



SHANDONG WINA GREEN POWER
TECHNOLOGY CO., LTD.

LITHIUM-ION BATTERY SPECIFICATION

Document No.:
Date: 2016-5-9

PRODUCT SPECIFICATION

Lithium-ion Battery

Model: IFP 2290110—15Ah

(LiFePO₄)

| Prepared | Checked | Approved |
|----------|---------|----------|
| | | |

Shandong Wina Green Power Technology Co., Ltd.

Add: East City Industrial District, Shouguang City, Shandong, China

Tel: +86 536 5920199 Fax: +86 536 5675066

E-mail: info@winabattery.com

<http://www.winabattery.com>

1. Scope

This description defines the general requirements for the Lithium-ion battery's normal parameter, conventional electrical requirement, safety performance, test and judgment, storage, shipment, usage instructions, safety regulation supplied by Shandong Wina Green Power Technology Co., Ltd.

2. Description

Product: Lithium-ion battery

Type: IFP2290110-15Ah

3. Adopted Standard

QC/T 743-2006: Lithium-ion batteries for electric vehicles

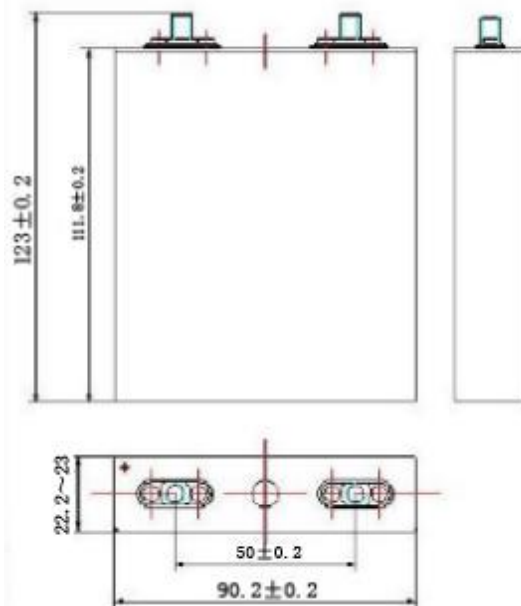
4. Configuration and Dimension

1) Product Configuration

Please refer to the figure on the right for product outline.

2) Product Dimension

22mm*90mm*110mm



5. Appearance

There can not have any deformation and crack,

The Surface should be smooth, dry, no trauma, no dirt, etc., and marks clearly and accurately.

6. Nominal Parameters

| No. | Items | Unit | Parameter | Remark |
|-----|--------------------------------------|------|-----------------------------|-----------------------------------------------------|
| 1 | Battery Type | | LiFePO ₄ battery | |
| 2 | Nominal Capacity | Ah | 15.0 | By standard charge and discharge (see 8.1) |
| 3 | Nominal Voltage | V | 3.2 | |
| 4 | Charging Mode | / | CC/CV | / |
| 5 | End of Charge Voltage | V | 3.7 | / |
| 6 | End of Discharge Voltage | V | 2.5 | / |
| 7 | Standard Charge Current | A | 1/3C (5A) | CC |
| 8 | Standard Discharge Current | A | 1/3C (5A) | CC |
| 9 | Max. Continuous Discharge Current | A | 1C (15A) | It could be adjusted based on customer requirements |
| 10 | Max. Instantaneous Discharge Current | A | 1C(15A), 10s | It could be adjusted based on customer requirements |
| 11 | Weight of Single Cell | g | 442±3 | / |



| | | | | | |
|----|-------------------------------------------------------------|--------------|-----|----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12 | Resistance | | mΩ | < 8 | AC, 20±5℃ |
| 13 | Dimension | | mm | 22.2 ₀ ^{+0.8} ×90.2 _{-0.2} ^{+0.2} ×123.0 _{-0.2} ^{+0.2} | The designing dimension(22 ₀ ^{+0.8} ×90.2 _{-0.2} ^{+0.2} ×110.0 _{-0.2} ^{+0.2} mm) is replaced by measuring dimension with film(22.2 ₀ ^{+0.8} ×90.2 _{-0.2} ^{+0.2} ×123.0 _{-0.2} ^{+0.2} mm) |
| 14 | Working Temperature | Charge | ℃ | 0~45 | / |
| | | Discharge | ℃ | -20~+55 | / |
| 15 | Storage Temperature | One Month | ℃ | 0~60 | Storage capacity should be 40%~50% of full charge capacity |
| | | Three Months | ℃ | 0~45 | |
| | | Six Months | ℃ | 0~25 | |
| | Air Pressure | | kPa | 86~106 | |
| | Relative Humidity | | RH | 25%~85% | |
| 16 | Cell Cycle Life (Times) | | / | >2000 | 1/3C charge-discharge at 20℃, 100%DOD till 5Ah |
| 17 | Self-Discharge Rate per Month | | % | <3 | Room temperature |
| 18 | Max. Torque Force While Fix a Screw On The Battery Terminal | | Nm | 7 | For packing procedure |

