test fixture, and test according to the following table:

步骤 No.	状态 Status	环境温度 Environment Temp.	内容 Content
1	标准放电 Standard Dch	25±2°C	1/3C 恒流放电至 2.8 V，搁置 30 min。记录放电容量。 1/3C CC Dch to 2.8 V, Rest 30 min, record the discharge capacity.
2	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C。搁置 30 min。 1/3C CCCV Ch to 4.2V, 1/50C cut off, rest 30 min.
3	测试前参数测试 Pre-test parameter testing		测试电池电压、内阻、重量，照片(3 个面：正极端、圆柱面、vent 端)。 Test: Voltage, DCR, weight, photo (3 directions: top, cell can, bottom).
4	外部短路 External short circuit	57±5°C	将样品正负极采用要求的总电阻回路进行短路，外部线路电阻 80±20 mΩ。当电池温度下降值达到温度最大值的 20%或短接时间达到 24 h，停止测试。 Short-circuited the positive and negative terminal for 1h, using the required total resistance circuit, with an external line resistance of 80±20 mΩ. The test is stopped when the temperature drop of the cell reaches 20% of the maximum temperature value or when the short-circuit time reaches 1h.
5	观察 Observe	25±2°C	6 h
6	测试后参数测试 After-test parameter testing		测试电池电压、内阻、重量，照片(3 个面：正极端、圆柱面、vent 端)。 Test: Voltage, DCR, weight, photo (3 directions: top, cell can, bottom).

通过标准：不起火，不爆炸。(参考 GB 31241-2022 便携式电子产品用锂离子电池和电池组安全技术规范)
Pass Criteria: No Fire, No Explosion. (Refer to GB 31241-2022)



图十 电池外部短路测试夹具及 Fuse 示意图
Fig 10 Cell external short circuit test fixture and fuse

3.8.6.2. 过充电测试 OVERCHARGE

步骤 No.	状态 Status	环境温度 Environment Temp.	内容 Content
1	标准放电 Standard Dch	25±2°C	1/3C 恒流放电至 2.8 V，搁置 30 min。 1/3C CC Dch to 2.8 V, rest 30 min.
2	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C。搁置 30 min。 1/3C CCCV Ch to 4.2 V, 1/50C cut off, rest 30 min.
3	测试前参数测试 Pre-test parameter testing		测试电池电压、内阻、重量，照片(3 个面：正极端、圆柱面、vent 端)。 Test: Voltage, DCR, weight, photo (3 directions: top, cell can, bottom).
4	恒流充电 CC Ch		1C 恒流充电至 4.6 V。 1C CC Ch to 4.6 V.
5	观察 Observe		1h
6	测试后参数测试 After-test parameter testing		测试电池电压、内阻、重量，照片(3 个面：正极端、圆柱面、vent 端)。 Test: Voltage, DCR, weight, photo (3 directions: top, cell can, bottom).
备注：①1C 对应电流为 29.6A 用工装 3.3.2 进行补电和过充测试 Remark: 1C corresponds to a current of 29.6A and the 3.3.2 Tooling can be used for recharge and overcharge testing.			

通过标准：不起火，不爆炸。(参考 GB 38031-2020 电动汽车用蓄电池安全要求)
Pass Criteria: No Fire, No Explosion. (Refer to GB38031-2020)

3.8.6.3. 强制放电 FORCED DISCHARGE

步骤 No.	状态 Status	环境温度 Environment Temp.	内容 Content
1	标准放电 Standard Dch	25±2°C	1/3C 恒流放电至 2.8 V，搁置 30 min。 1/3C CC Dch to 2.8 V, Rest 30 min.
2	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C。搁置 30 min。 1/3C CCCV Ch to 4.2 V, 1/50C cut off, rest 30 min.
3	测试前参数测试 Pre-test Parameter Testing		测试电池电压、内阻、重量，照片(3 个面：正极端、圆柱面、vent 端)。 Test: Voltage, DCR, weight, photo (3 directions: top, cell can, bottom).
4	强制放电测试 Forced Discharge		以 30.0A 的电流恒流恒压进行反向充电至负的充电上限电压(-4.2 V)，反向充电时间共计 90 min。 30.0A CCCV reverse Ch to -4.2 V, the total testing time is 90 min.
5	观察 Observe		1 h。
6	测试后参数测试 After-test Parameter Testing		测试电池电压、内阻、重量，照片(3 个面：正极端、圆柱面、vent 端)。 Test: Voltage, DCR, weight, photo (3 directions: top, cell can, bottom).
备注：①如果在反向充电 90 min 内，电压达到负的充电上限电压(-4.2 V)，转恒压(-4.2 V)继续进行反向充电，反向充电共计 90 min 后终止试验。 ②如果在反向充电 90 min 内，电压未达到负的充电上限电压(-4.2 V)，则反向充电共计 90 min 后终止试验。 Remarks: ① If the voltage reaches the negative charging upper limit voltage (-4.2 V) within 90 min of reverse charging, turn to constant voltage (-4.2 V) to continue reverse charging, and terminate the test after 90 min of reverse charging. ② If the voltage does not reach the negative upper charging voltage (-4.2 V) within 90 min of reverse charging, terminate the test after 90 min of reverse charging.			

