方形 110Ah 纳米钛酸锂动力电池规格书

SPECIFICATION of PRESMATIC 110Ah-LITHIUM TITANATE POWER BATTERY

（型号： **LTO51130205 /110Ah**）

Document No. 文件编号	**Version** 版本/次	**Department** 拟案单位	**Valid Date** 生效日期
YLE-WI-SPP-012	A/1	电池研究院	2022-4-28
Design 编制	**Check** 审核		**Approval** 批准
高娇阳	马美品		李海军

Customer Approval 客户确认	Signature/Date 签字/日期	
	Company Name 公司名称	
	Company Stamp 公司印章	

公司名称：格力钛新能源股份有限公司 公司地址：珠海市金湾区三灶镇金湖路 16 号 电话：+86-0756-7637666 传真：+86-0756-7637666 网址：http://www.zhyle.com	Company: GREE Altairnano New Energy Inc. Address: No. 16, Jinhu Road, Sanzao Town, Jinwan District, Zhuhai, China. Tel No.: +86-0756-7637666 Fax No.:+86-0756-7637666 Web: http://www.zhyle.com

修订履历

版本	变更内容	编制人	修订日期
A/0	初版发行	李巧	2021-7-15
A/1	增加电池充放电性能数据	高娇阳	2022-4-28

目录

Contents

1. 适用范围 Scope

本规格书描述纳米钛酸锂电池之基本参数、电化学特性、可靠性及其试验和判定标准、使用说明、安全规程、质量评定及包装、贮存和运输等，适用于格力钛新能源股份有限公司制造的 LTO51130205/110Ah 纳米钛酸锂电池。

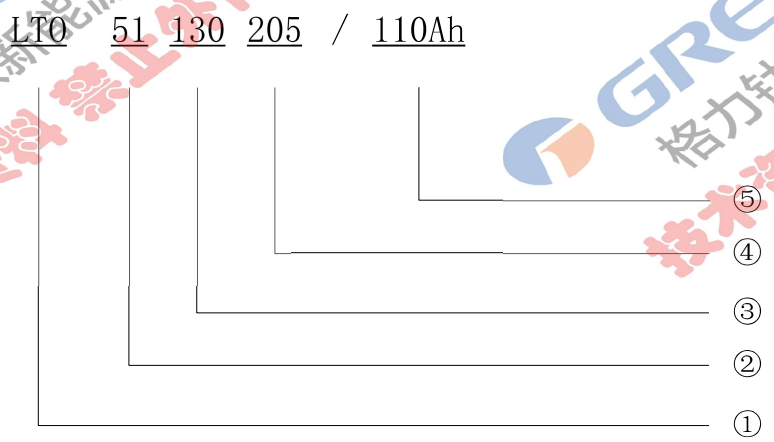
This specification describes the lithium titanate battery's basic parameters, electrochemical characteristics, reliability and its test method, decision criteria, instructions, safety procedures, quality evaluation, packaging, storage, and transportation, etc. The specification is applied to the LTO51130205/110Ah lithium ion battery manufactured by GREE Altairnano New Energy Inc.

2. 概述 Description

产品型号：LTO51130205/110Ah 纳米钛酸锂动力电池。

Product model: LTO51130205/110Ah Lithium Titanate Power Battery.

2.1 命名规则 Naming Rules



① 代表电芯采用的负极材料为钛酸锂。

Indicates the anode material of battery, the letter " LTO " defines Lithium Titanate.

② 代表电池厚度 (mm)。

Indicates the thickness of battery (mm).

③ 代表电池宽度 (mm)。

Indicates the width of battery (mm).

④ 代表电池高度(mm)，用三位数字表示。

Indicates the overall height of battery (mm) in three digits.

⑤ 代表电池容量。

Indicates the capacity of battery.

2.2 电池构成 Battery Component

本电池为纳米钛酸锂电池，由正极、负极（钛酸锂）、隔膜、电解液和铝制金属外壳等组成。

This battery is of cylindrical lithium titanate battery which is composed of negative and positive electrode, separator, electrolyte and metal case etc.

2.3 引用标准 Adopted Standard

GB/T 31484-2015 电动汽车用动力蓄电池循环寿命要求及试验方法

GB/T 31484-2015 Cycle life requirements and test methods for traction battery of electric vehicle

GB/T 31486-2015 电动汽车用动力蓄电池电性能要求及试验方法

GB/T 31486-2015 Electrical performance requirements and test methods for traction battery of electric vehicle

GB 38031-2020 电动汽车用动力蓄电池安全要求

GB 38031-2020 Electric vehicles traction battery safety requirments

Q/YL 2.01.001-2020 纳米钛酸锂电池

Q/YL 2.01.001-2020 Nano lithium titanate rechargeable battery

3. 电池性能测试条件 Test Conditions of Battery Properties

3.1 标准测试条件 Standard Test Conditions

3.1.1 标准测试环境 Standard Test Environment

除非有其他特殊说明，本规格书中所有测试都在以下环境条件进行：

Unless otherwise specified, all tests stated in this Product Specification are conducted at below condition:

温度：25 ± 5 °C；

Temperature：25 ± 5 °C；

相对湿度：15%~90%；

Humidity：15%~90%；

大气压力：86kPa~106kPa；

Atmospheric pressure：86kPa~106kPa.

海拔：≤4000m。

Height above sea level：≤4000m.

本规格书所提到的室温是指 25℃±5℃。

The room temperature mentioned in this product specification is 25°C±5°C.

3.1.2 标准充电方式 Standard Charge Method

在标准环境条件下，以 $1I_1$(110A)电流恒流充电至充电截止电压，停止充电。

Under standard test environment, a battery is charged to the standard charge cut-off voltage at a constant current of $1I_1$ (110A), then stopped charging.

3.1.3 标准放电方式 Standard Discharge Method

在标准环境条件下，以 $1I_1$(110A)电流恒流放电至放电截止电压，停止放电。

Under standard test environment, a battery is discharged to the standard discharge cut-off voltage at a constant current of $1I_1$ (110A), then stopped discharging.

3.1.4 初始容量 Initial Capacity

新出厂的电池，在室温下，完全充电后，以 $1I_1$ (110A)电流恒流放电至放电截至电压时所放出的容量（Ah）。

Under standard test environment, a fresh battery is charged in accordance with 3.1.2, and then discharged to the standard discharge cut-off voltage at a constant current of $1I_1$ (110A), the discharge capacity is defined to be initial capacity.

3.2 测量器具及设备 Measuring Instruments or Apparatus

3.2.1 尺寸测量设备 Dimension Measuring Instrument

测量尺寸的仪器精度应不小于 0.01mm。

Dimension measurement shall be implemented by instruments which accuracy should not be less than 0.01 mm.

