Specification Approval Sheet

Model：OSN-18650-2000mAH

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1. Scope

This document describes the Product Specification of the Lithium iron phosphate battery supplied by OSN (OSN Power Energy Co,. Ltd).

2. Model：OSN-18650-2000mAH

3. LiFePO4 battery 18650 3.2V 2000mAH

4. Specification

No.	Items	Specification
1	Nominal voltage	3.2V
2	Nominal capacity	2000mAh(0.2 C_5A Discharge)
3	Standard Charge current	0.5 C_5A (0℃～45℃)
4	Continue charge current	0.5 C_5A (0℃～45℃)
5	Standard Discharge Current	0.5 C_5A(-10℃~ +60℃)
6	Continue Discharge Current	1C_5A(-10℃~ +60℃)
7	Max. Discharge Current	3C_5A(Limited Voltage2.0V)
8	Charge limited voltage	3.65±0.05V(0℃～45℃)
9	Discharge cut-off voltage	2.0V(0℃～45℃)
10	Inner resistance	≤25mΩ (At AC 1kHz)
11	Cell Weight	45g
12	Cell Dimension	Max Length: 65.3mm Max Width: 18.4mm
13	Operating temperature	Charging: 0°C ~ 45°C Discharging: -20°C ~ 60°C (Cell skin temperature cannot exceed 70°C)
14	Storage temperature/humidity	≤one month -20℃ ~ 45℃ ≤three months -20℃ ~ 35℃ ≤a year -20℃ ~ 25℃

5. Electrical characteristics

No.	Items	Test Method and Condition	Criteria
1	Standard Charge	(The "Standard Charge" means charging with constant current 0.5C_5A to3.65V, then charging with constant voltage 3.65V to 0.01C_5A under 25±2 ℃	N.A.
2	Nominal Capacity	(The capacity means the discharge capacity of the cell, which is measured with discharge current 0.5C_5A to cut-off voltage at 2.0V at 25±2℃ rest for 30 minutes after the Standard Charge.)	Nominal Capacity ≥2000mAh
3	Cycle Life	After 2000 cycles of charge and discharge, the discharge capacity is measured with 0.2 C_5A discharge current and 2.0V cut-off voltage.	≥80%Nominal Capacity
4	Storage Characteristic	Test the cell initial capacity using 0.2C 5 current at 23±2℃ and record,then charge the cells with 45% capacity, then storage for 3, 6, 12 months respectively at 20±5℃and relative humidity of 45%~75%, then the cell is cycled for 5 times with charge with 0.2C_5A and discharge with 0.2C_5A at 23±2℃, The maximum discharge capacity (longest discharge time) is recorded.)	0.2C5Adischarge time: After 3 months storage ≥4.5hrs; After 6 months storage ≥4.25hrs; After 12 months storage ≥4.0hrs)
		The cell is charged and discharged using 0.2C 5 at 20±5℃. The discharge capacity is C1. The cell is stored for 28 days in 20 ±5℃ after fully charged and then is discharged using 0.2C 5 at 20±5℃. The capacity is defined as C2	C2/C1≥85% (Capacity Retention C2/C1≥85%)
		After the test as C 2 , The cell is charged and discharged using 0.2C 5 at 20± 5℃, The discharge capacity is C3	C3/C1≥90% (Capacity recoverable ratio C3/C1≥90%)
5	Rate Capacity	The discharge capacity is measured with 0.5 C_5A discharge current and 2.0V cut-off voltage after full charged.	≥100%Nominal Capacity

		The discharge capacity is measured with 1 C_5A discharge current and 2.0V cut-off voltage after full charged.	1C/0.5C=97%
		The discharge capacity is measured with 3 C_5A discharge current and 2.0V cut-off voltage after full charged.	3C/0.5C=90%

6.Environment Characteristics.