通过标准：不起火，不爆炸。(参考 GB 31241-2022 便携式电子产品用锂离子电池和电池组安全技术规范)
Pass Criteria: No Fire, No Explosion. (Refer to GB 31241-2022)

3.8.6.4. 低气压 LOW PRESSURE

步骤 No.	状态 Status	环境温度 Environment Temp.	内容 Content
1	标准放电 Standard Dch	25±2°C	1/3C 恒流放电至 2.8 V，搁置 30 min。 1/3C CC Dch to 2.8 V, Rest 30 min.
2	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C。搁置 30 min。 1/3C CCCV Ch to 4.2 V, 1/50C cut off, Rest 30 min.
3	测试前参数测试 Pre-test Parameter Testing		测试电池电压、内阻、重量，照片(3 个面：正极端、圆柱面、vent 端)。 Test: Voltage, DCR, weight, photo (3 directions: top, cell can, bottom).
4	低气压测试 Low pressure		将电池放入低气压箱中，调节试验箱中气压为 11.6 kPa，存储 6 h。 Put the cell into a low-pressure chamber, adjust the air pressure in the chamber to 11.6 kpa, and store for 6 hours.
5	观察 Observe		6 h。
6	测试后参数测试 After-test parameter testing		测试电池电压、内阻、重量，照片(3 个面：正极端、圆柱面、vent 端)。 Test: Voltage, DCR, weight, photo (3 directions: top, cell can, bottom).

通过标准：不漏液，不起火，不爆炸。(参考 GB 31241-2022 便携式电子产品用锂离子电池和电池组安全技术规范)

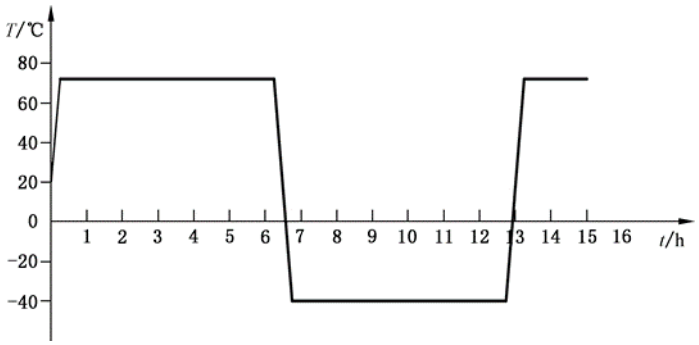
Pass Criteria: No Leakage, No Fire, No Explosion. (Refer to GB 31241-2022)

3.8.6.5. 温度循环 TEMPERATURE CYCLE

步骤 No.	状态 Status	环境温度 Environment Temp.	内容 Content
1	标准放电 Standard Dch	25±2°C	1/3C 恒流放电至 2.8 V，搁置 30 min。 1/3C CC Dch to 2.8 V, Rest 30 min.
2	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C。搁置 30 min。 1/3C CCCV Ch to 4.2 V, 1/50C cut off, Rest 30 min.
3	测试前参数测试 Pre-test parameter testing		测试电池电压、内阻、重量，照片(3 个面：正极端、圆柱面、vent 端)。 Test: Voltage, DCR, weight, photo (3 directions: top, cell can, bottom)
4	温度循环 Temperature Cycle	-40~72°C	a)常温升温至 72±2°C，并保持 6 h； b)72±2°C 降温至-40±2°C，保持 6 h，-40±2°C 升温至 72±2°C，保持 6 h，共循环 9 次； c)72±2°C 降温至-40±2°C，保持 6 h a) Raise the temperature to 72±2°C from room temperature and keep it for 6 h; b) Cool down from 72±2°C to -40±2°C in 30min, and keep it for 6 hours; raise the temperature from -40±2°C to 72±2°C in 30min and keep it for 6 h; cycle for 9 times c) Cool down from 72±2°C to -40±2°C in 30min, and keep it for 6 hours
5	观察 Observe	25±2°C	24 h。
6	测试后参数测试 After-test parameter testing		测试电池电压、内阻、重量，照片(3 个面：正极端、圆柱面、vent 端)。 Test: Voltage, DCR, weight, photo (3 directions: top, cell can, bottom)
备注：试验过程中，每两个温度之间的转换时间不大于 30 min Remark: During the test, the transition time between each two temperatures is not more than 30 min.			