7. Test Conditions and Equipment Requirements

7.1 Standard Test Conditions

Unless otherwise specified, all tests stated in this Product Specification are conducted at below condition: Temperature: 25℃ ±10℃ ; Relative Humidity: 25%~85%RH; Air pressure: 86kPa~106kPa.

7.2 Measuring Meter and Equipment Requires

1) Voltmeter

The accuracy is not less than 0.5, the resistance shall be 1kΩ/V at least.

2) Ammeter

The accuracy is not less than 0.5. Total external resistance including ammeter and wires shall be less than 0.01Ω.

3) Temperature Measuring Instrument

It has the appropriate measuring range, the scale value is not more than 1℃, the calibration value is no less than 0.5℃.

4) Timer

With scale mark hour, minute and second, the accuracy shall be ±0.1%.

5) Dimension Measuring Instrument

The scale value is not more than 1mm.

6) Quality Measuring Instrument

The accuracy shall be more than $\pm 0.05\%$

7) Impedance Meter

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

8. Battery Performance

8.1 Conventional Electrical Characteristics

| No. | Items | Test Method | Standard |
|-----|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| 1 | Standard Charge | Charged to 3.7V initially with constant current 1/3C and then charged with constant voltage 3.7V till the current declines to 0.02C. Standing 1h after charging. | CC/CV |
| 2 | Standard Discharge | Discharged to 2.5V with constant current 1/3C | CC |
| 3 | Nominal Capacity | After standard charge, discharged to 2.5V with constant current 1/3C | >15Ah |
| 4 | Rate Discharge Capability | After standard charge, discharged to 2.5V with constant current 2C | >12Ah |
| 5 | Low Temperature Discharge Performance | After standard charge, stored in an ambient temperature of $-20\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 20h, then discharged to 2.5V with constant current 1/3C. After that, fetch out the cell and place it in the ambient temperature of $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ for 2h, then to check its appearance. | >10.5Ah; No distortion |
| 6 | High Temperature Discharge Performance | After standard charge, stored in an ambient temperature of $55\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 5h, then discharged to 2.5V with constant current 1/3C. After that, fetch out the cell and place it in the ambient temperature of $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ for 2h, then check its appearance. | >13.5Ah; No distortion |
| 7 | Capacity Retention (20°C) | After standard charge, stored in an ambient temperature of $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ for 28d, then discharged to 2.5V with constant current 1/3C. | >12Ah |
| 8 | Capacity Retention (55°C) | After standard charge, stored in an ambient temperature of $55\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 7d. After that, fetch out the cell and place it in the ambient temperature of $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ for 5h, then discharged to 2.5V with constant current 1/3C. | >12Ah |
| 9 | Capacity Recovery | After capacity retention test and also standard charge, the capacity value that discharged to 2.5V with constant current 1/3C, Capacity resilience are expressed as a percentage of the nominal capacity. | >13.5Ah |

| | | | |
|----|------------|-----------------------------------------------------------------------------------------------------------------------------------|--------------------|
| 10 | Cycle Life | Perform charge-discharge cycle with standard charge-discharge method, till the capacity is less than 80% of the nominal capacity. | Cycle times > 2000 |
|----|------------|-----------------------------------------------------------------------------------------------------------------------------------|--------------------|