3.2.2 电压表 Voltmeter

国家标准或更灵敏等级，内阻不小于 10 kΩ/V。

Standard class specified in the national standard or more sensitive class having inner impedance not less than 10 kΩ/V.

3.2.3 电流表 Ammeter

国家标准或更灵敏等级，外部总体内阻包括电流表和导线应小于 0.01Ω。

Standard class specified in the national standard or more sensitive class. Total external resistance including ammeter and wire is less than 0.01Ω.

3.2.4 内阻测试仪 Impedance Meter

内阻测试仪测试方法为交流阻抗法(AC 1kHz LCR)。

Impedance shall be measured by a sinusoidal alternating current method (AC 1kHz LCR meter).

4. 技术规格 Specification

4.1 单体电池基本参数 Battery Specification

序号 No.	项目 Item	参数 Parameters	备注 Remark

1	外观 Appearance	符合外观检验标准 Accord with appearance inspection standard	电池外观应无划伤、破裂、污渍、生锈漏液等影响市场价值的缺陷。 There should be no such defects as flaw, crack, rust, leakage, which may depreciate the commercial value of battery.
2	额定容量 Rated Capacity	110Ah	25±5 ℃
3	标称电压 Nominal Voltage	2.3V	
4	内阻 Internal Impedance	≤0.5mΩ	50%荷电状态下用交流法测量内阻 Internal resistance measured at AC 1kHz after 50% charged.
5	标准充电截止电压 Standard Charge Cut-off Voltage	2.9V	
6	标准放电截止电压 Standard Discharge Cut-off Voltage	1.5V	
7	最大持续充电电流 Maximum Continuous Charge Current	330A	25±5 ℃
8	最大持续放电电流 Maximum Continuous Discharge Current	330A	25±5 ℃
9	最大脉冲充/放电电流（10s） Maximum Pulse Charge/Discharge Current (10s)	500A	25±5 ℃
10	工作温度范围 Operating Temperature Range	温度：-40~55℃ 相对湿度：≤85% Temperature: -40~55℃ Humidity: ≤85%RH	当电池温度低于 0℃时，建议充/放电电流≤1 I_1 (110A) Recommended charge/discharge current ≤ 1 I_1 (110A), when battery temperature is lower than 0 ℃.
11	储存温度范围 Storage Temperature Range	-20℃~45℃	推荐 Recommend（25±5 ℃）；≤90%RH 储存湿度范围。

编制：高娇阳 日期:2022/05/05　审核：马美品 日期:2022/05/05　标准化：王文华 日期:2022/05/05　批准：李海军 日期:2022/05/06

			≤90%RH storage moisture range.
12	尺寸 Dimension	厚度：$51.0^{+1.0}$mm 宽度：$130.0^{+1.0}$mm 高度：$205.0^{+1.0}$mm Thickness: $51.0^{+1.0}$mm Width: $130.0^{+1.0}$mm Height：$205.0^{+1.0}$mm	①电池详细尺寸，请参看本规格书“11. 电池结构示意图”。 The detailed dimension can be found in "11. Scheme of the battery structure" of this specification. ②测试厚度时需加压：压力 2000~2500N。 Using 2000~2500N pressure When test the thickness of battery
13	重量 Weight	3000±50g	
14	建议 SOC 使用范围 Recommended SOC using range	10%~90%	
15	质量能量密度 Weight-energy density	≥80Wh/kg	典型值：84 Wh/kg
16	体积能量密度 Volume-energy density	≥178Wh/L	典型值：186 Wh/L
17	电芯出货 SOC	50±3%	
18	电芯保护温度	55℃	

4.2 单体电池电化学性能参数 Battery Electrochemical Performance

序号 No.	项目 Item	测试方法 Test Method	标准 Criteria

1	循环寿命 Cycle Life	在标准测试环境下，电池按 3.1.2 规定充电，搁置 30 分钟，而后按 3.1.3 规定放电，搁置 30 分钟，再进行下一个充放电循环，连续进行充放电循环 16000 次。 Under standard test environment, a battery is charged in accordance with 3.1.2, rest 10 minutes, and then discharged in accordance with 3.1.2, rest 10 minutes prior to next charge-discharge cycle. The battery shall be continuously charged and discharged for 16000 cycles.	16000 次循环后，放电容量≥80%*初始容量 Discharge Capacity ≥ 80% * initial capacity after 16000 cycles
2	倍率充电性能 Rate Charge Performance	在标准测试环境下，电池按 3.1.3 规定放电，搁置 10 分钟，而后以 330A 电流充电至标准充电截止电压，计算充电容量（Ah）与初始容量的比值(%)。 Under standard test environment, a battery is discharged in accordance with 3.1.3, rest 10 minutes, and then charged to standard cut-off voltage at a constant current of 330A. Calculate the ratio of charge capacity (%).	330A 充电容量≥90%*初始容量 Charge capacity≥90% * initial capacity with 330A
3	倍率放电性能 Rate Discharge Performance	在标准测试环境下，电池按 3.1.2 规定充电，搁置 10 分钟，而后以 330A 电流放电至标准放电截止电压，计算放电容量（Ah）与初始容量的比值(%)。 Under standard test environment, a battery is charged in accordance with 3.1.2, rest 10 minutes, and then discharged to standard cut-off voltage at a constant current of 330A. Calculate the ratio of discharge capacity (%).	330A 放电容量≥90%*初始容量 Discharge capacity≥90% *initial capacity with 330A
4	低温充电性能 Low Temperature Charge	电池按 3.1.3 规定放电结束后，将电池放入-20 ±2℃/-40 ±2℃恒温环境中搁置 24±0.2h，然后-20 ±2℃以 $1I_1$ (110A)电流充电至标准充电截止电压，-40 ±2℃以 $0.5I_1$ (55A)电流充电至标准充电截止电压，计算充电容量	-20℃充电容量≥80%*初始容量 Charge capacity ≥ 80% * initial capacity at -20 ºC

	Performance	（Ah）与初始容量的比值(%)。 A battery is discharged in accordance with 3.1.3, and stored in an ambient temperature of -20±2 ºC /-40 ±2 ºC for 24±0.2h, and then charged to standard charge cut-off voltage at a constant current of $1I_1$ (110A) when in an ambient temperature of -20±2 ºC, charged to standard charge cut-off voltage at a constant current of $0.5I_1$ (55A) when in an ambient temperature of -40±2 ºC Calculate the ratio of charge capacity (%).	-40 ℃ 充电容量≥60%*初始容量 Charge capacity ≥ 60% * initial capacity at -40 ºC
5	低温放电性能 Low Temperature Discharge Performance	电池按 3.1.2 规定充电结束后，将电池放入-20 ±2℃/-40 ±2℃恒温环境中搁置 24±0.2h，然后以 $1I_1$ (110A)电流放电至放电截止电压 1.2V，计算放电容量（Ah）与初始容量的比值(%)。 A battery is charged in accordance with 3.1.2, and stored in an ambient temperature of -20±2 ºC /-40 ±2 ºC for 24±0.2h, and then discharged to 1.5V at a constant current of $1I_1$ (110A). Calculate the ratio of discharge capacity (%).	-20℃放电容量≥70%*初始容量 Discharge capacity ≥ 70% * initial capacity at -20 ºC
			-40 ℃ 放电容量≥55%*初始容量 Discharge capacity≥ 55% * initial capacity at -40 ºC

