Technical Specification for Sodium-Ion Battery Cell Products

Battery Cell Model: NFSP27174205P-46A

Prepared by: _____ Date: _____

Reviewed by: _____ Date: _____

Approved by: _____ Date: _____

Zmartec Technology(Shenzhen) Ltd

catalogue

1 Scope of Application

This specification describesZmartec Technology(Shenzhen) Ltd（ Hereinafter referred to as: Shengmate Energy (English) ZMARTEC）Detailed technical specifications for square aluminum-cased lithium-ion single cells, including performance requirements, test methods, inspection rules, marking, packaging, transportation, storage, and safety requirements. Users must strictly follow the testing or usage methods outlined in the specification manual. If there are any objections to the testing items or methods in the specification or matters not covered in this manual, please consult with the supplier for resolution.

2 Normative reference documents

The clauses in the following documents become part of this specification by partial reference. However, parties reaching agreements based on this standard are encouraged to consider whether the latest versions of these documents can be used. For undated references, the latest edition of the referenced document applies to this specification.

GB/T 2900.41-2008 "Electrotechnical Terminology - Primary and Storage Cells"

GB/T 36276-2018 "Lithium-ion batteries for electric power storage"

GB/T 31484-2015 "Requirements and Test Methods for Cycle Life of Power Storage Cells for Electric Vehicles"

GB/T 31485-2015 "Safety Requirements and Test Methods for Power Storage Cells Used in Electric Vehicles"

GB 38031-2020 "Safety Requirements for Power Storage Cells Used in Electric Vehicles"

GB/T 31486-2015 "Electric Performance Requirements and Test Methods for Power Storage Cells in Electric Vehicles"

CNESA 1006-2021 "General Specification for Sodium-Ion Batteries"

3 Terms and definitions

3.1 product

The product mentioned in this specification refers to the 160Ah 2.86V rechargeable NFPP square aluminum-cased cell product.

3.2 customer

A customer refers to a company, enterprise, or individual that purchases the products described in this specification.

3.3 cell

The basic unit for realizing the mutual conversion between chemical energy and electric energy.

3.4 Rated voltage

The appropriate voltage approximation for identifying a type of battery cell or an electrochemical system.

3.5 magnification

The abbreviation symbol C, where 1C indicates the current value for charging and discharging the battery cell at a 1-hour rate, and 0.5C indicates the current value for charging and discharging the battery cell at a 2-hour rate.

3.6 Rated charging current

Under the specified test conditions and methods, the charging current that can sustain the operation of the battery cell for a certain period of time.

3.7 Rated discharge current

Under specified test conditions and methods, the battery cell can sustain a discharge current for a certain duration.

3.8 rated current

Under specified test conditions and methods, the battery cell can sustain a current for a certain duration.

3.9 power

The abbreviation symbol P, where 1P indicates the power of the battery cell when charged and discharged at a 1-hour rate, and 0.5P indicates the power of the battery cell when charged and discharged at a 2-hour rate.

3.10 rated power

Under specified test conditions and methods, the battery cell can maintain a certain power output for a certain duration.

3.11 Rated charging power

Under specified test conditions and methods, the battery cell can maintain a charging power for a certain duration of continuous operation.

3.12 Rated discharge power

Under specified test conditions and methods, the battery cell can maintain a certain level of discharge power for a sustained period of time.

3.13 Nominal capacity

Under specified test conditions and methods, the discharge capacity refers to the capacity of a standard charged battery cell when discharged at a rated discharge current until it reaches the discharge cut-off voltage.

3.14 energy density

Under specified test conditions and methods, the ratio of the discharge energy of the battery cell to its weight or volume.

3.15 housing

The protective component that encapsulates the internal components of the battery cell and prevents direct contact with the outside is the container of the battery cell.

3.16 catch fire

Any sustained combustion lasting for more than 1 second in any part of the battery cell constitutes a fire, while sparks and arcing do not.

3.17 explosion

The battery cell casing has ruptured, accompanied by a loud noise, and solid substances and other main components have been ejected.

3.18 leakage

The internal liquid of the battery cell leaks to the outside of the casing.