8.2 Safety Characteristics

| No. | Items | Testing method | Standard |
|-----|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| 1 | Overcharge | After standard charge, shelving the battery 1h in the condition of 20 ± 5 . Place the battery that connected the thermocouple in the wind cabinet, Overcharge test can be performed with one of the following two charging mode: a. Charged to 5V with 1C current or charged till 90min (stop the test when one condition achieves firstly). b. Charged to 10V with 3C current then stop the test. Check the appearance after test, and record the change of voltage, current and temperature during the testing process. | No fire, No explosion |
| 2 | Over Discharge | After standard charge, discharged to 0V with 1/3C current in the condition of $20 \pm 5^{\circ}\text{C}$, Check the appearance after test, and record the change of voltage, current and temperature during the testing process. | No fire, No explosion, No leakage |
| 3 | Short Circuit | After standard charge, shelving the cell 1h in the condition of $20 \pm 5^{\circ}\text{C}$. Make the battery external short-circuit for 10 min (the total resistance of circuit should less than $5\text{m}\Omega$). Record the change of voltage, current and temperature during the testing process. | No fire, No explosion |
| 4 | Nail Penetration | After standard charge, shelving the cell 1h in the condition of $20 \pm 5^{\circ}\text{C}$. Using the high-temperature steel needle with $\phi 3\text{mm}-\phi 8\text{mm}$ diameter, transpierce the cell from vertical direction of cell plates (steel needle stays in the cell) in a speed of 10-40mm/s. The testing should to be performed under enough protection condition. Record the change of voltage, current and temperature during the testing process. | No fire, No explosion |
| 5 | Drop Test | After standard charge, make the cell drop from 1.5m height onto a hard board (thickness $\geq 20\text{mm}$), every time for each side. Record the change of voltage, current and temperature during the testing process. | No fire, No explosion, No leakage |
| 6 | Crush Test | After standard charge, shelving the cell 1h in the condition of $20 \pm 5^{\circ}\text{C}$. a) Direction of extrusion: vertical direction to the cell plate. b) Extrusion contact area: not less than 20cm^2 c) Extrusion degree: until the cell case burst or internal short circuit (the voltage of cell reaches 0V) Record the change of voltage and temperature during the | No fire, No explosion |

| | | | |
|---|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| | | testing process. | |
| 7 | Heating Test | After standard charge, place the cell into a thermostat, then make the temperature of the thermostat raised to $85^{\circ}\text{C} \pm 2^{\circ}\text{C}$ at a rate of $5^{\circ}\text{C} \pm 2^{\circ}\text{C} / \text{min}$ and remain 120min at that temperature, checking the cell appearance, record the voltage changes during the testing process. | No fire, No explosion |

9. Mark

Battery products should have the following marks: manufacturer name, product model or specification, manufacture date, brand, polarity symbol, battery safety precautions and warnings.

The packaging case should have the following marks: product name, model and specification quantity, manufacturer name, address and zip code, product standard number, net and gross weight of each case, marked with moisture-proof, not allowed to reverse, handle with care etc.

10. Packaging

The packaging of the battery should be in accordance with the requirements of moisture-proof and anti-vibration. The packaging case should be packed with the following documents along with the product: Packing List, Product Inspection and Quality Certificate, Product Instructions.

11. Shipment

The battery should be packed in cases under the condition of not more than 40% capacity for shipment. Any severe mechanical collision, sunlight exposure, raining, cell inversion and squeezing should be avoided during the transport process; The batteries shall be shipped by normal transportation such as by road, train, ocean or air. The batteries should be handled with care, prevent tossing, rolling and heavy press during loading and unloading.

12. Storage

1. The battery shall be stored in the dry, clean and draughty room at a temperature of $5^{\circ}\text{C} \sim 40^{\circ}\text{C}$
2. The battery shall be avoided contact with corrosive material and kept not less than 2m away from heat source
3. The battery shall not be stored reverse or lay down and shall be avoided mechanical shock or heavy press.
4. The battery shall be charged every 6 months during storage. Otherwise, it has a great impact on battery cycle life and result in product quality issues, which is beyond the warranty scope of the company.
5. Both the resorted battery picked from the stored battery in the warehouse and remain to be delivered battery shall comply with the principle "first come, first use".
6. The storage period shall be 12 months from the date of storage; batteries which are beyond storage period must receive an overall inspection in batches. And the qualified battery after

inspection shall be dispatched. .