No.	Items	Test Method and Condition	Criteria
1	Temperature Performance	Cells shall be charged according to 5.1 and discharged at 0.2C_5A to 2.0 V. Cells shall be stored for 4 hours at the test temperature prior to discharging and then shall be discharged at the test temperature, The percentage shall be calculated using discharging capacity compared to the minimum capacity.	No leakage, No Appearance defect
2	Constant Temperature and Humidity	Under the temperature of 23±2℃, after charging the cell with 0.2C_5A ,then put the cell into the constant temperature and humidity oven with 40±2℃and 90～95% for 48h，then store the cells at RT for 2hrs, and discharge the cells with 0.2C_5A to 2.0 volts	The cell should be no deformation, no rust, no leakage, no fire, no smoking and no explosion. Discharge time ≥3h
3	Free Fall Test)	The fully charged cell is dropped three times from a height of 1000 mm (the lowest point of the cell) onto a concrete floor. The cells or batteries are dropped so as to obtain impacts in random orientations. After the test, the cell shall be put on rest for a minimum of one hour and then a visual inspection shall be performed.)	No explosion, No fire,No smoke. The OCV after the test no less than 90% before free-fall test.)
4	Vibration Test	A full-charged cell is to be subjected to simple harmonic motion with amplitude of 0.8mm total maximum excursion. The frequency is to be varied at the rate of 1 hertz per minute between 10 and 55 hertz. After the test is completed, And the cell returned to the starting position. The cell shall be vibrated for 90~100 minutes per axis of XYZ axes. The samples should be observed for 6 hours after the test，and also check the weight loss of cells before and after the test	Not explosion, No fire, No leakage, Mass loss ≤ 0.1%

5	Crush Test	A full charged cell is to be crushed between two flat surfaces. The force for the crushing is applied by a hydraulic ram exerting a force of 13±1KN. Once the maximum force has been applied, or an abrupt voltage drop of one- third of the original voltage has been obtained, or 10% of deformation has occurred compared to the initial dimension, the force is released)	No explosion No fire
6	Shock Test	The full charged cell has only two axes of symmetry in which case only two directions shall be tested. Each shock is to be applied in a direction normal to the face of the cell. For each shock the cell is to be accelerated in such a manner that during the initial 3 milliseconds the minimum average acceleration is 75 g. The peak acceleration shall be between 125 and 175g. The samples should be observed for 6 hours after the test，and also check the weight loss of cells before and after the test. Cells shall be tested at a temperature of 20±5℃.)	No explosion, No fire, No leakage. Mass loss≤0.1%)
7	Altitude Simulation Test	The full-charged cells are to be stored for 6 hours at an absolute pressure of 11.6 KPa and a temperature of 20±3	No explosion, No fire, No leakage. Mass loss≤0.1%)

7.Safety Characteristics

No.	Items	Test Method and Condition	Criteria
1	Short Circuit	Each test sample cell is to be short-circuited by connecting the positive and negative terminals of the cell with a Cu wire having a maximum resistance load of 80±20mΩ. The sample is to discharge until a fire or exposition is obtained, or until it has reached a completely discharge state of less than 0.2V and the sample case temperature has returned to ±10 of the ambient temperature. Tests are to ℃ be conducted at 20±5℃ and 55±5℃. Cell Condition: Fresh, Fully charged cell	No fire，No explosion；Max.Temp, of battery surface should not exceed 150℃

2	Over-charge Characteristics	The battery is charged at a 3 C_5A constant current with a voltage limit of 4.8V for 8 hours after fully charged.	No fire，No explosion；Max.Temp, of battery surface should not exceed 150℃
3	Over Discharge	After standard charge.Cells are discharged at constant Current of 0.2C_5A to 2.0V, and the positive and negative terminal is connected by a 30Ω wire for 24 hours. Cell Condition: Fresh, Fully charged cell	No explosion No fire
4	Hot oven Characteristics	The fully charged battery is placed the battery in the hot box，then rose to 130℃±2℃ in the temperature to 5℃±2℃/min rate , insulation 30min.	No explosion No fire
5	Forced Discharge	The cell shall be discharge to 2.0V with the current 0.2C_5A, then the discharge cell is subjected to reverse charge at 1.0C_5A for not less than 90minutes	No explosion No fire
6	High Temperature Storage Test)	Put cell into the 80℃ box and keep the cell in the box for 7 hours after it be charged according to 6.1, and then take it out. Cell Condition: Fresh, Fully charged cell	No explosion No fire
7	Thermal-cold Cycling Performance Test)	The full-charged cell is placed in 75±2℃ for 6h, and then put the Cell in -40℃ for 6h; change temperature time <30min, then repeat it for 10 cycles. Finally the cell is placed in room temperature for 24h. Watch the appearance of cell	No explosion, No fire, No smoke, Open circuit voltage changed not less than 90%, mass loss limit: ≤0.1%)
8	Impact Test)	A test sample cell is to be placed on a flat surface. A 15.8 ± 0.1mm diameter bar is to be placed across the center of the sample. A 9.1Kg±0.46Kg mass is to be dropped from the height of 610 ± 25mm to the center of the cell vertically. Cell Condition: Fresh, Fully charged cell	No explosion No fire

8. Standard Testing Conditions and Requirements

8.1 Standard Testing Conditions and Requirements

Test should be conducted with new cells within three months after shipment from our factory and

cells shall not be cycled more than five times before test. Unless there is special requirement, test shall be done under temperature of 15~35℃ and relative humidity of 45%~85%.