4 Battery cell model and external dimensions

4.1 model

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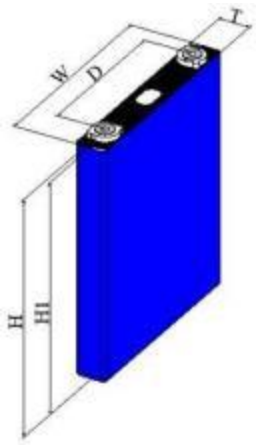
4.2 Overall dimensions

project	description	size	
T	Thickness at 50% SOC	26.8±0.5mm	
W	width	174.0±1.0mm	
H1	Height (excluding the pole)	201.3±0.5mm	
H	Height (total height)	205.5±1.0mm	
D	Center-to-center distance between positive and negative pole terminals	129.3±0.5mm	

5 Basic Performance

project	specs	remark
Rated capacity / Ah	46	1C@2.0~4.2V&25±2℃
Nominal voltage / V	3.6	
AC internal resistance / mΩ	<0.4	50%SOC
Standard charging	1C（46A）to 4.2V	25±2℃
Standard discharge	1C（46A）to 2.0V	
Maximum continuous charging current / A	200（4C）	25±2℃
Maximum continuous discharge current / A	500（10C）	25±2℃
Maximum continuous charging power/W	350（2P）	25±2℃
Maximum continuous discharge power/W	1400(8P)	25±2℃
It is recommended to use the SOC window	10%~95%	2.60V~4.15V
Charging temperature / ℃	-20~-10℃	0.3C
	-10~5℃	0.4C
	5~10℃	1C
	10~40℃	2C
	40~55℃	1C
Discharge temperature / ℃	-40~-60℃	5C (max) cut-off voltage 2.1V
	-30~-20℃	6C (max) cut-off voltage 2.3V
	-20~45℃	8C (max) cut-off voltage 2.6V
	45~55℃	5C (max) cut-off voltage 2.6V
Storage temperature / ℃	-30～45℃	/
Battery cell weight / kg	1.85±0.05	/

6 Test method and conditions

6.1 Standard test conditions

The tested battery cells must be new ones that have been produced by our company within the past month and have not undergone more than 5 charge-discharge cycles. Except for other special requirements, the testing conditions specified in this product specification are: temperature 25±2℃, relative humidity 15%~90%RH, and atmospheric pressure 86kPa~106kPa. The term "normal temperature" referred to in this specification refers to a temperature of 25±2℃.

6.2 Test equipment requirements

The precision of the instrument for measuring dimensions should be greater than or equal to 0.01mm, with an accuracy of ±0.1%.

The accuracy of measuring voltage and current should not be lower than level 0.5, and the internal resistance during voltage measurement should not be less than 10k Ω/V.

The current accuracy of the battery cell testing system should be ±0.1%, the constant voltage accuracy should be ±0.5%, and the timing accuracy should not be lower than ±0 1%.

The accuracy of the instrument for measuring temperature is ±0.5℃.
The accuracy of the device for measuring mass is ±0 1%.

6.3 Standard charging

Charge at 25±2℃ with a constant current and voltage of 1C (46A) until reaching 4.2V, with a cut-off current of 0.05C (2.3A).

6.4 Standard discharge

Discharge at 25±2℃ with a constant current of 1C (46A) until the voltage reaches 2.0V.

7 Battery cell performance

7.1 cyclic performance

Inspection Item	sampling method	Inspection instrument	detection method	Inspection Standard
Normal temperature circulation	random selection	Detection cabinet/Constant temperature incubator	1. Put on hold for 1 minute 2. 1C constant current discharge until reaching 2.6V 3. Put on hold for 30 minutes 4. 1C constant current and constant voltage charging until reaching 4.15V, with a cut-off current of 0.05C 5. Set aside for 30 minutes 6. 1C constant current discharge until reaching 2.6V 7. Cycle 3-6, with 6500 steps 8. end	The capacity retention rate after 6000 cycles is ≥80%

High temperature cycle (45℃)	random selection	Inspection cabinet/thermostatic chamber	1. Put on hold for 1 minute 2. 1C constant current discharge until 2.6V 3. Put on hold for 30 minutes 4. 1C constant current and constant voltage charging until reaching 4.05V, with a cut-off current of 0.05C 5. Put on hold for 30 minutes 6. 1C constant current discharge until reaching 2.6V 7. Cycle 3-6, 2500 steps 8. end	The capacity retention rate after 2000 cycles is ≥80%

7.2 High and low temperature discharge

Inspection Item	Detection method	Inspection instrument	detection method	Inspection Standard
High-temperature discharge	random selection	Inspection cabinet/ Programmable thermostat Constant humidity chamber	1. The initial capacity of the battery cell is tested based on standard charging and discharging (1C), with the discharge capacity recorded as C0. 2. Charge at a constant current and voltage of 1C(46A) to 4.2V at 25±2℃, with a cut-off current of 0.05C. 3. Place the battery at 55±2℃ for 5 hours, and then discharge it at a constant current of 1C (46A) to 2.6V in an environment at 55±2℃. The discharge capacity is recorded as C1. After being placed in a laboratory environment for 2 hours, visually inspect the appearance of the battery cell.	C1≥98% C0, with no deformation or bursting observed on the appearance of the battery cell
Low-temperature discharge	random selection	Inspection cabinet/ Programmable thermostat Constant humidity chamber	1. The initial capacity of the battery cell is tested based on standard charging and discharging (1C), with the discharge capacity recorded as C0. 4. Charge at a constant current and voltage of 1C(46A) to 4.2V at 25±2℃, with a cut-off current of 0.05C. 2. Place the battery at a constant temperature of -20±2℃ for 24 hours, and then discharge it at a constant current of 1C (46A) to 2.6V at -20±2℃. Record the discharge capacity as C1. After placing the battery in a laboratory environment for 2 hours, visually inspect the appearance of the battery cell.	C1≥90% C0, with no deformation or bursting observed on the cell appearance