13. Instructions and Safety Requirement

1. Do not immerse the battery in water or seawater, and keep the battery in a cool dry environment if it don't using during storage.
2. Do not using or leaving the battery near the heat source, such as fire or heater etc.
3. When charging, please make sure to use the lithium ion battery charger specifically.
4. Do not reverse the positive (+) and negative (-) terminals
Do not inversion and side place using in battery pack system for cell application.
5. Do not plugged the battery/cell into the power supply socket directly.
6. Do not discard the battery into fire or heater.
7. Do not short-circuit the battery by directly connecting the positive (+) and negative (-) terminal with metal objects such as wire.
8. Do not transport or store the battery along with metal objects such as necklaces, hairpins etc.
9. Do not strike or throw the battery.
10. Do not pierce the battery with a nail or other sharp object.
11. Do not use it in a location where with the strong electrostatic and magnetic field, otherwise, the safety devices may be damaged, and causing hidden trouble of safety.
12. If the battery leaks, and the electrolyte get into the eyes. Do not rub eyes, instead, rinse the eyes with clean running water, and immediately seek medical attention. Otherwise, it may injure eyes or cause a loss of sight.
13. If the battery gives off any peculiar smell, generates heat, discolored or deformed, or in any way appear abnormal during using time include charging or storage, immediately remove it from the device or battery charger and stop using it.
14. In case the battery terminals are dirty, please clean the terminals with a dry cloth before using. Otherwise power or charge failure may occurred due to the poor connection with the instrument.
15. The waste battery application should be packed on the electrodes with the insulation paper, in case of fire or explosion.
16. If there has the oxidation phenomenon of battery terminals due to long time store, please polish them gently with a fine sandpaper to avoid the bad contact.

14. Free-responsibility Declaration

Before using the battery, please carefully read the product specification, instructions and announcements under this document; learn the usage method and application area. All the following actions are belong to misuse: use the battery in wrong way, incorrect circuit connection or the parameter of input power and load function are not be consistent with the parameter stated in this

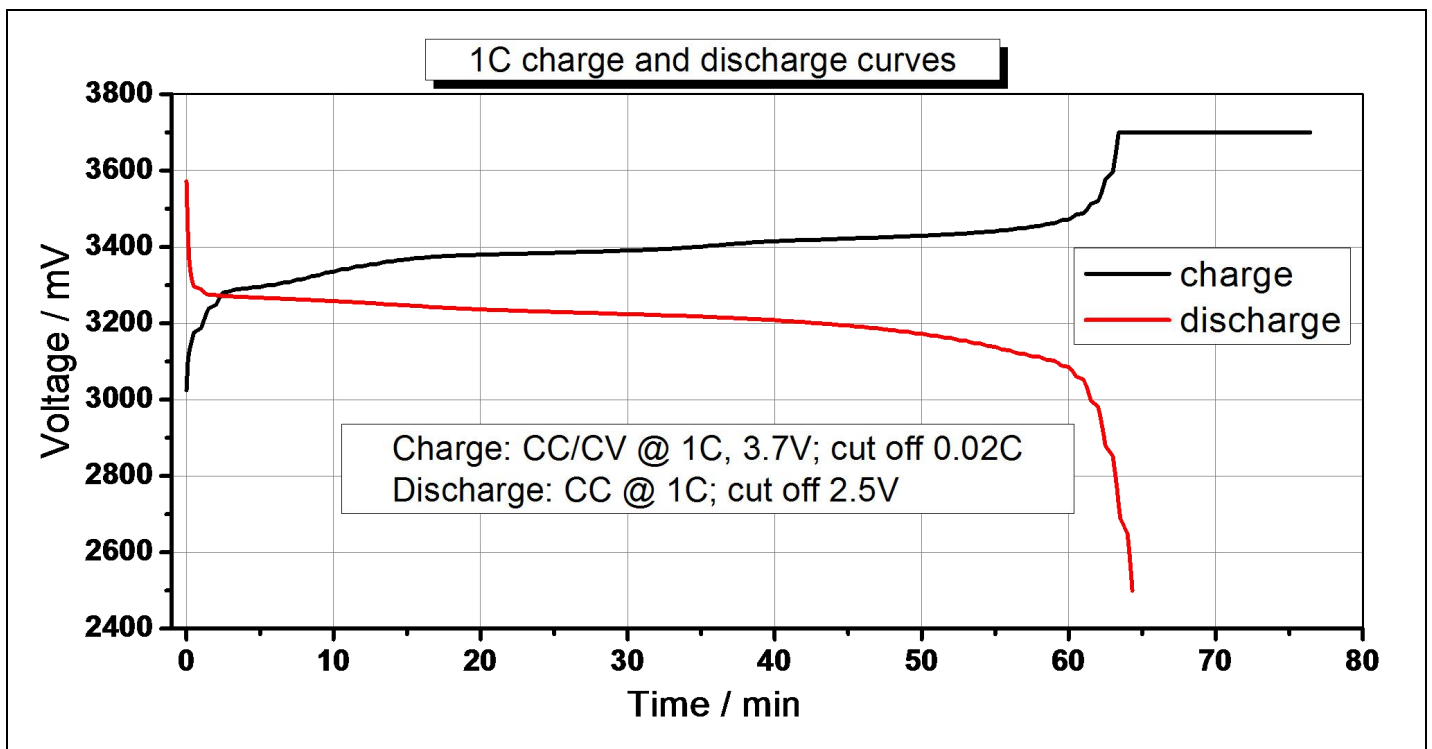
product specification. The company does not take any responsibilities of product, load and connectors caused by any misuse.