6	常温荷电保持与容量恢复能力 Retention Capability and Capacity recovery at Room Temperature	电池按 3.1.2 规定充电结束后，将电池在室温环境中搁置 28 天，然后按 3.1.3 规定放电，计算放电容量（Ah）与初始容量的比值(%)。再按 3.1.2 规定充电，搁置 10 分钟，按 3.1.3 规定放电，计算放电容量（Ah）与初始容量的比值(%)。 A battery is charged in accordance with 3.1.2, stored in an ambient temperature of 25±5 ºC for 28 days, then discharged in accordance with 3.1.3. Calculate the ratio of discharge capacity (%). Charged in accordance with 3.1.2, rest 10 minutes, discharged in accordance with 3.1.2. Calculate the ratio of discharge capacity (%).	常温剩余容量≥85%*初始容量，恢复容量≥95%*初始容量 The residual capacity is not less than 85% of the initial capacity, and the recoverable capacity is not less than 95% of the initial capacity at room temperature
7	55℃荷电保持与容量恢复能力 Retention Capability and Capacity Recovery at 55 ºC	电池按 3.1.2 规定充电结束后，将电池在 55±2℃环境下储存 7 天，然后按 3.1.3 放电，计算放电容量（Ah）与初始容量的比值(%)。再按照 3.1.2 规定充电，搁置 10 分钟，按 3.1.3 放电，计算放电容量（Ah）与初始容量的比值(%)。 A battery is charged in accordance with 3.1.2, and stored in an ambient temperature of 55 ±2 ºC for 7 days, then discharged to standard discharge cut-off voltage at a constant current of 1 I_1(110A). Calculate the ratio of discharge capacity (%). Charged in accordance with 3.1.2, rest 10 minutes, a discharged in accordance with 3.1.2. Calculate the ratio of discharge capacity (%).	55℃剩余容量≥85%*初始容量，恢复容量≥95%*初始容量 The residual capacity is not less than 90% of the initial capacity, and the recoverable capacity is not less than 95% of the initial capacity at 55 ºC
备注：测试项目 6 和 7 可任选其一。 Remark: Either 6th or 7th test item could be chosen.			

4.3 单体电池 OCV-SOC 曲线图 Battery OCV-SOC Curve

4.3.1 充电 OCV-SOC 曲线图 Charge OCV-SOC Curve

测试条件：

①25℃恒温箱中搁置10min；

②1.0C 恒流充电至 2.9V；

③搁置10min；

④1.0C 恒流放电至 1.5V；

⑤搁置10min；

⑥重复②③④⑤步骤3次；

⑦以1.0C恒流充电3min，搁置30min，选取此时的终止电压为5%SOC对应的开路电压；

⑧重复步骤⑦，直至终止电压 2.9V。

Test Conditions:

①Rest 10minutes at 25℃；
②1.0C charge to 2.9V；
③Rest 10minutes；
④1.0C discharge to1.5V；
⑤Rest 10minutes；
⑥Repeat②③④⑤for 3 times；
⑦1.0C charge 3minutes, rest 30min, the OCV of 5%SOC: choose the cut-off voltage;
⑧Repeat ⑦ to 2.9V。

表 1　单体电池常温充电 OCV-SOC

温度 / SOC	25℃
0%	2.073
5%	2.115
10%	2.128
15%	2.14
20%	2.151
25%	2.161
30%	2.171
35%	2.181
40%	2.191
45%	2.203
50%	2.215
55%	2.231
60%	2.251
65%	2.276
70%	2.307
75%	2.344
80%	2.385
85%	2.43
90%	2.477
95%	2.528
100%	2.614

4.3.2 放电 OCV-SOC 曲线图 Discharge OCV-SOC Curve

测试条件：
①25℃恒温箱中搁置10min；
②1.0C 恒流放电至 1.5V；
③搁置10min；
④1.0C 恒流充电至 2.9V；
⑤搁置10min；
⑥重复②③④⑤步骤3次；
⑦以1.0C恒流放电3min，搁置30min，选取此时的终止电压为5%SOC对应的开路电压；
⑧重复步骤⑦，直至终止电压 1.5V。

Test Conditions:

①Rest 10minutes at 25℃；

②1.0C discharge to 1.5V；

③Rest 10minutes；

④1.0C charge to2.9V；

⑤Rest10minutes；

⑥Repeat②③④⑤for 3 times；

⑦1.0C charge 3minutes, rest 30min, the OCV of 5%SOC: choose the cut-off voltage;

⑧Repeat ⑦ to 1.5V.

表 2　单体电池常温放电 OCV-SOC

温度 / SOC	25℃
100%	2.732
95%	2.532
90%	2.478
85%	2.429
80%	2.384
75%	2.342
70%	2.304
65%	2.273
60%	2.247
55%	2.227
50%	2.212
45%	2.198
40%	2.187
35%	2.177
30%	2.167
25%	2.157
20%	2.146
15%	2.135
10%	2.123
5%	2.109
0%	2.085

4.4 单体电池充放电性能 Battery Charge-Discharge Curve

4.4.1 常温 1C 充放电性能 1C Charge-Discharge Performance at Room Temperature

测试条件：

①25℃恒温箱中搁置10min；

②1.0C 恒流充电至 2.9V；

③搁置10min；

④1.0C 恒流放电至 1.5V；

⑤搁置10min；

⑥重复②③④⑤步骤3次；

⑦取最后一步的充电容量和放电容量作为电池的初始充电容量和初始放电容量。

Test Conditions:

①Rest 10minutes at 25℃；

②1.0C charge to2.9V；

③Rest 10minutes；

④1.0C discharge to1.5V；

⑤Rest10minutes；

⑥Repeat②③④⑤for 3 times；

⑦Initial charge capacity : choose the final charge capacity from②to⑥；Initial discharge capacity : choose the final discharge capacity from②to⑥.