通过标准：不漏液，不起火，不爆炸。(参考 GB 31241-2022 便携式电子产品用锂离子电池和电池组安全技术规范)

Pass Criteria: No Leakage, No Fire, No Explosion. (Refer to GB 31241-2022)



图十一 温度循环示意图

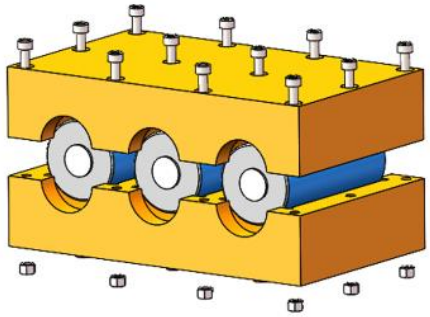
Fig. 11 Temperature cycle

3.8.6.6. 振动 VIBRATION

步骤 No.	状态 Status	环境温度 Environment Temp.	内容 Content
1	标准放电 Standard Dch	25±2°C	1/3C 恒流放电至 2.8 V，搁置 30 min。 1/3C CC Dch to 2.8 V, Rest 30 min.
2	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C。搁置 30 min。 1/3C CCCV Ch to 4.2 V, 1/50C cut off, Rest 30 min.
3	测试前参数测试 Pre-test Parameter Testing		测试电池电压、内阻、重量，照片(3 个面：正极端、圆柱面、vent 端)。 Test: Voltage, DCR, weight, photo (3 directions: top, cell can, bottom).
4	振动 Vibration		a)将电池紧固在振动台的台面上，不使其变形且能有效的传递振动； b)从 7 Hz 开始，以 1gn 的峰值加速度保持不变，直到达到 18 Hz。然后将振幅保持在 0.8 mm(总偏移 1.6 mm)并且频率增加直到出现 8gn 的峰值加速度(大约 50 Hz)。保持 8gn 的峰值加速度，直到频率增加到 200 Hz； c)在三个互相垂直的安装方位分别重复 12 次测试，即每个方位各 3 h，其中必须有一个振动方向与端面垂直。 a)The cell is fastened to the vibration table in such a way that it is not deformed and transmits the vibration efficiently; b)Starting at 7 Hz, maintain a constant peak acceleration of 1 gn until 18 Hz is reached, then maintain the amplitude at 0.8 mm (total offset 1.6 mm) and increase the frequency until a peak acceleration of 8 gn occurs (approximately 50 Hz). The peak acceleration of 8gn is maintained until the frequency is increased to 200 Hz; c)Repeat the test 12 times in three mutually perpendicular mounting orientations, i.e. 3 h in each orientation, one of which must be perpendicular to the end face.
5	观察 Observe		1 h。
6	测试后参数测试 After-test Parameter Testing		测试电池电压、内阻、重量，照片(3 个面：正极端、圆柱面、vent 端)。 Test: Voltage, DCR, weight, photo (3 directions: top, cell can, bottom).
备注：振动过程无需采集温度、电压数据。振动对数扫描频率从 7 Hz 到 200 Hz 摆动为一个循环，一个循环持续 15 min。 Remark: The vibration process does not require the acquisition of temperature and voltage data. The logarithmic scanning frequency of the vibration oscillates from 7 Hz to 200 Hz as a cycle, and a cycle lasts 15 min.			

通过标准：不漏液，不起火，不爆炸。OCV 压降 < 10%(参考 UN38.3)

Pass Criteria: No Leakage, No Fire, No Explosion, OCV Drop＜10%.(Refer to UN38.3)