7.3 Storage performance

Inspection Item	Detection method	Inspection instrument	detection method	Inspection Standard
High-temperature storage	random selection	Inspection cabinet/ Programmable thermostat Constant humidity chamber	1. The initial capacity of the battery cell is tested based on standard charging and discharging (1C), with the discharge capacity recorded as C0. 2. The battery cell is charged according to the standard charging method. 3. After standard charging, discharge at a current of 1C for 30 minutes in an environment with a temperature of 25±2℃. 4. Leave it at a constant temperature of 45±2℃ for 28 days, and then let it stand at 25±2℃ for 5 hours. 5. Charge at a constant current and voltage of 1C to 4.2V at an environment temperature of 25±2℃, with a cut-off current of 0.05C. 6. Under an environment of 25±2℃, discharge at 1C until the terminal voltage reaches 2.0V, and record the discharge capacity as C1.	$C_1 \geq 95\% C_0$

7.4 Charge retention and capacity recovery

Inspection Item	Detection method	Inspection instrument	detection method	Inspection Standard
High-temperature charge retention and capacity recovery	random selection	Inspection cabinet/ Programmable thermostat Constant humidity chamber	1. The initial capacity of the battery cell is tested based on standard charging and discharging (1C), with the discharge capacity denoted as C_0. 2. Under an environment of 25±2℃, charge at a constant current and voltage of 1C (46A) until reaching 4.2V, with a cut-off current of 0.05C. 3. Under an environment with a temperature of 55±2℃, it is placed at a constant temperature for 7 days, then placed at 25±2℃ for 5 hours, and discharged at 1C to a terminal voltage of 2.0V under 25±2℃. The discharge capacity is recorded as C1. 4. Charge at a constant current and voltage of 1C (46A) to 4.2V in an environment with a temperature of 25±2℃, with a cut-off current of 0.05C. 5. Under an environment of 25±2℃, discharge at 1C until the terminal voltage reaches 2.0V, and record the discharge capacity as C2.	$C_1 \geq 85\% C_0$ $C_2 \geq 95\% C_0$

Normal temperature charge retention and capacity recovery	random selection	Inspection cabinet/blast oven	1. The initial capacity of the battery cell is tested based on standard charging and discharging (1C), with the discharge capacity recorded as C0. 2. Under an environment of 25±2℃, charge at a constant current and voltage of 1C (46A) until reaching 4.2V, with a cut-off current of 0.05C. 3. Place it at a constant temperature of 25±2℃ for 28 days, and then discharge it at 1C to a final voltage of 2.0V at 25±2℃. The discharge capacity is recorded as C1. 4. Under the environment of 25±2℃, charge to 4.2V with a constant current of 1C (46A) and a constant voltage, with a cut-off current of 0.05C. 5. Under an environment of 25±2℃, discharge at 1C until the terminal voltage reaches 2.0V, and record the discharge capacity as C2.	C1≥94% C0 C2≥97% C0

7.5 Safety performance test

Inspection Item	Detection method	Inspection instrument	**detection method**	Inspection Standard
overcharge	random selection	Test cabinet/explosion-proof box	1. The battery cell is placed in an explosion-proof box and charged at a constant current and voltage of 1C (46A) until it reaches 4.2V, with a cut-off current of 0.05C. 2. After charging at a constant current and voltage of 1C (46A) until reaching 6.3V, or after charging for 1.5 hours, stop charging and observe for 1 hour.	No fire, no explosion
over-discharge	random selection	Test cabinet/explosion-proof box	1. The battery cell is placed in an explosion-proof box and charged at a constant current and voltage of 1C (46A) until it reaches 4.2V, with a cut-off current of 0.05C. 2. Discharge at 1C current for 90 minutes, and observe for 1 hour.	No fire, no explosion, no leakage
short circuit	random selection	Test cabinet/explosion-proof box/temperature recorder	1. The battery cell is placed in an explosion-proof box and charged at a constant current and voltage of 1C (46A) until it reaches 4.2V, with a cut-off current of 0.05C. 2. Short-circuit the positive and negative electrodes of the battery cell with a 20±5mΩ resistor for 60 minutes, then observe it for 6 hours. During the test, monitor the temperature change of the battery cell with a point thermometer that has a continuous recording function.。	No fire, no explosion
fall	random selection	Falling platform	1. The battery cell is charged at a constant current and voltage of 1C (46A) until it reaches 4.2V, with a cut-off current of 0.05C. 2. Drop the positive and negative terminals of the battery cell from a height of 1.5m onto the concrete floor, and observe for 1 hour.	No fire, no explosion, no leakage
Thermal abuse test	random selection	high temperature chamber	1. The battery cell is charged at a constant current and voltage of 1C (46A) until it reaches 4.2V, with a cut-off current of 0.05C. 2. Place the battery cell in the high-temperature chamber, adjust the temperature of the chamber to rise at 5℃/min to 130℃±2℃, maintain it for 30 minutes, then stop heating and observe for 1 hour.	No fire, no explosion

