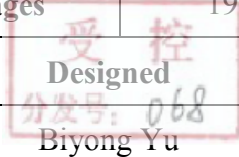


锂离子电芯规格书

Specification For Lithium-ion Rechargeable Cell

电芯型号： N18650CL-29

Cell Type： N18650CL-29

| | | | |
|--------------------|-------------------------------|---|----------|
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| Approved | Checked |  | |
| Huajie Song | Xinke Sun | | |

■ Revision history 修订履历

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| A/01 | Add contact information 增加联系方式 | P14 | Biyong Yu | 2020-4-22 |
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| A/03 | The maximum charge and discharge current in the characteristics of the cell are noted respectively at 2750mA and 8250mA. 电芯特性中的最大充电电流, 最大放电电流分别备注电流值2750mA, 8250 mA | P2 | Nannan Zhao | 2021-6-28 |
| B/00 | Add the related terms required by GB31241-2022 增加 GB31241-2022 要求的相关术语 | All 全部 | Biyong Yu | 2023-8-2 |
| | | | | |

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1 Preface 前言

This specification describes the type, dimension, performance, technical characteristics, warnings and cautions of the cylindrical lithium-ion rechargeable cell. The specification only applies to N18650CL-29 cell supplied by Zhengzhou BAK Battery Co., Ltd.

本标准描述了圆柱型锂离子电芯的外型、尺寸、特性、技术要求及注意事项。本标准适用于郑州比克电池有限公司生产的圆柱型 N18650CL-29 锂离子电芯。

2 Definition 定义

2.1 Standard charge method 标准充电方式

At $25 \pm 2^\circ\text{C}$, the cell is charged to 4.20 V at constant current of 0.5 C (1400 mA), then charged at constant voltage of 4.20V until the current is $\leq 0.01\text{C}$ (28 mA) followed by resting for 5min.

在 $25 \pm 2^\circ\text{C}$ 下,电芯以 0.5C (1400mA) 恒流充电至 4.20V 后,以 4.20V 恒压充电至电流小于等于 0.01C (28 mA), 静置 5min。

2.2 Standard discharge method 标准放电方式

Under $25 \pm 2^\circ\text{C}$, the cell is discharged to 2.50V at a constant current of 0.2C (560 mA).

指在 $25 \pm 2^\circ\text{C}$ 环境下,电芯以 0.2C (560 mA) 恒流放电至 2.50V。

2.3 Rated capacity 额定容量

Rated capacity refers to the minimum capacity of the cell, using mAh as unit. Specifically, it refers to the minimum value of the capacity, which is obtained by discharging a cell via standard discharge method after standard charge.

额定容量指的是电芯的最小容量,单位为毫安时 (mAh)。具体地说,是指电芯按标准充电方式充电后,按标准放电方式放电得到的容量最小值。

2.4 Typical capacity 典型容量

Typical capacity is the typical value of the cell's capacity, which is obtained by discharging a cell via standard discharge method after standard charge, using mAh as unit.

典型容量指的是电芯容量的典型值,指电芯按标准充电方式充电后,按标准放电方式放电得到的容量典型值,单位为毫安时 (mAh)。

2.5 Nominal voltage 标称电压

Nominal voltage of the cell, refers to the platform value of the discharge voltage via standard discharge method after standard charge. The unit is volt (V).

电芯标称电压,指的是按标准充电方式充电后,按标准放电方式放电电压的平台值,单位为伏特 (V)。

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2.6 Rated energy 额定能量

Rated energy of the cell is calculated by multiplying the nominal voltage by the rated capacity. The unit is watt hour (Wh).

电芯额定能量通过标称电压乘以额定容量计算得出，单位为瓦时（Wh）。

2.7 Typical energy 典型能量

Typical energy of the cell is calculated by multiplying the nominal voltage by the typical capacity. The unit is watt hour (Wh).

电芯典型能量通过标称电压乘以典型容量计算得出，单位为瓦时（Wh）。

2.8 Limited charging voltage 充电限制电压

Limited charging voltage of the cell, refers to the rated maximum charging voltage of the cell, expressed in U_{cl} .

电芯充电限制电压，指的是电芯的额定最大充电电压，以 U_{cl} 表示。

2.9 End of discharge voltage 放电终止电压

End of discharge voltage of the cell, refers to the voltage at the end of the standard discharge of the cell, expressed in U_{de} .

电芯放电终止电压，指的是电芯标准放电结束时的电压，以 U_{de} 表示。

2.10 Upper limited charging voltage 充电上限电压

Upper limited charging voltage of the cell, refers to the highest safe charging voltage that the cell can withstand, expressed in U_{up} .

电芯的充电上限电压，指的是电芯能承受的最高安全充电电压，以 U_{up} 表示。

2.11 Discharge cut-off voltage 放电截止电压

Discharge cut-off voltage of the cell, refers to the minimum safe discharge loaded voltage that the cell can withstand, expressed in U_{do} .

电芯的放电截止电压，指的是电芯能承受的安全放电最低负载电压，以 U_{do} 表示。

2.12 Allowable maximum surface temperature 可允许的最高表面温度

Allowable maximum surface temperature of the cell, refers to the allowable maximum surface temperature of the cell under normal working conditions, expressed in T_{max} .

电芯可允许最高表面温度，指的是电芯在正常的工作条件下电芯表面可允许的最高温度，以 T_{max} 表示。

3 Cell model and dimensions 电芯型号及尺寸

3.1 Description and model 电芯说明及型号

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Description: Cylindrical lithium-ion rechargeable cell

说明：圆柱型锂离子二次电芯

Model: N18650CL-29

型号： N18650CL-29

3.2 Cell dimensions 电芯尺寸

Cell physical dimensions are showed in Figure 1 (unit: mm), with tube.

电芯尺寸示意图如图 1 所示（单位：mm），带热缩膜。

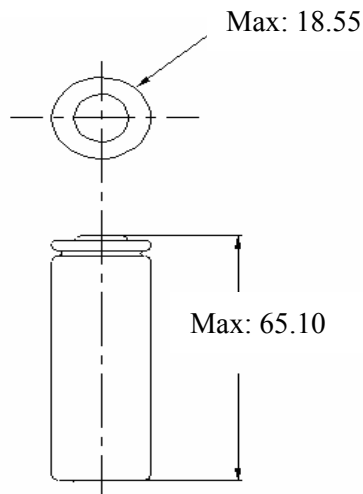


Figure 1/ 图 1

4 Cell characteristics 电芯特性

Unless otherwise specified, the cell should be fresh cell and tested by standard charge and standard discharge.