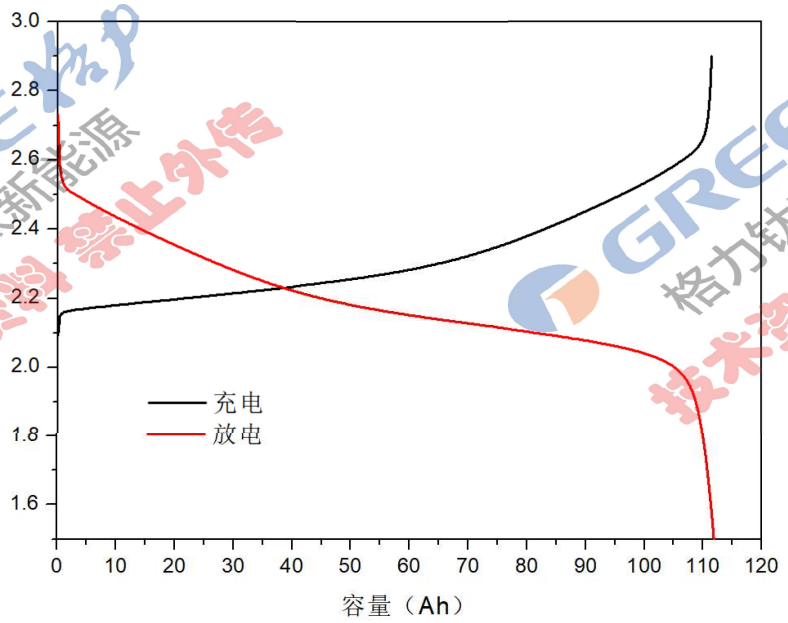


图 1　常温 1C 充放电性能曲线图

4.4.2 单体电池最大持续充电性能　Battery Maximum Continuous Charge Performance

表 3　单体电池最大持续充电电流限制表

SOC / 温度	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%	100%
T＞55℃	0	0	0	0	0	0	0	0	0	0	0	0
50℃＜T≤55℃	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.33C	0.1C	0
45℃＜T≤50℃	1C	1C	1C	1C	1C	1C	1C	1C	1C	0.5C	0.33C	0
40℃＜T≤45℃	2C	2C	2C	2C	2C	2C	2C	2C	2C	1.5C	1C	0
35℃＜T≤40℃	2.5C	2.5C	2.5C	2.5C	2.5C	2.5C	2.5C	2.5C	2.5C	2C	1C	0
25℃＜T≤35℃	3C	3C	3C	3C	3C	3C	3C	3C	3C	2C	1C	0
15℃＜T≤25℃	3C	3C	3C	3C	3C	3C	3C	3C	3C	2C	1C	0

5℃＜T≤15℃	3C	3C	3C	3C	3C	3C	3C	3C	3C	2C	1C	0
0℃＜T≤5℃	3C	3C	3C	3C	3C	3C	3C	3C	3C	2C	1C	0
-10℃＜T≤0℃	3C	3C	3C	3C	3C	3C	3C	3C	3C	1.5C	0.5C	0
-20℃＜T≤-10℃	2C	2C	2C	2C	2C	2C	2C	2C	2C	1C	0.5C	0
-30℃＜T≤-20℃	1C	1C	1C	1C	1C	1C	1C	1C	1C	0.5C	0.5C	0
-40℃＜T≤-30℃	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0

4.4.2 单体电池脉冲充电性能　Battery Pulse Charge Performance

表 4　单体电池脉冲 60s 充电电流限制表

SOC / 温度	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%	100%
T＞55℃	0	0	0	0	0	0	0	0	0	0	0	0
50℃＜T≤55℃	1C	1C	1C	1C	1C	1C	1C	1C	1C	1C	1C	0
45℃＜T≤50℃	2C	2C	2C	2C	2C	2C	2C	2C	2C	2C	2C	0
40℃＜T≤45℃	3C	3C	3C	3C	3C	3C	3C	3 C	3C	3C	2C	0
35℃＜T≤40℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	2C	0
25℃＜T≤35℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	2C	0
15℃＜T≤25℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	2C	0
5℃＜T≤15℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	2C	0
0℃＜T≤5℃	3C	3C	3C	3C	3C	3C	3C	3C	3C	3C	1C	0
-10℃＜T≤0℃	3C	3C	3C	3C	3C	3C	3C	3C	3C	2C	1C	0
-20℃＜T≤-10℃	2C	2C	2C	2C	2C	2C	2C	2C	2C	1C	0.5C	0
-30℃＜T≤-20℃	1C	1C	1C	1C	1C	1C	1C	1C	1C	1C	0	0
-40℃＜T≤-30℃	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0	0

表 5 单体电池脉冲 30s 充电电流限制表

SOC / 温度	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%	100%
T＞55℃	0	0	0	0	0	0	0	0	0	0	0	0
50℃＜T≤55℃	1.5C	1.5C	1.5C	1.5C	1.5C	1.5C	1.5C	1.5C	1.5C	1.5C	1C	0
45℃＜T≤50℃	2.5C	2.5C	2.5C	2.5C	2.5C	2.5C	2.5C	2.5C	2.5C	2.5C	1.5C	0
40℃＜T≤45℃	3 C	3 C	3 C	3 C	3 C	3 C	3 C	3 C	3 C	3 C	2C	0
35℃＜T≤40℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	3C	0
25℃＜T≤35℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	3C	0
15℃＜T≤25℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	3C	0
5℃＜T≤15℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	3C	0
0℃＜T≤5℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	3C	0
-10℃＜T≤0℃	3C	3C	3C	3C	3C	3C	3C	3C	3C	2C	1C	0
-20℃＜T≤-10℃	2C	2C	2C	2C	2C	2C	2C	2C	2C	1C	1C	0
-30℃＜T≤-20℃	1C	1C	1C	1C	1C	1C	1C	1C	1C	1C	0	0
-40℃＜T≤-30℃	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0	0

表 6 单体电池脉冲 10s 充电电流限制表

SOC / 温度	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%	100%
T＞55℃	0	0	0	0	0	0	0	0	0	0	0	0
50℃＜T≤55℃	2C	2C	2C	2C	2C	2C	2C	2C	2C	2C	2C	0
45℃＜T≤50℃	3C	3C	3 C	3C	3C	3C	3C	3C	3C	3C	3C	0
40℃＜T≤45℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	3C	0
35℃＜T≤40℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	3C	0
25℃＜T≤35℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	3C	0
15℃＜T≤25℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	3C	0
5℃＜T≤15℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	3C	0
0℃＜T≤5℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	3C	0
-10℃＜T≤0℃	3C	3C	3C	3C	3C	3C	3C	3C	3C	2C	1C	0
-20℃＜T≤-10℃	3C	3C	3C	3C	3C	3C	3C	3C	2C	1C	1C	0
-30℃＜T≤-20℃	1C	1C	1C	1C	1C	1C	1C	1C	1C	1C	0	0
-40℃＜T≤-30℃	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0	0