图十二 振动工装示意图

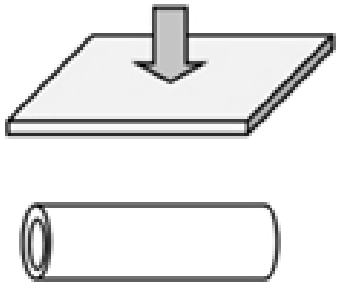
Fig. 12 Vibration setup

3.8.6.7. 挤压测试 SQUEEZE

步骤 No.	状态 Status	环境温度 Environment Temp.	内容 Content
1	标准放电 Standard Dch	25±2°C	1/3C 恒流放电至 2.8 V，搁置 30 min。 1/3C CC Dch to 2.8 V, Rest 30 min.
2	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C。搁置 30 min。 1/3C CCCV Ch to 4.2 V, 1/50C cut off, Rest 30 min.
3	测试前参数测试 Pre-test Parameter Testing		测试电池电压、内阻、重量，照片(3 个面：正极端、圆柱面、vent 端)。 Test: Voltage, DCR, weight, photo (3 directions: top, cell can, bottom).
4	挤压 Squeeze		a)挤压方向：将电池置于两个平板内，纵轴向与两平板平行； b)挤压板形式：两平板施加 13.0±0.78 kN，对电芯进行挤压； c)挤压速度：0.1 mm/s； d)挤压程度：电池电压下降 1/3 或挤压力达到 13 kN 后停止挤压。 a) Extrusion direction: the cell is placed in two flat plates, and the longitudinal axis is parallel to the two flat plates; b)Extrusion plate form: 13.0±0.78 kN is applied to the two flat plates to extrude the cell; c)Extrusion speed: 0.1 mm/s; d)Extruding degree: stop extruding after the battery voltage drops 1/3 or the extruding force reaches 13 kN.
5	观察 Observe		1 h。
6	测试后参数测试 After-test Parameter Testing		测试电池电压、内阻、重量，照片(3 个面：正极端、圆柱面、vent 端)。 Test: Voltage, DCR, weight, photo (3 directions: top, cell can, bottom).

通过标准：不起火，不爆炸。(参考 GB 31241-2022 便携式电子产品用锂离子电池和电池组安全技术规范)

Pass Criteria: No Fire, No Explosion. (Refer to GB 31241-2022)



图十三 挤压工装示意图

Fig. 13 Squeeze setup

3.8.6.8. 机械冲击测试 MECHANICAL IMPACT TEST

步骤 No.	状态 Status	环境温度 Environment Temp.	内容 Content
1	标准放电 Standard Dch	25±2°C	1/3C 恒流放电至 2.8 V，搁置 30 min。 1/3C CC Dch to 2.8 V, Rest 30 min.
2	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C。搁置 30 min。 1/3C CCCV Ch to 4.2V, 1/50C cut off, Rest 30 min.
3	测试前参数测试 Pre-test Parameter Testing		测试电池电压、内阻、重量，照片(3 个面：正极端、圆柱面、Vent 端)。 Test: Voltage, DCR, weight, photo (3 directions: top, cell can, bottom).
4	机械冲击 Mechanical Impact Test		a)将电池紧固在振动台的台面上，该支架支撑每个电池的所有安装面； b)每个电池经受最大加速度 150gn 和脉冲持续时间 6 ms 的半正弦波冲击； c)电池在三个互相垂直的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。 a)The cells are fastened to the table of the shaker, which supports all mounting surfaces of each cell; b)Each cell is subjected to a half-sine wave shock with a maximum acceleration of 150 gn and a pulse duration of 6 ms; c)The cells were subjected to three shocks in the forward direction of the three perpendicular mounting orientations, followed by three shocks in the reverse direction, for a total of 18 shocks.
5	观察 Observe		1 h。
6	测试后参数测试 After-test Parameter Testing		测试电池电压、内阻、重量，照片(3 个面：正极端、圆柱面、Vent 端)。 Test: Voltage, DCR, weight, photo (3 directions: top, cell can, bottom).
备注：机械冲击过程无需采集温度、电压数据。 Remark: The mechanical impact process eliminates the need to collect temperature and voltage data.			

通过标准：不漏液，不起火，不爆炸。(参考 UN38.3)

Pass Criteria: No Leakage, No Fire, No Explosion.(Refer to UN38.3)

3.8.6.9. 热滥用 THERMAL ABUSE

步骤 No.	状态 Status	环境温度 Environment Temp.	内容 Content
1	标准放电 Standard Dch	25±2°C	1/3C 恒流放电至 2.8 V，搁置 30 min。 1/3C CC Dch to 2.8 V, Rest 30 min.
2	标准充电 Standard Ch		1/3C 恒流恒压充电至 4.2 V，截止电流为 1/50C。搁置 30 min。 1/3C CCCV Ch to 4.2 V, 1/50C cut off, Rest 30 min.
3	测试前参数测试 Pre-test parameter testing		测试电池电压、内阻、重量，照片(3 个面：正极端、圆柱面、vent 端)。 Test: Voltage, DCR, weight, photo (3 directions: top, cell can, bottom).
4	加热 Heating	RT~130°C	将电池放入温度箱，温度箱按照 5°C/min 的速率由室温升至 130±2°C，并保持此温度 30 min 后停止加热。 The cell is placed in a temperature chamber, which is heated from room temperature to 130±2°C at a rate of 5°C/min and maintained at this temperature for 30 min before the heating is stopped.
5	观察 Observe	25±2°C	1 h。
6	测试后参数测试 After-test parameter testing		测试电池电压、内阻、重量，照片(3 个面：正极端、圆柱面、vent 端)。 Test: Voltage, DCR, weight, photo (3 directions: top, cell can, bottom).