除非有特殊说明，否则所有样品均为新鲜电芯，且按标准充电和标准放电方式进行测试。

| ITEM 项目 | | SPECIFICATION 规格 |
|-------------------------|--------------------------|---|
| Capacity 容量 | Rated capacity 额定容量 | 2800mAh by standard charge and discharge 以标准充放电制式进行充放电，额定容量为 2800mAh |
| | Typical capacity 典型容量 | 2900mAh by standard charge and discharge 以标准充放电制式进行充放电，典型容量为 2900mAh |
| Nominal voltage 标称电压 | | 3.6V |
| Energy 能量 | Rated Energy 额定能量 | 10.08Wh |
| | Typical Energy 典型能量 | 10.44Wh |

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| | | | |
|---|---|--|--|
| Limited charging voltage (U_{cl}) 充电限制电压(U_{cl}) | | 4.20V | |
| End of discharge voltage(U_{de}) 放电终止电压(U_{de}) | | 2.50V | |
| Upper limited charging voltage(U_{up}) 充电上限电压(U_{up}) | | 4.25V ⁽¹⁾ | |
| Discharge cut-off voltage(U_{do}) 放电截止电压(U_{do}) | | 2.00V ⁽²⁾ | |
| Standard charging current(I_{cr}) 标准充电电流(I_{cr}) | | 0.5C (1400mA) | |
| Standard discharging current(I_{dr}) 标准放电电流(I_{dr}) | | 0.2C (560mA) | |
| Maximum charging current(I_{cm}) 最大充电电流(I_{cm}) | | 1C (2800mA, 25°C, not for cycle life 不支持循环) | |
| Maximum discharging current(I_{dm}) 最大放电电流(I_{dm}) | | 3C (8400mA, 25°C, not for cycle life 不支持循环) | |
| Using temperature range ⁽³⁾ 使用温度 范围 ⁽³⁾ | Upper limited charging temperature(T_{cm}) 上限充电温度(T_{cm}) | | 45 °C |
| | Lower limited charging temperature(T_{cl}) 下限充电温度(T_{cl}) | | 0 °C |
| | Upper limited discharging temperature(T_{dm}) 上限放电温度(T_{dm}) | | 60°C |
| | Lower limited discharging temperature(T_{dl}) 下限放电温度(T_{dl}) | | -20°C |
| | Allowable maximum surface temperature (T_{max}) 可允许的最高表面温度 (T_{max}) | Charge 充电 | 55°C ⁽⁴⁾ (Recommended recharge release $\leq 45^\circ\text{C}$ 再次重新充电电芯表面温度要求 $\leq 45^\circ\text{C}$) ⁽⁵⁾ |
| Discharge 放电 | | 70°C ⁽⁶⁾ (Recommended re-discharge release $\leq 60^\circ\text{C}$ 再次重新放电电芯表面温度要求 $\leq 60^\circ\text{C}$) ⁽⁷⁾ | |
| Storage temperature 存储温度 | | 1 year: -20~25°C (1年: -20~25°C) 3 months: -20~45°C (3个月: -20~45°C) 1 month: -20~60°C (1个月: -20~60°C) | |
| Humidity range 湿度范围 | | 0 ~ 60% RH (non-condensing) 0 ~ 60% RH (不冷凝) | |
| Internal resistance 内阻 | | $\leq 30\text{ m}\Omega$ (AC Impedance, 1000 Hz) 交流阻抗测量频率为 1000 Hz, 交流内阻 $\leq 30\text{ m}\Omega$ | |
| Weight 重量 | | $\leq 48\text{g}$ | |

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Note(1): Cell's upper limited charging voltage shall not exceed 4.25V to prevent any safety events. And cell performances have negative effect between 4.20V and 4.25V. 备注(1):电芯的充电上限电压值不得超过 4.25V, 以防发生任何安全事件。同时, 电芯性能在 4.20V 到 4.25V 之间会有负面影响。

Note(2): Cell's discharge cut-off voltage shall not drop below 2.00V to prevent any safety events. And cell performances have negative effect between 2.50V and 2.00V. 备注(2):电芯放电截止电压值不得低于 2.00V, 以防发生任何安全事件。同时, 电芯性能在 2.50V 和 2.00V 之间会有负面影响。

Note(3): Charge-discharge current and voltage profile at different temperature range shall be defined by BAK. 备注(3):不同温度范围下充放电电流和电压策略请联系比克获取。

Note(4): Cell's maximum surface temperature during charging shall not exceed 55°C, cell performance and safety can't be guaranteed above 55°C. 备注(4):充电过程中电芯最高表面温度不允许超过 55°C 使用, 高于 55°C 电芯性能和安全无法得到保证。

Note(5): Charge shall not be allowed after reaching the temperature limits until cell has cooled down to less than or equal to 45°C. 备注(5):达到温度限制后, 电芯表面温度需冷却到 $\leq 45^{\circ}\text{C}$ 以下, 才允许再次充电。

Note(6): Cell's maximum surface temperature during discharging shall not exceed 70°C, cell performance and safety can't be guaranteed above 70°C. 备注(6):放电过程中电芯最高表面温度不允许超过 70°C 使用, 高于 70°C 电芯性能和安全无法得到保证。

Note(7): Discharge shall not be allowed after reaching the temperature limits until cell has cooled down to less than or equal to 60°C. 备注(7):达到温度限制后, 电芯表面温度需冷却到 $\leq 60^{\circ}\text{C}$ 以下, 才允许再次放电。

5 Technical requirements 技术要求

5.1 Cell testing conditions 电芯试验环境

Unless otherwise specified, all tests stated should be done at $25 \pm 2^{\circ}\text{C}$.

除非有特殊说明, 所有测试须在 $25 \pm 2^{\circ}\text{C}$ 下进行。

5.2 Requirement of the testing equipment 测量仪表要求

The voltage measurement device: not less than 0.5 grade

电压测量装置: 不低于 0.5 级

The current measurement device: not less than 0.5 grade

电流测量装置: 不低于 0.5 级

AC Impedance: 1000 Hz

交流阻抗测量频率: 1000 Hz

Temperature meter: precision $\leq 0.5^{\circ}\text{C}$

温度仪表要求: 测量温度的仪表精度不高于 0.5°C

The time measurement device: $\pm 0.1\%$

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时间测量装置: $\pm 0.1\%$

The size measurement device: $\pm 0.1\%$

尺寸测量装置: $\pm 0.1\%$

The quality measurement device: $\pm 0.1\%$

质量测量装置: $\pm 0.1\%$

5.3 Electrochemical characteristics 电化学特性

Unless otherwise specified, the temperature should be $25 \pm 2^\circ\text{C}$, the cell should be fresh cell, and tested by standard charge and discharge.