Any other items not mentioned in this specification shall be determined by both parties.

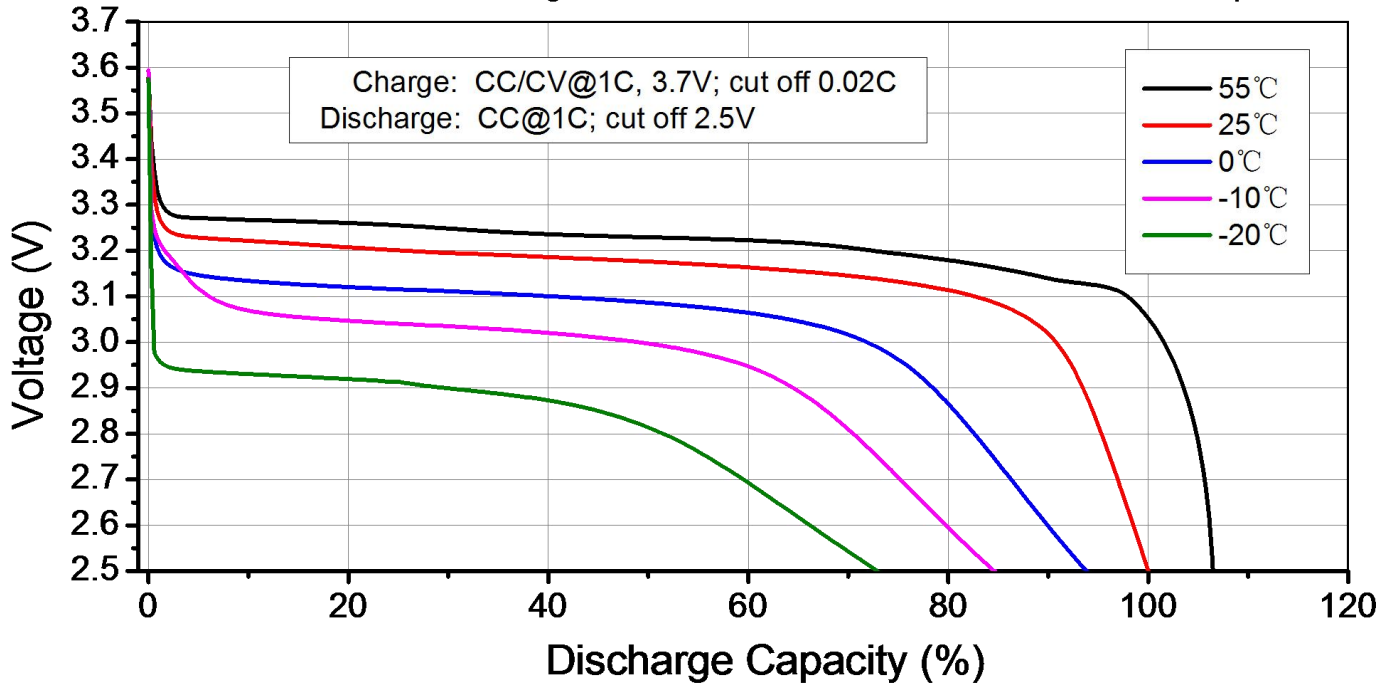
The right of final interpretation of the specification belongs to Shandong Wina Green Power Technology Co., Ltd.

15. Appendices:

Typical testing curves of sample



1C rate of continuous discharge curves of Wina standard batteries at different temperature



30-day capacity retention ratio