4.4.3 单体电池最大持续放电性能 Battery Maximum Continuous Discharge Performance

表 7 单体电池最大持续放电电流限制表

SOC / 温度	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%	5%	0%
T＞55℃	0	0	0	0	0	0	0	0	0	0	0	0
50℃＜T≤55℃	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.33C	0.33C	0
45℃＜T≤50℃	1C	1C	1C	1C	1C	1C	1C	1C	1C	0.5C	0.33C	0
40℃＜T≤45℃	2C	2C	2C	2C	2C	2C	2C	2C	1.5C	1.5C	1C	0
35℃＜T≤40℃	2.5C	2.5C	2.5C	2.5C	2.5C	2.5C	2.5C	2.5C	2.5C	2C	1C	0
25℃＜T≤35℃	3C	3C	3C	3C	3C	3C	3C	3C	3C	2C	1C	0
15℃＜T≤25℃	3C	3C	3C	3C	3C	3C	3C	3C	3C	2C	1C	0
5℃＜T≤15℃	3C	3C	3C	3C	3C	3C	3C	3C	3C	2C	1C	0
0℃＜T≤5℃	3C	3C	3C	3C	3C	3C	2.5C	2C	2C	2C	1C	0
-10℃＜T≤0℃	3C	3C	3C	3C	3C	3C	2.5C	2C	1C	0.5C	0.5C	0
-20℃＜T≤-10℃	2C	2C	2C	2C	2C	2C	2C	2C	1C	0.5C	0.5C	0
-30℃＜T≤-20℃	1C	1C	1C	1C	1C	1C	1C	1C	1C	0.5C	0.5C	0
-40℃＜T≤-30℃	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.33C	0.33C	0

4.4.4 单体电池脉冲放电性能 Battery Pulse Discharge Performance

表 8 单体电池脉冲 60s 放电电流限制表

SOC	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%	5%	0%

温度												
T＞55℃	0	0	0	0	0	0	0	0	0	0	0	0
50℃＜T≤55℃	1C	1C	1C	1C	1C	1C	1C	1C	1C	0.5C	0.5C	0
45℃＜T≤50℃	2C	2C	2C	2C	2C	2C	2C	2C	1C	1C	0.5C	0
40℃＜T≤45℃	3C	3C	3C	3C	3C	3C	3C	3C	2C	1.5C	1C	0
35℃＜T≤40℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	2C	2C	0
25℃＜T≤35℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	2C	2C	0
15℃＜T≤25℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	2C	1.5C	0
5℃＜T≤15℃	3.5C	3.5C	3.5C	3.5C	3.5C	3.5C	3.5C	3.5C	3C	2C	1C	0
0℃＜T≤5℃	3C	3C	3C	3C	3C	3C	3C	3C	2.5C	2C	1C	0
-10℃＜T≤0℃	3C	3C	3C	3C	3C	3C	3C	2C	1.5C	1C	1C	0
-20℃＜T≤-10℃	3C	3C	3C	3C	3C	3C	3C	2C	1.5C	1C	0.5C	0
-30℃＜T≤-20℃	1C	1C	1C	1C	1C	1C	1C	1C	1C	1C	0.5C	0
-40℃＜T≤-30℃	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.33C	0.33C	0

表 9 单体电池脉冲 30s 放电电流限制表

SOC / 温度	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%	5%	0%
T＞55℃	0	0	0	0	0	0	0	0	0	0	0	0
50℃＜T≤55℃	1.5C	1.5C	1.5C	1.5C	1.5C	1.5C	1.5C	1.5C	1.5C	0.5C	0.5C	0
45℃＜T≤50℃	2.5C	2.5C	2.5C	2.5C	2.5C	2.5C	2.5C	2.5C	2C	1C	0.5C	0
40℃＜T≤45℃	3C	3C	3C	3C	3C	3 C	3C	3C	2C	1.5C	1C	0
35℃＜T≤40℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	2C	2C	0
25℃＜T≤35℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	2C	2C	0
15℃＜T≤25℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	2C	1.5C	0
5℃＜T≤15℃	3.5C	3.5C	3.5C	3.5C	3.5C	3.5C	3.5C	3.5C	3C	2C	1C	0
0℃＜T≤5℃	3C	3C	3C	3C	3C	3C	3C	3C	2.5C	2C	1C	0
-10℃＜T≤0℃	3C	3C	3C	3C	3C	3C	3C	3C	1.5C	1C	1C	0
-20℃＜T≤-10℃	3C	3C	3C	3C	3C	3C	3C	2C	1.5C	1C	0.5C	0
-30℃＜T≤-20℃	1C	1C	1C	1C	1C	1C	1C	1C	1C	1C	0.5C	0
-40℃＜T≤-30℃	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.5C	0.33C	0.33C	0

表 10 单体电池脉冲 10s 放电电流限制表

SOC / 温度	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%	5%	0%
T＞55℃	0	0	0	0	0	0	0	0	0	0	0	0
50℃＜T≤55℃	2C	2C	2C	2C	2C	2C	2C	2C	2C	1C	0.5C	0
45℃＜T≤50℃	3C	3C	3C	3C	3C	3C	3C	3C	2C	1C	0.5C	0
40℃＜T≤45℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	2C	1.5C	0
35℃＜T≤40℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	2C	2C	0
25℃＜T≤35℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	2C	2C	0

15℃＜T≤25℃	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	4.5C	2C	1.5C	0
5℃＜T≤15℃	3.5C	3.5C	3.5C	3.5C	3.5C	3.5C	3.5C	3.5C	3C	2C	1C	0
0℃＜T≤5℃	3C	3C	3C	3C	3C	3C	3C	3C	2.5C	2C	1C	0
-10℃＜T≤0℃	3C	3C	3C	3C	3C	3C	3C	3C	1.5C	1C	1C	0
-20℃＜T≤-10℃	3C	3C	3C	3C	3C	3C	3C	2C	1.5C	1C	0.5C	0
-30℃＜T≤-20℃	2C	2C	2C	2C	2C	2C	1C	1C	1C	1C	0.5C	0
-40℃＜T≤-30℃	1C	1C	1C	1C	1C	1C	0.5C	0.5C	0.5C	0.33C	0.33C	0