除非有特殊说明, 否则所有测试要求为: 温度在 $25 \pm 2^\circ\text{C}$ 条件下, 样品为新鲜电芯, 充放电制度为标准充电和标准放电。

| No. 序号 | Item 测试项目 | Test method and conditions 测试方法与条件 | Criterion 性能标准 | | | | | | | | | | | | |
|---------------|---------------------------------------|--|--|---------------|----------------------------|------|------|------|-------------|----|-------------|----|-------------|----|-------------|
| 5.3.1 | Rate discharge performance 倍率放电性能 | (1) Charge: 0.5C constant current charge to 4.20V followed by 4.20V constant voltage charge to cut-off current $\leq 0.01\text{C}$; (2) Discharge: 0.2C, 0.5C, 1C, 2C, 3C constant current discharge to voltage $\leq 2.50\text{V}$. (1) 充电: 以 0.5C 恒流充电至 4.20V 后, 以 4.20V 恒压充电至电流 $\leq 0.01\text{C}$; (2) 放电: 以 0.2C, 0.5C, 1C, 2C, 3C 恒流放电至电压 $\leq 2.50\text{V}$ 。 | <table border="1"> <thead> <tr> <th>Current 电流</th> <th>Relative Capacity 相对容量比</th> </tr> </thead> <tbody> <tr> <td>0.2C</td> <td>100%</td> </tr> <tr> <td>0.5C</td> <td>$\geq 95\%$</td> </tr> <tr> <td>1C</td> <td>$\geq 90\%$</td> </tr> <tr> <td>2C</td> <td>$\geq 90\%$</td> </tr> <tr> <td>3C</td> <td>$\geq 85\%$</td> </tr> </tbody> </table> | Current 电流 | Relative Capacity 相对容量比 | 0.2C | 100% | 0.5C | $\geq 95\%$ | 1C | $\geq 90\%$ | 2C | $\geq 90\%$ | 3C | $\geq 85\%$ |
| Current 电流 | Relative Capacity 相对容量比 | | | | | | | | | | | | | | |
| 0.2C | 100% | | | | | | | | | | | | | | |
| 0.5C | $\geq 95\%$ | | | | | | | | | | | | | | |
| 1C | $\geq 90\%$ | | | | | | | | | | | | | | |
| 2C | $\geq 90\%$ | | | | | | | | | | | | | | |
| 3C | $\geq 85\%$ | | | | | | | | | | | | | | |
| 5.3.2 | Room temperature cycle life 常温循环寿命 | (1) Charge: 0.5C constant current charge to 4.20V followed by 4.20V constant voltage charge to cut-off current $\leq 0.01\text{C}$; (2) Discharge: 1C constant current discharge to voltage $\leq 2.75\text{V}$. (1) 充电: 以 0.5C 恒流充电至 4.20V 后, 以 4.20V 恒压充电至电流 $\leq 0.01\text{C}$; (2) 放电: 以 1C 恒流放电至电压 $\leq 2.75\text{V}$ 。 | $\frac{\text{Discharge capacity of 801th cycle}}{\text{Original discharge capacity}} \geq 80\%$ $\frac{\text{第801次循环的放电容量}}{\text{初始放电容量}} \geq 80\%$ | | | | | | | | | | | | |

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| 5.3.3 | High-low temperature discharge performance 高低温放电性能 | <p>(1) Charge: 0.5C constant current charge to 4.20V followed by 4.20V constant voltage charge to cut-off current $\leq 0.01C$ at $25\pm 2^\circ C$;</p> <p>(2) Discharge: 0.2C constant current discharge to voltage $\leq 2.50V$ at $25^\circ C$, $60^\circ C$, $45^\circ C$, $10^\circ C$, $0^\circ C$, $-10^\circ C$, $-20^\circ C$.</p> <p>(1) 充电: $25\pm 2^\circ C$ 下, 以 0.5C 恒流充电至 4.20V 后, 以 4.20V 恒压充电至电流 $\leq 0.01C$;</p> <p>(2) 放电: 在 $25^\circ C$, $60^\circ C$, $45^\circ C$, $10^\circ C$, $0^\circ C$, $-10^\circ C$, $-20^\circ C$ 下以 0.2C 恒流放电至电压 $\leq 2.50V$。</p> | <table border="1"> <thead> <tr> <th>Temperature 温度</th> <th>Relative Capacity 相对容量比</th> </tr> </thead> <tbody> <tr> <td>$25^\circ C$</td> <td>100%</td> </tr> <tr> <td>$60^\circ C$</td> <td>$\geq 100\%$</td> </tr> <tr> <td>$45^\circ C$</td> <td>$\geq 100\%$</td> </tr> <tr> <td>$10^\circ C$</td> <td>$\geq 90\%$</td> </tr> <tr> <td>$0^\circ C$</td> <td>$\geq 85\%$</td> </tr> <tr> <td>$-10^\circ C$</td> <td>$\geq 80\%$</td> </tr> <tr> <td>$-20^\circ C$</td> <td>$\geq 70\%$</td> </tr> </tbody> </table> | Temperature 温度 | Relative Capacity 相对容量比 | $25^\circ C$ | 100% | $60^\circ C$ | $\geq 100\%$ | $45^\circ C$ | $\geq 100\%$ | $10^\circ C$ | $\geq 90\%$ | $0^\circ C$ | $\geq 85\%$ | $-10^\circ C$ | $\geq 80\%$ | $-20^\circ C$ | $\geq 70\%$ |
|---------------------------|--|--|--|-------------------|----------------------------|---------------------------|-------------|---------------------------|--------------|--------------------------|--------------|--------------|-------------|-------------|-------------|---------------|-------------|---------------|-------------|
| Temperature 温度 | Relative Capacity 相对容量比 | | | | | | | | | | | | | | | | | | |
| $25^\circ C$ | 100% | | | | | | | | | | | | | | | | | | |
| $60^\circ C$ | $\geq 100\%$ | | | | | | | | | | | | | | | | | | |
| $45^\circ C$ | $\geq 100\%$ | | | | | | | | | | | | | | | | | | |
| $10^\circ C$ | $\geq 90\%$ | | | | | | | | | | | | | | | | | | |
| $0^\circ C$ | $\geq 85\%$ | | | | | | | | | | | | | | | | | | |
| $-10^\circ C$ | $\geq 80\%$ | | | | | | | | | | | | | | | | | | |
| $-20^\circ C$ | $\geq 70\%$ | | | | | | | | | | | | | | | | | | |
| 5.3.4 | Storage performance at $25^\circ C$ (100% SOC) $25^\circ C$ 满电存储性能 | <p>(1) Charge: 0.5C constant current charge to 4.20V followed by 4.20V constant voltage charge to cut-off current $\leq 0.01C$; Discharge: 0.2C constant current discharge to voltage $\leq 2.50V$, to obtain the initial capacity;</p> <p>(2) Charge: 0.5C constant current charge to 4.20V followed by 4.20V constant voltage charge to cut-off current $\leq 0.01C$;</p> <p>(3) Stored at $25\pm 2^\circ C$ for 28 days;</p> <p>(4) Discharge: 0.2C constant current discharge to voltage $\leq 2.50V$, to obtain the residual capacity;</p> <p>(5) Charge: 0.5C constant current charge to 4.20V followed by 4.20V constant voltage charge to cut-off current $\leq 0.01C$; Discharge: 0.2C constant current discharge to voltage $\leq 2.50V$, to obtain the recovery capacity.</p> <p>(1) 充电: 以 0.5C 恒流充电至 4.20V 后, 以 4.20V 恒压充电至电流 $\leq 0.01C$; 放电: 以 0.2C 恒流放电至电压 $\leq 2.50V$, 获得初始容量;</p> <p>(2) 充电: 以 0.5C 恒流充电至 4.20V 后, 以 4.20V 恒压充电至电流 $\leq 0.01C$;</p> <p>(3) 于 $25\pm 2^\circ C$ 下存储 28 天;</p> <p>(4) 放电: 以 0.2C 恒流放电至电压 $\leq 2.50V$, 获得残余容量;</p> <p>(5) 充电: 以 0.5C 恒流充电至 4.20V 后, 以 4.20V 恒压充电至电流 $\leq 0.01C$; 放电: 以 0.2C 恒流放电至电压 $\leq 2.50V$, 获得恢复容量。</p> | <table border="1"> <thead> <tr> <th>Capacity 容量</th> <th>Relative Capacity 相对容量比</th> </tr> </thead> <tbody> <tr> <td>Residual capacity 残余容量</td> <td>$\geq 90\%$</td> </tr> <tr> <td>Recovery capacity 恢复容量</td> <td>$\geq 95\%$</td> </tr> <tr> <td>Initial capacity 初始容量</td> <td>100%</td> </tr> </tbody> </table> | Capacity 容量 | Relative Capacity 相对容量比 | Residual capacity 残余容量 | $\geq 90\%$ | Recovery capacity 恢复容量 | $\geq 95\%$ | Initial capacity 初始容量 | 100% | | | | | | | | |
| Capacity 容量 | Relative Capacity 相对容量比 | | | | | | | | | | | | | | | | | | |
| Residual capacity 残余容量 | $\geq 90\%$ | | | | | | | | | | | | | | | | | | |
| Recovery capacity 恢复容量 | $\geq 95\%$ | | | | | | | | | | | | | | | | | | |
| Initial capacity 初始容量 | 100% | | | | | | | | | | | | | | | | | | |