通过标准：不起火，不爆炸。(参考 GB 31241-2022 便携式电子产品用锂离子电池和电池组安全技术规范)
Pass Criteria: No Fire, No Explosion. (Refer to GB 31241-2022)

4. BMS 设计参数建议 BMS DESIGN PARAMETERS RECOMMENDATIONS

以下数据为 4695E 电池参考性能数据，仅供 BMS 设计时参考使用，实际使用以双方约定的使用方式和条件为准。

The following data are 4695E Cell reference performance data for reference use in BMS design, actual use is subject to the use and conditions agreed by both parties.

4.1. 电性能数据 ELECTRICAL PERFORMANCE DATA

4.1.1. 推荐充电 RECOMMENDED CHARGE

常规充电(10~45°C)：1/3C 恒流恒压充电至 4.2 V，1/50C 截止。
Regular charging (10~45°C): 1/3C constant current and constant voltage charging to 4.2 V, 1/50C cutoff.

4.2. 电池安全操作限制 CELL SAFETY OPERATING LIMITS

4.2.1. 电流限制 CURRENT LIMITS

4.2.1.1. 充放电操作电流限制 CHARGE AND DISCHARGE OPERATION CURRENT LIMIT

温度 Temperature (°C)	放电操作电流限制 Discharge Operation Current Limit	充电操作电流限制 Charge Operation Current Limit
	$I_{max-peak}$(A)	$I_{max-peak}$(A)
(-15, -20]	8	1
(-10, -15]	15	3
(-5, -10]	21	4
(0, -5]	25	7
(5, 0]	36	8
(10, 5]	55	12
(15, 10]	66	15
(20, 15]	84	21
(25, 20]	101	25
[55, 25]	120	30

注：放电操作电流限制 $I_{max-peak}$ 指 10%SOC，耐受时间为 5 s 电池的最大允许电流。充电操作电流限制 $I_{max-peak}$ 指 90%SOC，耐受时间为 5 s 电池的最大允许电流。

Remark: The above discharge $I_{max-peak}$ refers to 10% SOC, and the withstand time is the maximum allowable current of 5 s. The above charge $I_{max-peak}$ refers to 90% SOC, and the withstand time is the maximum allowable current of 5 s.

4.2.1.2. 安全电流限制 SAFETY CURRENT LIMIT

如果在 0-200 ms 范围内电流超过 $I_{max-safety}$，电池不会触发安全事件(EUCAR 危险等级≤L3：电池漏液，且电解液损失<50%)，但是该电池不能继续充放电，且必须更换。

如果在操作电流限制与安全电流限制之间使用，电池会严重加速衰减，但不会发生安全事件。

在未指定温度的情况下，可通过下表中两个相邻条件之间的线性插值来确定安全限制电流。

If the current exceeds $I_{max-safety}$ in the range 0-200 ms, the battery does not trigger a safety event (EUCAR hazard class ≤ L3: battery leakage with electrolyte loss < 50%), but the battery cannot be further charged or discharged and must be replaced.

If used between the operating current limit and the safety current limit, the battery will severely accelerate decay, but no safety event will occur.

In the case of unspecified temperatures, the safety limiting current can be determined by linear interpolation between two adjacent conditions in the table below.

温度 Temperature(°C)	安全电流限制 Safety Current Limit			
	放电 Discharge		充电 Charge	
	$I_{max\text{-}Safety}$(A)	最大允许时间 Max. Time (s)	$I_{max\text{-}Safety}$(A)	最大允许时间 Max. Time (s)
(-15, -20]	13	5	1	5
(-10, -15]	22	5	3	5
(-5, -10]	30	5	4	5
(0, -5]	33	5	7	5
(5, 0]	45	5	9	5
(10, 5]	81	5	25	5
(15, 10]	92	5	28	5
(20, 15]	110	5	31	5
(25, 20]	127	5	35	5
[55, 25]	145	5	40	5

注：以上安全电流限制指充电起始电量 90%SOC、放电起始电量 10%SOC。

Remark: The above safety current limits refer to 90% SOC for charging start-up power and 10% SOC for discharging start-up power.