8.2 Measurement Equipment and Instrumentation

8.2.1 Measurement Tool

With a precision of 0.01mm caliper or higher precision instruments for measuring size, range 0~100mm.

8.2.2 Measurement Voltage

With a precision of 0.01V voltage meter measuring voltage, range 0~20V.

8.2.3 Measurement Current

With a precision of± 0.4% current Ammeter to measure the current, range 0~10A.

8.2.4 Measurement Impedance

The impedance is measured with 1KHz sinusoidal alternating current resistance instrument.

9. Outside Appearance

There should not be any appearance defect such as leakage, rust, deformation, severe blow fire effect on cell performance.

10. Packing/Storage/Shipment

10.1 Pre shipment inspection

The battery should be checked the voltage, resistance and the function of protective circuit before shipment.

10.2 Packing and Shipping

10.2.1

The battery should be in a half state of charge packaging boxes for transport, in the transport process,prevent severe vibration, shock, extrusion, prevent the sun and rain, should be in automobile, train, ship, airplane and other forms.

10.3 Abnormal Condition

Do not use the battery when it's smell like abnormal cell electrolyte because of transport stress, sag,short circuit or any other.

11. Safety precaution and prohibitions

In order to prevent battery leakage, heating, fire, reduced performance or life drops, explosion and other accidents， please do the following provisions of the normal use of battery, and compliance with preventive matters.

11.1 Charging

11.1.1 Charging Current

Charging current should be less than maximum charge current specified in the Product Specification.

Charging with higher current than recommended value may cause damage to cell electrical, mechanical and safety performance and could lead to heat generation or leakage.

11.1.2 Charging Voltage
Charging shall be done by voltage less than that specified in the Product Specification (3.65V/cell).Charging beyond 3.65V, which is the absolute maximum voltage, must be strictly prohibited. The charger shall be designed to comply with this condition. It is very dangerous that charging with higher voltage than maximum voltage may cause damage to the cell electrical, mechanical safety performance and could lead to heat generation, leakage or explosion.

11.1.3 Charging Temperature
The cell shall be charged within 0℃~60℃ range in the Product Specification.

11.1.4
Reverse charging is prohibited. The cell shall be connected correctly. The polarity has to be confirmed before wiring, In case of the cell is connected improperly, the cell cannot be charged. Simultaneously, the reverse charging may cause damaging to the cell which may lead to degradation of cell performance and damage the cell safety, and could cause heat generation, leakage or explosion.

11.2 Discharging

11.2.1 Discharging Current
The cell shall be discharged at less than the maximum discharge current specified in the Product Specification. High discharging current may reduce the discharging capacity significantly or cause
over-heat.
11.2.2 Discharging Temperature
The cell shall be discharged within -10℃~60℃range specified in the Product Specification.

11.2.3 Over-Discharging
It should be noted that the cell would be at over-discharged state by its self-discharge characteristics in case the cell is not used for long time. In order to prevent over-discharging, the cell shall be charged periodically to maintain between 3.0V and 3.45V. Over-discharging may causes loss of cell performance,characteristics, or battery functions. The charger shall be equipped with a device to prevent further discharging exceeding a cut-off voyage specified in the Product Specification. Also the charger shall beequipped with a device to control the recharging procedures.

11.3 Exception Handling
Do not use the cell if you find it in unusual conditions such as distortion, leakage (or odors).The cell should be kept away from fire to avoid an explosion.

12. Storage
12.1 Storage temperature and humidity
The cell shall be storied at temperature range of -20 ℃~ +35 ℃，relative humidity of 25~75%，

clearing，drying，ventilated，and kept away from corrosive substances and fire.

12.2 Long Time Storage

If the battery is stored for a long time, the battery should be conducted a cycle of charge and discharge, and the voltage should be about 3.3V and the battery is to be stored at temperature range of

-20 ℃~ +25 ℃, low moisture and corrosive gases environment.

13. Guarantee Period of Quality

The guarantee period of quality extend for one year after code. OSN POWER would replace battery which due to the manufacturing problems and it is not abnormal use, if the battery appears during the abnormal situation.

14. Appearance structure and Size of The Battery