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| 5.3.5 | Storage performance at 60°C (100% SOC) 60°C 满电存储性能 | <p>(1) Charge: 0.5C constant current charge to 4.20V followed by 4.20V constant voltage charge to cut-off current $\leq 0.01C$ at $25\pm 2^\circ C$; Discharge: 0.2C constant current discharge to voltage $\leq 2.50V$ at $25\pm 2^\circ C$, to obtain the initial capacity;</p> <p>(2) Charge: 0.5C constant current charge to 4.20V followed by 4.20V constant voltage charge to cut-off current $\leq 0.01C$ at $25\pm 2^\circ C$;</p> <p>(3) Stored at $60 \pm 2^\circ C$ for 7 days;</p> <p>(4) Kept at $25 \pm 2^\circ C$ for 5 hours;</p> <p>(5) Discharge: 0.2C constant current discharge to voltage $\leq 2.50V$ at $25\pm 2^\circ C$, to obtain the residual capacity;</p> <p>(6) Charge: 0.5C constant current charge to 4.20V followed by 4.20V constant voltage charge to cut-off current $\leq 0.01C$ at $25\pm 2^\circ C$; Discharge: 0.2C constant current discharge to voltage $\leq 2.50 V$ at $25\pm 2^\circ C$, to obtain the recovery capacity.</p> <p>(1) 充电: $25\pm 2^\circ C$ 下, 以 0.5C 恒流充电至 4.20V 后, 以 4.20V 恒压充电至电流 $\leq 0.01C$; 放电: $25\pm 2^\circ C$ 下, 以 0.2C 恒流放电至电压 $\leq 2.50V$, 获得初始容量;</p> <p>(2) 充电: $25\pm 2^\circ C$ 下, 以 0.5C 恒流充电至 4.20V 后, 以 4.20V 恒压充电至电流 $\leq 0.01C$;</p> <p>(3) 于 $60\pm 2^\circ C$ 下存储 7 天;</p> <p>(4) 于 $25\pm 2^\circ C$ 下放置 5 小时;</p> <p>(5) 放电: $25\pm 2^\circ C$ 下, 以 0.2C 恒流放电至电压 $\leq 2.50V$, 获得残余容量;</p> <p>(6) 充电: $25\pm 2^\circ C$ 下, 以 0.5C 恒流充电至 4.20V 后, 以 4.20V 恒压充电至电流 $\leq 0.01C$; 放电: $25\pm 2^\circ C$ 下, 以 0.2C 恒流放电至电压 $\leq 2.50V$, 获得恢复容量。</p> | <table border="1"> <thead> <tr> <th>Capacity 容量</th> <th>Relative Capacity 相对容量比</th> </tr> </thead> <tbody> <tr> <td>Residual capacity 残余容量</td> <td>$\geq 85\%$</td> </tr> <tr> <td>Recovery capacity 恢复容量</td> <td>$\geq 90\%$</td> </tr> <tr> <td>Initial capacity 初始容量</td> <td>100%</td> </tr> </tbody> </table> | Capacity 容量 | Relative Capacity 相对容量比 | Residual capacity 残余容量 | $\geq 85\%$ | Recovery capacity 恢复容量 | $\geq 90\%$ | Initial capacity 初始容量 | 100% |
|---------------------------|---|--|--|----------------------------|----------------------------|---------------------------|-------------|---------------------------|-------------|--------------------------|------|
| | | | Capacity 容量 | Relative Capacity 相对容量比 | | | | | | | |
| Residual capacity 残余容量 | $\geq 85\%$ | | | | | | | | | | |
| Recovery capacity 恢复容量 | $\geq 90\%$ | | | | | | | | | | |
| Initial capacity 初始容量 | 100% | | | | | | | | | | |