4.2.2. 电压限制 VOLTAGE LIMITS

类别 Type	项目 Project	数值 Value	备注 Comment
安全限制 Safety Limits	充电电压 Charge Voltage	4.25 V	当充电电压高于 4.25V 时，EVE 不能保证电池的安全性能。如果电压超过安全限制电压，请立刻对电池放电，使其达到安全限制条件下。 EVE cannot guarantee the safe performance of the battery when the charging voltage is higher than 4.25V. If the voltage exceeds the safe limiting voltage, immediately discharge the battery to bring it under the safe limiting conditions.
	放电电压 Discharge Voltage	T>0°C，2.5 V -20≤T≤0°C，2.3 V	当放电电压低于安全限制电压时，EVE 不能保证电池的安全性能。 如果电压超过安全限制电压，请立刻对电池充电，使其达到安全限制条件上。 EVE cannot guarantee the safe performance of the battery when the discharge voltage is below the safe limit voltage. If the voltage exceeds the safe limiting voltage, charge the battery immediately to bring it up to the safe limiting conditions on.
操作限制 Operation Limits	充电电压 Charge Voltage	详见备注 Refer to comment	当 T>55°C 不允许充电； 当 0<T≤55°C 时，充电截止电压为 4.2 V。 当-20≤T≤0°C 时，充电建议不超过 90%SOC，充电截止电压为 4.1V，持续时间≤5s。When T>55°C, no charging allowed; When 0<T≤55°C, the charging cut-off voltage is 4.2 V. When -20 ≤ T ≤ 0°C, charging is recommended to be no more than 90% SOC, with a charging cutoff voltage of 4.1 V and a duration of ≤ 5s.
	放电电压 Discharge Voltage		当 0<T≤55°C 时，放电截止电压为 2.8 V； 当-20≤T≤0°C 时，放电截止电压为 2.5 V。 When 0<T≤55°C, the discharge cutoff voltage is 2.8 V. When -20≤T≤0°C, the discharge cutoff voltage is 2.5 V.

4.2.3. 温度限制 TEMPERATURE LIMITS

安全操作的温度限制 Temperature Limits for Safe Operation			
类别 Type	项目 Project	数值 Value	备注 Comment
安全限制 Safety Limits	最高安全温度 Maximum safety temperature	60°C	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。 If the cell temperature exceeds the maximum safe temperature, it will cause irreversible and permanent damage to the cell, so the user should not use it above the maximum safe temperature.
	最低安全温度 Minimum safe temperature	-25°C	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。 If the cell temperature exceeds the minimum safe temperature, it will cause irreversible and permanent damage to the cell, so the user should not use it below the minimum safe temperature.
操作限制 Operation Limits	最高操作温度 Maximum operating temperature	55°C	如果电池使用温度超过最高操作温度，功率需要降为 0。 If the cell is used at a temperature above the maximum operating temperature, the power needs to be reduced to 0.
	放电最低操作温度 Minimum Discharge temperature	-20°C	如果电池使用温度超过最低操作温度，功率需要降为 0。 If the cell is used at a temperature above the minimum discharge temperature, the power needs to be reduced to 0.
	充电最低操作温度 Minimum Charge temperature	0°C	如果电池使用温度超过最低操作温度，功率需要降为 0。 If the cell is used at a temperature above the minimum discharge temperature, the power needs to be reduced to 0.
	推荐操作温度范围 Recommended operating temperature range	10~35°C	推荐使用电池的温度范围。 Recommended temperature range for 4695E cells.
备注：以上温度均为电芯壳体表面温度 Remark: The above temperatures are the surface temperatures of the battery cell shells.			

5. 电池操作说明及注意事项 CELL OPERATION INSTRUCTIONS AND PRECAUTIONS

5.1. 充电 CHARGE

电芯应在规格书限定的充电电流范围内与充电温度范围内充电，充电电压不得超过规格书中限定的电压。电芯充电连接时应保证正负极连接正确，严禁反向充电，如果电芯正负极连接错误，电芯可能损坏。

The battery cell should be charged within the charging current range and charging temperature range limited by the specification, and the charging voltage should not exceed the voltage limited by the specification. The positive and negative poles of the battery cell should be connected correctly when charging, and reverse charging is strictly prohibited; if the positive and negative poles of the battery cell are connected incorrectly, the battery cell may be damaged.

5.2. 放电 DISCHARGE

电芯应在规格书限定的放电电流范围内与放电温度范围内放电，如果需要设置更高的放电电流，请与 EVE 讨论。系统应配备保护板，防止进一步放电，避免电压低于规格书中规定的放电截止电压。过放电会导致电芯性能的损失。如果电芯放置很长一段时间不使用，电芯自放电可能会导致过放。充电器应配置保护板检测电池包电压和确定重新充电程序。

The cells shall be discharged within the discharge current range and discharge temperature range limited by the specification, if a higher discharge current setting is required, please discuss with EVE. The system should be equipped with a protection plate to prevent further discharging below the discharge cut-off voltage specified in the datasheet. Over-discharge can lead to a loss of performance of the cells. Self-discharge of the cells may lead to over-discharge if the cells are left unused for a long period of time. The charger shall be equipped with a protection board to detect the pack voltage and determine the re-charging procedure.