5. 单体电池可靠性测试 Battery Reliability Test

序号 No.	项目 Items	测试方法及条件 Test Method and Conditions	标准 Criteria
1	过放电 Over Discharge	电池按 3.1.2 规定充电结束后，对电池以 1 I_1(110A)电流放电 90min，观察 1h。 A battery is charged in accordance with 3.1.2, then discharged at a constant current of 1 I_1(110A) for 90 minutes, observed for 1h.	不爆炸、不起火、不漏液 No explosion, No fire, No leakage
2	过充电 Over Charge	电池按 3.1.2 规定充电结束后，对电池以 1 I_1(110A)恒流充电，至电压达到 4.35V 或充电时间达到 1h，观察 1h。 A battery is charged in accordance with 3.1.2, then charged to 4.35V or charge time is over 1h at a constant current of 1 I_1(110A), observed for 1h.	不爆炸、不起火 No explosion, No fire
3	短路 Short Circuit	电池按 3.1.2 规定充电结束后，将电池正、负极经外部短路 10min，外部线路电阻应小于 5mΩ，观察 1h。 A battery is charged in accordance with 3.1.2, then short-circuited by connecting the positive and negative terminals for 10 min with a external line having a maximum resistance of 5mΩ, then observed for 1h.	不爆炸、不起火 No explosion, No fire
4	加热 Heating	电池按 3.1.2 规定充电结束后，在温度箱中按照 5℃/min 的速率由室温升至 130±2℃，并保持 30min 后停止加热，观察 1h。 A battery is charged in accordance with 3.1.2, stored in a temperature box for 30min at the temperature of 130±2 ºC with a heating rate of 5 ºC /min，stopped heating , then observed for 1h.	不爆炸、不起火 No explosion, No fire

<table>
<tr><td>5</td><td>挤压
Crush</td><td>电池按 3.1.2 规定充电结束后，挤压板（半径 75mm、长度大于被挤压电池的尺寸的半圆柱体）以（5±1）mm/s 的速度垂直于电池极板方向施压，直至电池电压变为 0V 或变形量达到 30%或挤压力达到 200kN 后停止挤压，观察 1h。
A battery is charged in accordance with 3.1.2, crushed by a plate (a half cylinder with the radius of 75mm and length is longer than the battery's) in the vertical direction at a rate of (5±1) mm/s until the voltage drops to 0V or the battery's deformation rate increases to 30% or the pressure increases to 200kN, and then observed for 1h.</td><td>不爆炸、不起火
No explosion,
No fire</td></tr>
<tr><td>6</td><td>针刺
Puncture Test</td><td>电池按 3.1.2 规定充电结束后，用 1 个直径 5mm~8mm 的钢针以（25±5）mm/s 的速度从垂直于电池极板的方向贯穿电池(靠近所刺面的几何中心)，并把钢针停留在电池内，观察 1h。
A battery is charged in accordance with 3.1.2, punctured through (near the geometric center of the surface) by a nail which diameter of 3mm at a rate of 25±5 mm/s, the nail stay within the battery, and then observed for 1h.</td><td>不爆炸、不起火
No explosion,
No fire</td></tr>
<tr><td>7</td><td>海水浸泡
Seawater Immersion</td><td>电池按 3.1.2 规定充电结束后，将电池完全浸没入 3.5%NaCl 溶液中 2h。
A battery is charged in accordance with 3.1.2, completely soaked into the 3.5% NaCl solution for 2h.</td><td>不爆炸、不起火
No explosion,
No fire</td></tr>
<tr><td>8</td><td>低气压
Low Pressure</td><td>电池按 3.1.2 规定充电结束后，在室温下将电池放入气压为 11.6kPa 的低气压箱中，静置 6h 后，观察 1h。
A battery is charged in accordance with 3.1.2, stored in a case with the low pressure of 11.6kPa at room temperature for 6 hours, then observed for 1h.</td><td>不爆炸、不起火、不漏液
No explosion,
No fire, No leakage</td></tr>
<tr><td>9</td><td>温度循环
Temperature Cycling</td><td>电池按 3.1.2 规定充电结束后，放入温度箱中，温度按照下表进行调节，循环 5 次后，观察 1h。
A battery is charged in accordance with 3.1.2, stored in a temperature box, regulating temperature as the following table, observed for 1 h after cycling 5 times.
<table>
<tr><td>温度(℃)
Temperature</td><td>时间增量
(min)
Incremental Time</td><td>累计时间
(min)
Total Time</td><td>温度变化率
(℃/min)
Temperature Rate</td></tr>
</table></td><td>不爆炸、不起火、不漏液
No explosion,
No fire, No leakage</td></tr>
</table>

		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	

6. 电池使用时危险、警告及注意事项 Danger Warning and Caution in Handling the Battery

6.1 推荐事项 Recommending Usage

6.1.1 使用电池前，请仔细阅读使用说明书和电池表面标识。

Please read the battery instructions and the label on its surface before use.

6.1.2 在使用过程中，应远离热源、高压，避免儿童玩弄电池，切勿摔打电池。

When in use, the battery shall be kept out of heat, high voltage and avoided children's touching. Do not drop the battery.

6.1.3 应使用制造商认可的充电器和充电程序，不恰当的充电方式会导致电池发热或损坏。

Use only approved chargers and procedures, improperly charging a battery may cause to flame or damage.

6.1.4 切勿将电池正负极短路，切勿自己拆装电池，也勿让电池放在受潮处，以免发生危险。

Do not touch contacts together. Do not demolish or assemble the battery by yourself. Do not put the battery in the damp place.

6.1.5 长期不用时，请将电池储存完好，应让电池保持半荷电状态。请用不导电材料包裹电池，以避免金属直接接触电池，造成电池损坏，将电池保存在阴凉干燥处。

When the battery was stored for a long period, put it well in its half capacity. Do not wrap it with conduct material to avoid the damage caused by the direct contact between the metal and battery. Keep the battery in day places.

6.1.6 废弃电池请安全妥当处理，不要投入火中或水中。

Safely disposed the disused battery. Do not put it into fire or water.

6.2 危险警告 Hazard Warning

6.2.1 禁止拆解电池 Forbid Disassemble Batteries

自行拆解会造成电池发热、冒烟、变形或燃烧。

Disassemble the battery will cause the battery heat, smoke, deformation or burn.

6.2.2 禁止让电池短路 Forbid Short-circuit Batteries

不要将电池的正负极用金属连接，也不要将电池与金属片放在一起存储和移动。如果电池被短路，将会

有超大电流流过，将会损坏电池，造成电池发热、冒烟、变形或燃烧。

Do not connect the battery's positive and negative with metal. Do not put the battery with metal together either storage or movement. If the battery is short circuit, there will be a large current flows through the battery, will cause the battery heat, smoke, deformation or burn and damage the battery.

6.2.3 严禁加热和焚烧电池 Forbid Heat and Burn the Battery

加热和焚烧电池将会造成电池隔离物的熔化、安全功能丧失或电解质燃烧，过热就会使电池发热、冒烟、变形或燃烧。

If heating or burning the battery, it will caused the isolated element in the battery dissolved, protection function stopped or the electrode burning, over heated, which will make the battery heat, smoke, distort or burning.