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5.4 Environmental and safety characteristics 环境适应性能和安全性能

| No. 序号 | Item 测试项目 | Criterion 性能标准 | Testing method 测试条件与方法 | Standard 标准 |
|-----------|-------------------------|---|---|----------------|
| 5.4.1 | Vibration test 振动测试 | No fire, No explosion, No leakage, The maximum mass loss $\leq 0.1\%$ 电芯不起火、不爆炸、不漏液, 最大质量损失 $\leq 0.1\%$ | After standard fully charge, the cell shall be fixed on a vibration table, then to be subjected to simple harmonic motion with an amplitude of 0.8 mm (1.6mm total maximum excursion).The frequency is to be varied at the rate of 1 Hz/min between 10 and 55 Hz, and return in not less than 90 nor more than 100 min. The cylindrical cell shall be vibrated in two directions along axis of the cylinder and the vertical directions of axis of the cylinder. 将按标准充电方式充满电的电芯固定在振动实验台上, 进行振幅为 0.8mm (最大偏移 1.6mm) 的振动, 振动频率以 1Hz/min 的速度从 10Hz 增加至 55Hz, 每 90min~100min 往复一次回到原位。圆柱电芯按照其轴向和和径向两个方向进行振动实验。 | UL1642 |
| 5.4.2 | Drop test 跌落测试 | No fire, No explosion 电芯不起火、不爆炸 | The cell is charged following the standard charge method; The cell is dropped three times from a height of 1.0 m onto a concrete floor at $25^{\circ}\text{C}\pm 2^{\circ}\text{C}$, to obtain impacts in random orientations; Observation for 1 h. 将电芯按标准充电方式充满电后; $25^{\circ}\text{C}\pm 2^{\circ}\text{C}$ 下, 将电芯从 1.0m 高度处自由跌落三次到水泥地面上, 以此获得随机方向的冲击; 观察 1h。 | IEC62133 |
| 5.4.3 | Overcharge test 过充测试 | No fire, No explosion 电芯不起火、不爆炸 | The cell is discharged following the standard discharge method. After that, the cell is to be charged with 1C current to 4.6V, then constant voltage charged at 4.6V, until one of the following situations occurs: the temperature drop's value of the cell reaches 20% of the maximum temperature, or the test time reaches 7 hours. 电芯按照标准放电方式放完电后, 采用 1C 电流恒流充电到 4.6V 后, 转为 4.6V 恒压充电, 当出现以下情况之一时结束测试, 电芯温度下降值达到温度最大值的 20%, 或总测试时间达到 7 小时。 | GB31241 |

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|-------|--|---|---|----------|
| 5.4.4 | Forced discharge test 强制放电测试 | No fire, No explosion 电芯不起火、 不爆炸 | The cell is discharged following the standard discharge method, and then the cell is subjected to a reverse charge at 1C for 90 min at 25±2°C 电芯按照标准放电方式放完后, 在 25±2°C 条件下以 1C 反向充电 90 分钟。 | IEC62133 |
| 5.4.5 | 130°C hot oven test 130°C 热箱测试 | No fire, No explosion 电芯不起火、 不爆炸 | The cell is charged following the standard charge method. After charging the cell is put in the oven. And then the oven temperature will be raised at a rate of 5°C/min±2°C/min to 130°C±2°C, and held at 130°C±2°C for 30 minutes. 电芯按照标准充电方式充满电后, 将电芯放进试验箱中。然后将试验箱按 5°C/min±2°C/min 的速率升温到 130°C±2°C, 当箱内温度达到 130°C±2°C 后恒温, 并持续 30 分钟。 | GB31241 |
| 5.4.6 | Crush test 挤压测试 | No fire, No explosion 电芯不起火、 不爆炸 | After charging a cell following the standard charge method, the cell shall be crushed between two flat surfaces. The direction of the crushing force shall be vertical to axis of the cylinder. The crushing force is to be applied by a hydraulic ram with a 32mm diameter piston. Crushing force is approximately 13±1 KN. Once the maximum pressure has been obtained it is to be released. 电芯按照标准充电方式充满电后, 放在两个平整的表面进行挤压测试, 压力器必须施加一个与圆柱电芯轴向垂直的力, 平压于电芯。采用 32 mm 直径的液压活塞, 所用压力为 13±1 KN, 一旦达到最大压力值, 即释放压力。 | UL1642 |
| 5.4.7 | Short circuit test at room temperature 室温短路测试 | No fire, No explosion 电芯不起火、 不爆炸 | Cell shall first be charged according to the standard charge method, and then cell is to be short-circuited by connecting the positive and negative terminals of the cell with a cooper circuit load having a resistance load of 80mΩ±20 mΩ, test is done at room temperature. The cell is to discharge until a fire or explosion is obtained, or until it has reached a completely discharged state of less than 0.2V and the cell temperature has returned to ±10°C of ambient temperature. 首先按照标准充电方法对电芯进行充电, 然后用电阻负载为 80mΩ±20mΩ 的铜线将电芯的正极和负极端子连接起来, 使电芯短路, 在室温下进行测试。电芯短接放电, 直到发生起火或爆炸, 或者达到小于 0.2V 的完全放电状态且电芯温度恢复到环境温度的 ±10°C 时, 停止实验。 | UL1642 |

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| 5.4.8 | Short circuit test at high temperature 高温短路测试 | No fire, No explosion 电芯不起火、不爆炸 | Cell shall first be charged according to the standard charge method, and then is to be placed in an environment of $57\text{ }^{\circ}\text{C} \pm 4\text{ }^{\circ}\text{C}$, wait for the surface temperature of the cell reach to $57\text{ }^{\circ}\text{C} \pm 4\text{ }^{\circ}\text{C}$, and stand for 30 minutes. Then connect the positive and negative terminals of the cell with cooper wires and ensure that all external resistance is $80\text{m}\Omega \pm 20\text{m}\Omega$. Monitor the cell temperature while testing. The cell is continuously discharged until the temperature drop's value of the cell reaches 20% of the maximum temperature, or the short circuit time reaches 24 hours. 电芯按照标准充电方式充满电后, 放置在 $57\text{ }^{\circ}\text{C} \pm 4\text{ }^{\circ}\text{C}$ 的环境中, 待电芯表面温度达到 $57\text{ }^{\circ}\text{C} \pm 4\text{ }^{\circ}\text{C}$ 后, 再放置 30min; 然后用铜线连接电芯正负极端, 并确保全部外部电阻为 $80\text{m}\Omega \pm 20\text{m}\Omega$ 。实验过程监测电芯温度变化, 当电芯温度下降值达到温度最大值的 20% 时, 或短接时间达到 24h 后, 停止实验。 | GB31241 |
| 5.4.9 | Low pressure test 低气压测试 | No fire, No explosion, No leakage, The maximum mass loss $\leq 0.1\%$ 电芯不起火、不爆炸、不漏液, 最大质量损失 $\leq 0.1\%$ | Cell shall first be charged according to the standard charge method, and then cell is to be stored at an absolute pressure of 11.6 kPa for six hours at ambient temperature. 电芯按照标准充电方式充满电后, 在绝对气压等于 11.6 kPa 的室温条件下存储 6h。 | UL1642 |
| 5.4.10 | Shock test 冲击测试 | No fire, No explosion, No leakage, The maximum mass loss $\leq 0.1\%$ 电芯不起火、不爆炸、不漏液, 最大质量损失 $\leq 0.1\%$ | Cell shall first be charged according to the standard charge method, fix the cell on the shock table, and perform axial and radial half-sine pulse shock test, the minimum average acceleration within the initial 3ms is $75g_n$, and the peak acceleration during the test is $150g_n \pm 25g_n$. Three acceleration shock experiments in one direction. 电芯按照标准充电方式充满电后, 将电芯固定在冲击台上, 进行轴向和径向半正弦脉冲冲击实验, 最初 3ms 内的最小平均加速度为 $75g_n$, 测试过程峰值加速度为 $150g_n \pm 25g_n$, 每个方向进行三次加速度冲击实验。 | UL1642 |