5.3. 长期存储 LONG TERM STORAGE

电芯应在规格书规定的温度范围内储存，否则，可能会导致电芯性能的损失，漏液或生锈。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。若需要存储，则电池需要在低 SOC 态下进行存储。推荐的存储条件为：以出货 SOC 状态存储，0~25°C，≤60%RH。每 6 个月需要进行充放电操作，充放电步骤按照 3.7.2 操作，并将 SOC 调整到出货 SOC 状态，即 30%至 50%SOC 左右。

The battery cells should be stored within the temperature range specified in the specification, otherwise, it may lead to loss of performance, leakage or rusting. Batteries need to be used as soon as possible after recharging to avoid loss of usable capacity due to self-discharge. If storage is required, the battery needs to be stored in a low SOC state. Recommended storage conditions are: stored in shipping SOC state, 0~25°C, ≤60%RH. Every 6 months, charging and discharging operations are required. Follow the charging and discharging steps in 3.7.2 and adjust the SOC to the shipping SOC state, which is around 30% to 50% SOC.

5.4. 循环寿命 CYCLE LIFE

电芯经历多次充放电循环后，可达到规格书中指定次数下规定的容量水平。充放电方式、电芯使用温度或存储条件会影响电芯的循环性能。

A battery cell may undergo multiple charge/discharge cycles to achieve the capacity level specified in the specification for the number of cycles specified. The method of charging and discharging, the temperature at which the cells are used, or the storage conditions can affect the cycling performance of the cells.

5.5. 运输 TRANSPORTATION

产品的运输应在不大于 50%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。

The products should be transported in boxes at no more than 50% SOC. During transportation, it should be prevented from violent vibration, impact or extrusion, avoid sun and rain.

5.6. 操作说明 OPERATING INSTRUCTIONS

- 禁止反向充电，正确连接电池的正负极，严禁反向充电。
  Reverse charging is prohibited. Connect the positive and negative terminals of the cell correctly, reverse charging is strictly prohibited.
- 禁止过放电，电池正常使用过程中，为防止过放电发生，电池应定期充电，电压维持在 2.8 V 以上。
  Prohibit over-discharging. During the normal use of the cell, in order to prevent the occurrence of over-

discharge, the cell should be charged regularly to maintain the voltage above 2.8V.

- 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 strictly forbidden to immerse the cell in water, and it should be placed in a cool and dry environment when kept out of use.
- 禁止将电池放在热高温源旁边，如明火、加热器等。
  It is forbidden to put the cell next to hot and high temperature sources, such as fire, heater, etc. to use and leave it.
- 充电时请选用锂离子电池专用充电器。
  Please use the special charger for lithium-ion cell when charging.
- 在使用过程中，严禁将电池正负极颠倒。
  During use, it is strictly forbidden to reverse the positive and negative poles of the cell.
- 禁止将电池置于火中或加热电池。
  It is forbidden to throw the cell into fire or to heat the cell.
- 禁止用金属直接导通电池正负极。
  It is forbidden to use metal to directly conduct the positive and negative terminals of the cell.
- 禁止将电池与金属物品，如发夹、项链等一起运输或贮存。
  It is forbidden to transport or store the cell with metal, such as hairpin, necklace, etc.
- 禁止敲击或抛掷、踩踏和弯折电池等。
  Do not knock or throw, step on or bend the cell.
- 禁止直接焊接电池。
  It is forbidden to solder the cell directly.
- 禁止用钉子或其它利器刺穿电池。
  Do not pierce the cell with nails or other sharp objects.
- 不要使用处于极热环境中的电池，如阳光直射或热天的车内。
  Do not use the cell in an extremely hot environment, such as in direct sunlight or in a car on a hot day.
- 禁止在强静电和强磁场的地方使用。
  Do not use in areas of strong static electricity and strong magnetic fields.
- 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。
  If the cell leaks and electrolyte is spilled on skin or clothes, wash the affected area with running water immediately.
- 如果电池出现异味、发热、变色、变形或使用、贮存、充电过程中出现任何异常时不得使用。
  Do not use the cell if there is any odor, heat, discoloration, deformation or any abnormality during use, storage or charging.
- 电池组应配备合适的减震器，以最大限度地减少震动，避免损坏电芯。
  Battery packs should be equipped with suitable shock absorbers to minimize vibration and avoid damage to the cells.
- 在休眠状态下时，电池组消耗电流应 < 10 μA。系统应配置设备监测每个电芯电压，避免电芯不平衡造成电池损坏。
  The battery pack should consume <10 μA of current when in sleep state. The system should be configured with equipment to monitor the voltage of each cell to avoid battery damage caused by cell imbalance.
- 电池组或系统应具有过热、过压、过流等预警系统。

The battery pack or system shall have an early warning system for overheating, overvoltage and overcurrent.