6.2.4 避免在热源附近使用电池 To Avoid Using the Battery near the Heat

不要在火源、烤炉附近或超过 80℃的环境中使用电池，过热将会导致电池内部短路，使电池发热、冒烟、变形或燃烧。

Do not use the battery near the fire, stove, or the environment temperature over 80 ºC, and overheating will cause the battery internal short-circuit and make it heat, smoke, distort or burning.

6.2.5 禁止弄湿电池 Forbid Bathing the Battery

不要弄湿电池，更不能将电池投入水中，否则会造成电池内部保护电路和功能丧失及发生不正常的化学反应，电池有可能发热、冒烟、变形或燃烧。

Do not dampen the battery, or even immerse it in the water, which will cause internal protection circuit and its function lost or abnormal chemical reactions, which will lead to heating, smoking, distortion or burning.

6.2.6 使用非专用充电器给电池充电，会发生危险 Danger in Using Non-indicated Chargers to Charge the Battery

不要使用高于本规格书规定的最大电流或电压充电。严禁反充电池（正负极接反）。在非正常的条件下充电会造成电池内部保护电路功能丧失和发生不正常的化学反应，电池有可能发热、冒烟、变形或燃烧。

Do not charge the battery with a current or voltage higher than the specified maximum value in this specification. Prohibit reverse charging of the battery. Charging in abnormal condition, will cause internal protection circuit and its function lost or abnormal chemical reactions, which will lead to heating, smoking, distortion or burning.

6.2.7 禁止破坏电池 Forbid Damage Battery

禁止用金属凿入电池、锤打或摔打电池或其他方法破坏电池，否则会造成电池发热、冒烟、变形或燃烧，甚至会发生危险。

Do not allow damage the battery with the metals gouged, forged or dropped etc.，otherwise, it will cause overheating, distort, smoke or burning, even in danger.

6.2.8 禁止在电池主体上直接焊接 Forbid directly welding on the Battery

过热将会造成电池隔离物的熔化、安全保护功能丧失，使电池发热、冒烟、变形或燃烧。

Over-heated will cause the isolated element dissolved in the battery and losing protective function, even will cause overheating, distort, smoke or burning.

6.2.9 不要直接触及漏液电池 Do not Touch the Leak-out Battery

渗漏的电解液会造成皮肤不适，万一电解液进入眼睛，尽快用清水冲洗，不可揉眼，并迅速送医院处理。

The leak-out electrolyte will cause the skin uncomfortable. If it drops into eyes, do not rob the eyes but wash in time, and go to hospital for treatment immediately.

6.2.10 不要混用电池　Do not Mixed-using Batteries

避免将新的和旧的或不同型号、不同规格、不同化学成分的电池配对使用。

Avoid of old and new or different types, different specifications and different chemical composition of the batteries matching use.

6.2.11 其它注意事项 Other Warnings

不要将电池放入微波炉、洗衣机或者烘干机里；不要使用已经损坏的电池。

Do not put the battery into microwave, washing machine or drying machine. Do not use a damaged battery.

6.2.12 其它 Others

如不按以上规定操作导致发生意外，本公司不承担相应责任。

YLE shall make no liability for problems that occur when the above specifications are not followed.

7. 保质期及产品责任 Period of Warranty and Product Liability

电池的保质期：从出厂日期（打码）开始起 180 天。如果有证据表明电池的缺陷是在制造过程中形成的，而不是由于用户滥用及错误使用造成的，本公司负责退换电池，否则本公司不承诺免费更换。

Warranty period of this product is 180 days from manufacturing code. We guarantee to give a replacement in case of batteries with defects proven due to the manufacturing process instead of abuse and misuse by the customers, otherwise, YLE are not promised free replacement.

8. 贮存 Storage

电池应贮存在温度为-20℃~45℃，相对湿度≤90%的清洁、干燥、通风的环境中，应避免与腐蚀性物质接触，远离火源及热源。并且应使电池处于 50%~60%的荷电状态。如长时间贮存，建议每半年充电一次以防止电池过放电。

The battery shall be stored in the clean and dry ventilation room at the temperature of -20℃~45℃ and shall be kept out of fire or heat and avoid touching corrosion elements. The battery should be stored with 50%~60% charged condition. We recommend that batteries should be charged about once per half a year to prevent over-discharge.

9. 运输注意事项 Shipment Requirement

电池应在荷电 50%~60%状态下包装成箱进行运输，在运输过程中应防止剧烈振动、冲击或挤压，防止日晒雨淋，应适用汽车、火车、轮船、飞机等普通运输工具。

The battery should be packed in cartons under the condition of 50%~60% charged for shipment. The violent vibration, impaction or squeezing should be avoided in the transport process; Avoid to be exposed to the sun and rain. The batteries shall be shipped by normal transportation such as by road, by train, by ocean or by air.

10. 其它化学反应 Other Chemical Reactions

电池利用的是化学反应的原理，即使存放很长一段时间不使用，电池的性能也会随时间的增加而降低。如果使用条件如充电、放电及周围环境温度等情形不在指定的使用范围内，会缩短电池的使用寿命，或者会产生漏液导致设备损坏。如果电池长时间不能充电，即使充电方法正确，也需要更换电池了。

Because batteries utilize chemical reaction, battery performance will deteriorate over time even if stored for a long period of time without being used. In addition, if the various usage conditions such as charge, discharge, ambient temperature, etc. are not maintained within the specified ranges the life expectancy of the battery may be shortened or the device in which the battery used may be damaged by electrolyte leakage. If the batteries cannot maintain a charge for long periods of time, even they are charged correctly, this may indicate it is time to change the battery.

11. 免责声明

如果样品需求单位不按本说明书中的规定进行使用，如果电芯出现任何问题，所有责任由样品需求单位承担，格力钛新能源股份有限公司将不承担任何责任。

如果由于样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，并对格力钛新能源股份有限公司的声誉造成影响的，格力钛新能源股份有限公司将会追究样品需求单位的责任。根据对格力钛新能源股份有限公司造成的影响程度，样品需求单位需向格力钛新能源股份有限公司提供赔偿。

If the users do not use it in accordance with the regulations in this manual, which causes any problems with the batteries, all responsibilities shall be borne by the users, and GREE Altairnano New Energy Inc. will not bear any responsibility.

If the users does not use it in accordance with the requirements in this manual, which causes social impact and affects the reputation of GREE Altairnano New Energy Inc., GREE Altairnano New Energy Inc. will pursue the responsibility of the sample requesting department/company according to the level of influence on GREE Altairnano New Energy Inc., the users shall provide compensation to GREE Altairnano New Energy Inc.