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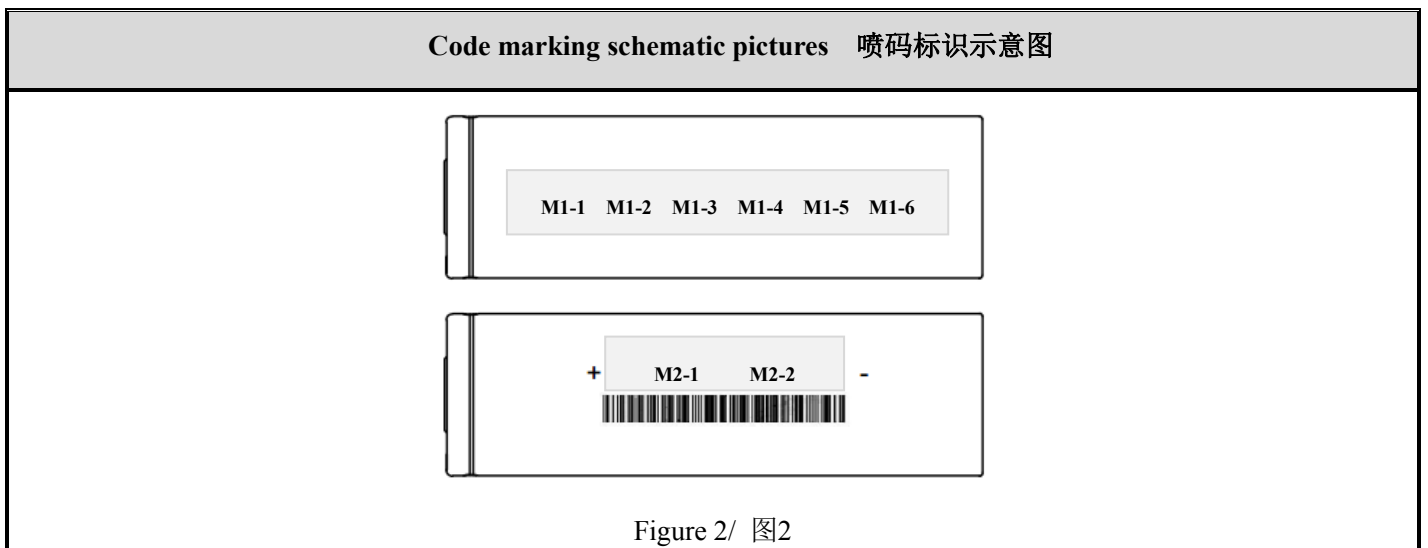
| | | | | |
|------------|--|--|--|---------|
| 5.4.11 | Temperature cycling test 温度循环 | No fire, No explosion, No leakage 电芯不起火、不爆炸、不漏液 | <p>The standard fully charged cells are to be placed in a test chamber and subjected to the following cycles:(1) Raising the chamber-temperature to $72 \pm 2^{\circ}\text{C}$ within 30 minutes and maintaining this temperature for 6 hours. (2)Reducing the chamber temperature to minus $40 \pm 2^{\circ}\text{C}$ within 30 minutes and maintaining this temperature for 6 hours. (3) Repeating the sequence for a further 9 cycles. (4) After the 10th cycle, storing the cells for a minimum of 6 hours, at a temperature of $20 \pm 5^{\circ}\text{C}$ prior to examination.</p> <p>电芯按照标准充电方式充满电后，放入测试箱内，按如下方式测试： (1) 30 分钟内升温至 $72 \pm 2^{\circ}\text{C}$，保持 6h; (2) 30 分钟内降温至 $-40 \pm 2^{\circ}\text{C}$，保持 6h; (3) 重复以上步骤 9 次; (4) 10 次循环后，在 $20 \pm 5^{\circ}\text{C}$ 下观察电芯至少 6h。</p> | GB31241 |
| Note 备注 | <p>All above safety tests will be conducted at $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ except where specified differently. Use proper ventilation with protective equipment.</p> <p>除特殊说明，以上所有安全测试均应在 $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ 通风橱中，且附带有保护装置的条件下进行。</p> | | | |

6 Cell code and packing instructions 电芯喷码和包装说明


6.1 Code rules and instructions 喷码规则及说明

The cell is packed by tube, and on the tube's surface marking code, the contents are as follows.

电芯表面有热缩膜，并在膜表面进行喷码标识，内容如下。



| | | | | | |
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| Mark No. 标识序号 | Mark content 标识内容 | Mark example 标识示例 | Mark instructions 标识说明 |
|------------------|---|----------------------|--|
| M1-1 | Cell model 电芯型号 | N18650CL-29 | Cell model mark 电芯型号标识 |
| M1-2 | Manufacturer 生产厂 | BAK | BAK company name logo mark BAK 公司名称 logo 标识 |
| M1-3 | Cell grade 电芯等级 | A01 | Cell grade mark, use three digits “AXX” to represent. For example, A01 represent the cell’s grade is A01 grade. 电芯等级标识, 使用三位字符“AXX”表示。例如 A01 代表电芯等级为 A01 等级。 |
| M1-4 | Nominal voltage 标称电压 | 3.6V | Cell nominal voltage mark 电芯标称电压标识 |
| M1-5 | Cell capacity 电芯容量 | 2.9Ah | Cell typical capacity mark 电芯典型容量标识 |
| M1-6 | Cell energy 电芯能量 | 10.44Wh | Cell typical energy mark 电芯典型能量标识 |
| M2-1 | Production batch 生产批号 | D1K | Cell production batch mark, 1 st digit is year code, 2 nd digit is month code, 3 rd digit is day code. For example, D1K represent the put into production time is Jan 19, 2023. 电芯生产批号标识, 第一位字符代表年份, 第二位字符代表月份, 第三位字符代表日期。例如, D1K 表示生产时间是 2023 年 1 月 19 日。 |
| M2-2 | Cell serial number 电芯流水码 | 1000001 | Cell serial number mark, use seven digits “X ₁ X ₂ X ₃ X ₄ X ₅ X ₆ X ₇ ” to represent. For example, the cell serial number is 1000001. 电芯流水码标识, 使用七位数字 “X ₁ X ₂ X ₃ X ₄ X ₅ X ₆ X ₇ ” 表示, 例如电芯流水号为 1000001。 |
| + | | | Cell positive polarity symbol mark 电芯正极性符号标识 |
| - | | | Cell negative polarity symbol mark 电芯负极性符号标识 |
| |  | | Cell barcode mark 电芯条形码标识 |