- 电池包装配前应目视检查每个电芯。如果电芯套管损坏、钢壳变形或有电解液气味，则电芯不能继续使用。
  Each cell should be visually inspected before the battery is packaged and dispensed. If the casing of the cell is damaged, the steel case is deformed, or there is an odor of electrolyte, the cell cannot be used further.
- 焊接连接片时，应避免对两端施加过大的力。
  When welding connection tabs, avoid applying excessive force to the ends.
- 电芯不应从电池组中拆下。
  The cells should not be removed from the battery pack.
- 拆卸引起的内部短路可能导致电芯发热或产气。
  Internal short circuits caused by disassembly may cause the cell to heat up or produce gas.
- 如果电池泄漏的液体进入你的眼睛，不要揉眼睛，请用清水清洗，并立即去看医生。
  If liquid from a leaking battery gets into your eyes, do not rub them, wash them with water and see a doctor immediately.
- 使用时应采用正确的线路，防止意外短路。
  Use with proper wiring to prevent accidental short circuits.
- 严禁用火焚烧和处置电芯，可能会引起电芯破裂和爆炸。
  Burning and disposing of the core with fire is strictly prohibited and may cause the core to rupture and explode.
- 严禁使用不同类型的电芯，或不同的电芯制造商同种类型的电芯进行电池包组装，由于电芯的不同特性，可能导致电芯不平衡，电芯破裂或系统损坏。
  It is strictly prohibited to use different types of cells, or cells of the same type from different cell manufacturers for battery pack assembly, which may lead to cell imbalance, cell rupture or system damage due to the different characteristics of the cells.
- 电芯不含铅、镉等有害环境成分，但处理时应按当地法规处理。
  The cores do not contain lead, cadmium or other environmentally hazardous components, but should be handled in accordance with local regulations.

5.7. 注意事项 CAUTION

- 如果电芯使用不当，可能会导致火灾或化学烧伤。
  If the batteries are not used properly, they may cause fire or chemical burns.
- 禁止拆解电芯、在 100°C 以上高温加热或火烧电芯。
  It is prohibited to dismantle the core, to heat it at temperatures above 100°C or to fire it.
- 不要将电芯短路、过充或过放。
  Do not short-circuit, overcharge or over-discharge the cell.
- 不要使电芯承受过重的机械冲击。
  Do not subject the cell to excessive mechanical shock.
- 不要颠倒电芯的正负极。
  Do not reverse the positive and negative terminals of the cell.
- 不要拆卸或修整电芯。
  Do not disassemble or tinker with the batteries.
- 不要将电芯与插座连接。

Do not connect the batteries to the socket.

- 不要直接接触漏液的电芯。
  Do not touch the leaking cell directly.
- 不要将锂离子电芯混合使用。
  Do not mix lithium-ion cells.
- 不要将电芯放置在太阳光直射的地方(或在太阳底下暴晒的汽车里)。
  Do not leave the cell in direct sunlight (or in a car exposed to the sun).
- 将电芯放置在远离儿童的地方。
  Keep the batteries away from children.
- 不要针刺、捶打或践踏电芯。
  Do not pin, pound or trample on the core.
- 只能更换 EVE 的电芯。
  Only EVE cells can be replaced.

6. 免责声明 DISCLAIMER

如果由于产品需求单位不按本说明书中的规定进行使用，造成社会性影响，并对湖北亿纬动力有限公司的声誉造成影响的，湖北亿纬动力有限公司将会追究产品需求单位的责任。根据对湖北亿纬动力有限公司造成的影响程度，产品需求单位需向湖北亿纬动力有限公司提供赔偿。

If the product demanding party does not use the provisions in this manual, which causes social impact and affects the reputation of EVE Power Co., Ltd., EVE Power will pursue the responsibility of the product demanding party. According to the degree of impact on EVE Power, the product demand party must provide compensation to EVE Power.

7. 其他 OTHER

本规格书受中华人民共和国法律管辖，但不包括其冲突规范。因本规格书或者履行过程引发的争议应由双方友好协商解决，协商不成，任何一方均可向湖北亿纬动力有限公司所在地人民法院提起诉讼。

These specifications shall be governed by the laws of the People's Republic of China, excluding its conflict specifications. Any dispute arising from this specification document or the performance process shall be settled by both sides through friendly negotiation. If no agreement can be reached through negotiation, either side may file a lawsuit with the people's court where EVE Power Co., Ltd. is located.

本规格书为中英互译版本，如中文与英文约定内容有歧义，以中文内容为准。

This specification is a Chinese English translation version. In case of any ambiguity between the Chinese and English agreed terms, the Chinese content shall prevail.

本规格书自双方签字盖章之日起生效，有效期至：_____年___月___日。一式两份，具有同等法律效力。

This specification shall come into force upon being signed and sealed by both parties and shall be valid until DATE：_____. In duplicate, both copies shall have the same legal effect.

本规格书未尽事宜，由双方另行签订补充协议，补充协议与本规格书具有同等法律效力。非经双方签署书面的文件，本规格书的任何条款不得被修改或者变更。

For matters not covered in this specification, both parties shall separately sign a supplementary agreement which shall have the same legal effect as this specification document. No provision of this specification shall be modified or altered without a written document signed by both parties.

8. 联系方式 CONTACT

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