12. 电池结构示意图 Scheme of the Battery Structure

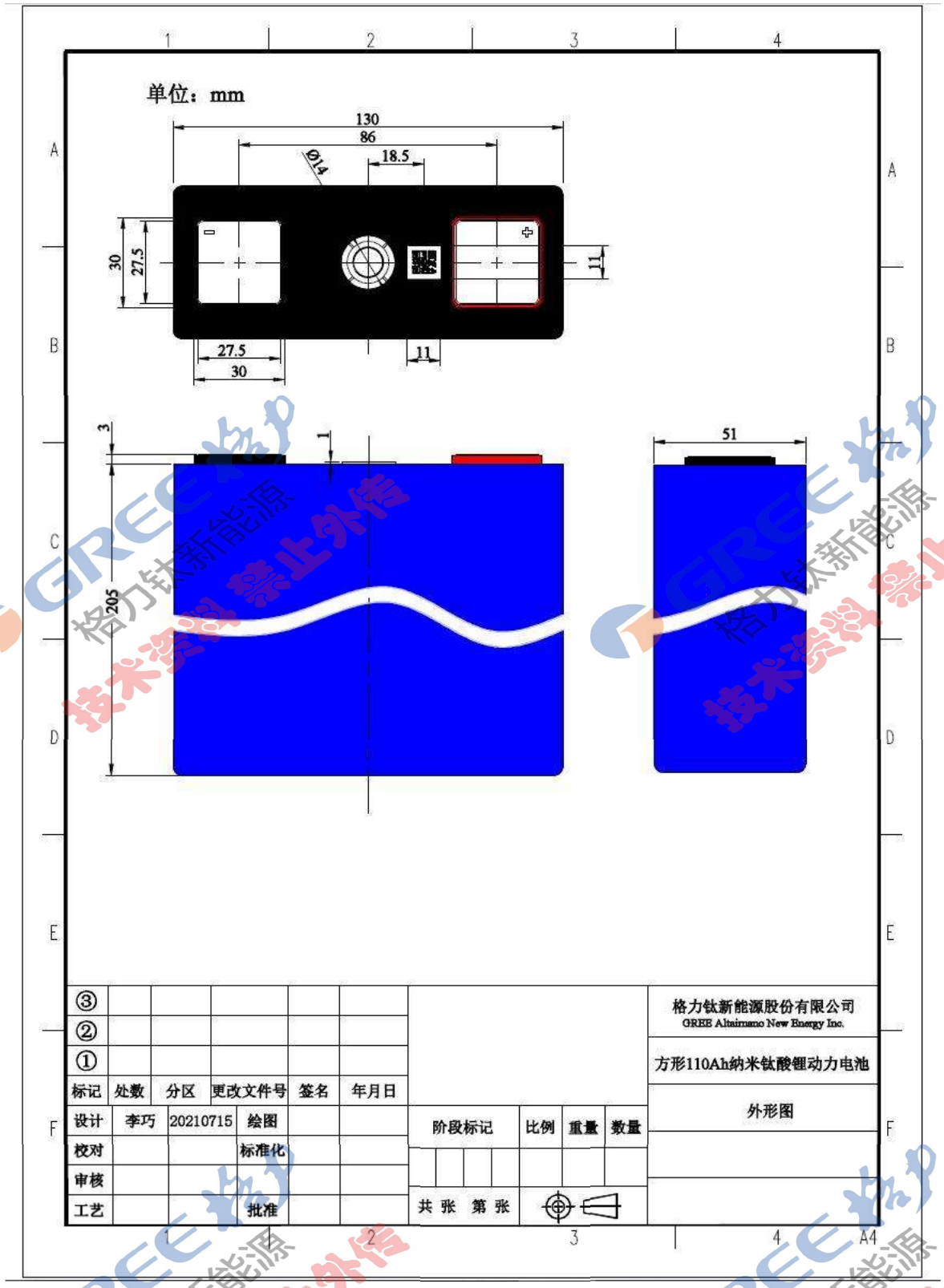
详见附图一、附图二

13. 备注 Remark

本说明书未包括事项应由双方协议确定。

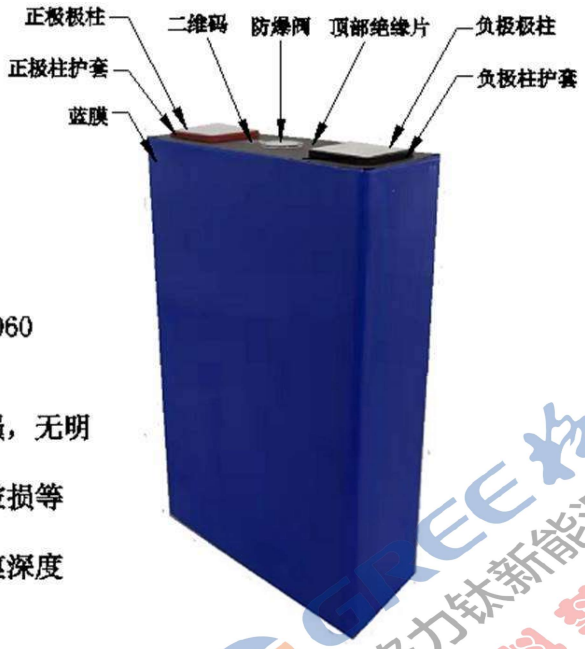
Any other items which are not covered in this specification shall be agreed by both sides.

附图一



编制：高娇阳 审核：马美品 标准化：王文华 批准：李海军
日期:2022/05/05 日期:2022/05/05 日期:2022/05/05 日期:2022/05/06

附图二



技术要求：

1. 壳体和极柱材质：

壳体：Al 3003 0态；极柱：Al 1060 H18；

2. 外观要求：

（1）防爆阀金属箔清洁，无破损，无明显划痕，无明显变形；

（2）电芯表面清洁，无油污、破损等不良；

（3）极柱表面清洁无异物，划痕深度不超过0.20mm；

3、功能：

（1）防爆阀爆破气压1.2±0.05MPa；

（2）极柱护套绝缘阻抗不小于1Gohm@500V，击穿电压不小于1500V@DC；

（3）表面蓝膜防火等级在UL94-HB以上；

（4）壳体承受压力小于5KN；

（5）电芯重量3000±50g；

（6）电芯满足ROHS要求。

③									格力钛新能源股份有限公司 GREE Altainnano New Energy Inc.
②									
①									方形110Ah纳米钛酸锂动力电池
标记	处数	分区	更改文件号	签名	年月日				电芯图
设计	李巧	20210630	绘图			阶段标记	比例	重量	数量
校对			标准化						
审核									
工艺			批准			共 张	第 张		

编制：高娇阳 日期:2022/05/05　审核：马美品 日期:2022/05/05　标准化：王文华 日期:2022/05/05　批准：李海军 日期:2022/05/06