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Attached tables of production time instructions 生产时间说明附表:

| Year Code (30years for one cycle) 年份代码 (30 年一次循环) | | | | | | | | | | |
|---|------|------|------|------|------|------|------|------|------|------|
| Year 年份 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
| Code 代码 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A |
| Year 年份 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
| Code 代码 | B | C | D | E | F | G | H | J | K | L |
| Year 年份 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 |
| Code 代码 | M | N | P | R | S | T | V | W | X | Y |

| Month Code 月份代码 | | | | | | | | | | | | |
|-----------------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|
| Month 月份 | Jan 1 月 | Feb 2 月 | Mar 3 月 | Apr 4 月 | May 5 月 | Jun 6 月 | Jul 7 月 | Aug 8 月 | Sept 9 月 | Oct 10 月 | Nov 11 月 | Dec 12 月 |
| Code 代码 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C |

| Day Code 日期代码 | | | | | | | | | | | |
|---------------|----|----|----|----|----|----|----|----|----|----|----|
| Day 日期 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 |
| Code 代码 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B |
| Day 日期 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| Code 代码 | C | D | E | F | G | H | J | K | L | M | N |
| Day 日期 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | | |
| Code 代码 | P | R | S | T | V | W | X | Y | 0 | | |

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6.2 Packing instructions 包装说明

The cell's shipment package drawing is shown in Figure 3.

电芯出货包装示意图，如图 3 所示。

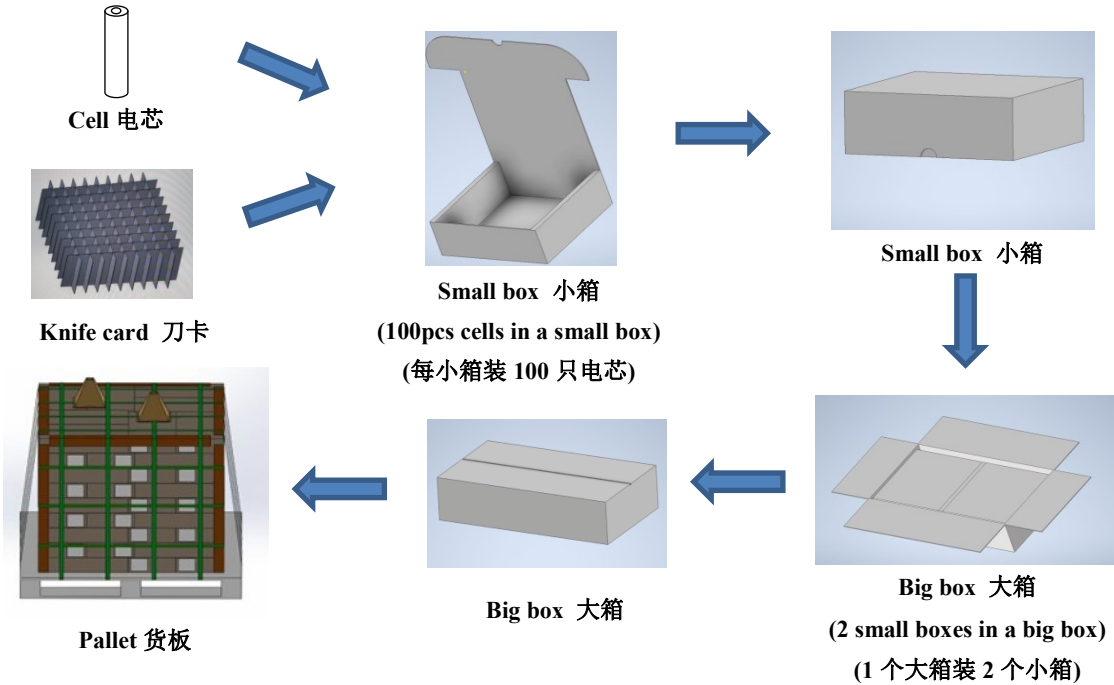


Figure 3/ 图 3

7 Shipment 出货

The cell's shipment voltage range is in the voltage rang of 3.45~3.60V when transported by air, or in the voltage range of 3.55~3.70V when transported by sea and land. The remaining capacity and voltage of the cell after shipment depend on the storage time and conditions.

单体电芯出货充电电压范围，空运 3.45~3.60V，海运和陆运 3.55~3.70V，电芯出货后的剩余容量与电压取决于储存时间和条件。

8 Warranty 质量保证

The warranty period of cell is made according to business contract. However, even though the problem occurs within this period, BAK won't replace a new cell for free as long as the problem is not due to the failure of BAK manufacturing process but is due to customers' abuse or misuse.

自出货之日起，电芯的保质期限依合同而定。但是，在此期限内，如果非比克公司的制程原因，而是客户的误用造成的电芯质量问题，比克公司不承诺免费更换。

BAK will not be responsible for the trouble caused by handling in violation of cautions in instructions.

比克公司对违反安全守则操作所产生的问题不承担任何责任。

BAK will not be responsible for the trouble caused by matching electric circuit, cell pack and charger.

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比克公司对与电路、电芯组、充电器搭配使用所产生的问题不承担任何责任。

BAK will not be responsible for any defect of cells caused during assembling after acceptance.

出货后客户在电芯组装过程中产生的不良电芯不在比克公司质量保证的范围之列。

9 Storage and shipment requirement 存储及运输要求

| Item 项目 | Conditions 环境 | Permissible time 允许时间 |
|---|-------------------------|-------------------------------|
| Storage environment 储存环境 | -20°C~ 60°C, 60% RH Max | Less than 1 month 少于 1 个月 |
| | -20°C~ 45°C, 60% RH Max | Less than 3 months 少于 3 个月 |
| | -20°C~ 25°C, 60% RH Max | Less than 1 year 少于 1 年 |
| About long time storage: If the cell needs to be stored for a long time, the cell's storage voltage should be 3.45 ~ 3.70 V 关于长期存储：若电芯需长期存储，电芯的存储电压应该为 3.45 ~ 3.70 V。 | | |

10 Warnings and cautions in handling the lithium-ion cell 电芯使用时警告事项及注意事项

Lithium-ion rechargeable cells subjected to abuse can cause damage to the cell and/or personal injury. Please read and observe the standard cell precautions below before utilization.

滥用锂离子充电电芯可能会造成电芯的损害或人身的伤害。在使用锂离子充电电芯以前，请仔细阅读以下的安全守则：

Note 1. The customer is required to contact BAK in advance, if and when the customer needs other applications or operating conditions not described in this document.

注释 1. 如果客户需要其它应用程序或本档中描述之外的操作条件，客户需要提前联系比克。

Note 2. BAK will take no responsibility for any accident when the cell is used under other conditions not described in this document.

注释 2. 在该文件说明的条件之外使用该电芯而产生的事故，比克公司不承担任何责任。

Warnings 警告

To prevent the possibility of the cell from leaking, heating, explosion, please observe the following precautions: (It should be indicated especially in manual or instruction for users.)

危险警告：（应在使用说明手册或说明书中，特别注明）为防止电芯可能发生泄漏，发热，爆炸，请注意以下预防措施：

| | |
|---|--|
| 1 | Do not use and leave the cell near a heat source such as fire or heater. |
| | 禁止将电芯在热高温源旁，如火，加热器等旁边使用和留置。 |

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| 2 | Do not use or leave the cell under the blazing sun. | | | | |
| | 不要将电芯放置在太阳光直射的地方。 | | | | |
| 3 | Do not use or leave the cell at very high temperature conditions (e.g., strong direct sunlight or a vehicle in extremely hot conditions). Otherwise, it can overheat or catch fire or its performance will be degenerate and its service life will be decreased. | | | | |
| | 禁止在高温下（强烈的阳光直射下或车辆处于酷热条件下）使用或放置电芯，否则可能会引起电芯过热，起火或功能失效，寿命减短。 | | | | |
| 4 | Do not short circuit, over-charge or over-discharge the cell. | | | | |
| | 不要将电芯短路，过充或过放。 | | | | |
| 5 | Don't immerse the cell in water and seawater. Please put it in cool and dry environment if no using. | | | | |
| | 严禁将电芯浸入海水或水中，保存不用时，应放置在阴凉干燥的环境中。 | | | | |
| 6 | Don't reverse the positive and negative terminals | | | | |
| | 严禁颠倒正负极使用电芯。 | | | | |
| 7 | Do not disassemble or modify the cell. | | | | |
| | 不要拆卸或修整电芯。 | | | | |
| 8 | Do not transport or store the cell together with metal objects such as necklaces, hairpins, coins, etc. | | | | |
| | 禁止将电芯与金属，如发夹，项链等一起运输或贮存。 | | | | |
| 9 | Make sure the cell is not with conspicuous damage or deformation. | | | | |
| | 不要使电芯受到明显的损害或变形。 | | | | |
| 10 | Don't connect the cell to an electrical outlet directly. | | | | |
| | 严禁将电芯直接插入电源插座。 | | | | |
| 11 | If the cell leaks and the electrolyte splashes into the eyes, rinse the eyes with clean running water immediately for at least 15 minutes, and go to hospital for treatment if necessary. | | | | |
| | 如果电芯发生泄露，电解液进入眼睛，请立即用清水冲洗眼睛至少 15 min，必要时请立即前往医院接受治疗。 | | | | |
| 12 | Mixed use of cells of different types is not allowed. | | | | |
| | 禁止与不同型号的锂离子电芯混合使用。 | | | | |
| 13 | The cell that may be swallowed by children must be placed out of reach of children. Do not swallow the cell, as swallowing may cause burning. If swallowed accidentally , seek medical immediately. | | | | |
| | 须将可能会被儿童吞食的电芯放置到儿童无法触及之处。切勿吞咽电芯，吞咽可能导致灼烧。如果不慎吞食，须迅速就医。 | | | | |
| 14 | Do not directly solder the cell and pierce the cell with a nail or other sharp object | | | | |
| | 禁止直接焊接电芯和用钉子或其它利器刺穿电芯。 | | | | |

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| | |
|----|---|
| 15 | Do not strike, throw or trample the cell. |
| | 禁止敲击或抛掷， 踩踏电芯等。 |
| 16 | Use the cell charger specifically for that purpose when charging. |
| | 充电时请选用锂离子电芯专用充电器。 |
| 17 | Please separate cells of different electrochemical systems from one another when disposing of secondary cells. |
| | 二次电芯处理时， 请将电芯和其他电化学体系的产品分开。 |
| 18 | Clean the terminals with a dry cloth before use if the cell terminals are dirty. Otherwise power failure or charge failure may occur due to the poor connection with the instrument. |
| | 如果电芯弄脏， 使用前应用干布抹净， 否则可能会导致接触不良功能失效。 |
| 19 | Cells should be removed from the device or charger immediately and not used again if they are over heat, give off odor, discolor or deform, or appear abnormally in any way during use, charging and storage. |
| | 如果电芯发出异味， 发热， 变色， 变形或使用， 贮存， 充电过程中出现任何异常现象， 立即将电芯从装置或充电器中移离并停用。 |
| 20 | The cell replacement shall be done only by either cell supplier or device supplier instead of the user. |
| | 更换电芯应由电芯供应商或设备供应商完成， 用户不得自行更换。 |
| 21 | Please tape the terminals to insulate cells before discarding them in case of fire and explosion. |
| | 废弃电芯之前应用绝缘纸包住电极， 以防起火、 爆炸。 |
| 22 | Do not use cells in strong electrostatic and magnetic occasions. Otherwise, it can cause safety problems easily. |
| | 禁止在强静电和强磁场的地方使用， 否则易带来不安全的隐患。 |
| 23 | Use of damaged cells is not permitted. |
| | 禁止使用已损坏的电芯。 |
| 24 | Make sure package designing will not cause cell damages. |
| | 电芯外壳设计和包装禁止损伤电芯。 |
| 25 | Cell packing should be conducted strictly according to level range, any misuse of different levels should not be permitted. |
| | 电芯配组时需严格按等级执行， 不能跨等级成组。 |
| 26 | Disassembling cells from pack or module is not permitted unless under the guidance of professional technicians. |
| | 严禁将电芯从电池包或模组中拆卸， 除非在专业技术人员的指导下进行。 |

11 Restriction of hazardous substances 有害物质控制要求

This model of lithium-ion cell is in accordance with our company's request of "The hazardous substances and material management standard" or customer's requirements.

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本型号锂离子电芯符合本公司《有害物质与材料管理规范》要求或参照客户要求执行。

12 Contact information 联系方式

If you have any questions regarding the cell, please contact the following address:

如有疑问，请按以下地址联系：

1. ZHENGZHOU BAK BATTERY CO., LTD

The intersection 300 meters West of Zhongxing Road & BAK Avenue, Zhongmu Country, Zhengzhou City, Henan, China. ZIP: 451450

Contact phone number: 0371-62033101

郑州比克电池有限公司

郑州市中牟县中兴路与比克大道交叉口向西 300 米 邮编 451450

联系电话：0371-62033101

2. SHENZHEN BAK POWER BATTERY CO., LTD

BAK Industrial Park on Kuichong Road, Dapeng District, Shenzhen. ZIP: 518119

Contact phone number: 0755-61886818

深圳市比克动力电池有限公司

深圳市大鹏新区葵涌街道比克工业园 邮编：518119

联系电话：0755-61886818