extrude	random selection	Extruder/multimeter	1. The battery cell is charged at a constant current and voltage of 1C (46A) until it reaches 4.2V, with a cut-off current of 0.05C. 2. A semi-cylinder with a radius of 75mm (the length of the cylinder is greater than the size of the battery cell) is used to press between the two largest surfaces of the battery cell at a speed of 5±1m/s. The pressing is stopped when the battery cell voltage indicates 0V, the deformation reaches 15%, or the pressing force reaches 100kN. Observations are made for 1 hour.	No fire, no explosion
acupuncture	random selection	Needle punching machine	1. The battery cell is charged at a constant current and voltage of 1C (46A) until it reaches 4.2V, with a cut-off current of 0.05C. 2. A heat-resistant steel needle with a diameter of 8mm is pierced through the geometric center perpendicular to the large surface of the cell at a speed of 25± 5mm/s, with the steel needle remaining inside the cell.	No fire, no explosion
low pressure	random selection	Inspection cabinet/Vacuum box	1. The battery cell is charged at a constant current and voltage of 1C (46A) until it reaches 4.2V, with a cut-off current of 0.05C. 2. Place the battery cell into a low-pressure chamber, adjust the pressure to 11.6 kPa, let it stand at room temperature for 6 hours, and then remove it for observation for 1 hour.	No fire, no explosion

8 Visual inspection

No appearance defects that affect the performance of the battery cell are allowed, such as cracks, fissures, leaks, etc.

9 shipment

The single cell is shipped at 2.0~2.5V or as per customer requirements. The remaining capacity of the cell after shipment and before charging depends on the storage time and conditions.

10 quality assurance

(1) From the date of shipment, the shelf life of the battery cells is determined by the contract. However, within this period, if the quality issue of the battery cells is caused by customer misuse rather than ZMARTEC's manufacturing process, ZMARTEC does not promise to replace them for free.

(2) ZMARTEC shall not be held liable for any issues arising from operations conducted in violation of safety regulations.

(3) ZMARTEC shall not be held liable for any issues arising from the use of its products in conjunction with circuits, battery packs, or chargers

(4) Defective batteries that occur during the battery assembly process by the customer after shipment are not covered by ZMARTEC's quality assurance.

11 Safety regulations

Abusing sodium-ion rechargeable batteries may cause damage to the batteries or personal injury. Before using sodium-ion rechargeable batteries, please carefully read the following safety guidelines:

Note 1: If the customer intends to operate or apply the battery cell under conditions not specified in this document, please consult with Shengmate for relevant matters first.

Note 2: Shenmate shall not be held liable for any accidents arising from the use of this battery cell outside the conditions specified in this document.

11.1 Precautions for battery cells

（1） Do not expose the battery cell to extreme heat or an environment with sparks.

（2） Do not short circuit, overcharge, or overdischarge the battery cell.

（3） Do not subject the battery cell to excessive mechanical shock.

（4） Do not immerse the battery cell in seawater or water, or allow it to absorb moisture.

(5) Do not reverse the positive and negative poles of the battery cell.

(6) Do not disassemble or refurbish the battery cell.

(7) Do not store it together with metal items such as necklaces, coins, or hairpins.

(8) Do not subject the battery cell to significant damage or deformation.

(9) Do not connect the battery cell to the socket.

(10) Do not directly touch the leaking battery cell.

(11) Do not use the battery cell in other devices.

(12) Do not mix sodium-ion batteries for use.

(13) Do not place the battery cell in direct sunlight.

(14) Keep the battery cell out of reach of children.

(15) Do not prick, hammer or trample on the battery cells.

(16) Do not impact or throw the battery cell.

11.2 Battery cell usage instructions

11.2.1 charge

(a) The charging temperature range for the battery cell is 5℃~55℃.

(b) Charge at a constant current and voltage of 1C until reaching 4.2V, with a cut-off current of 0.05C. (C: nominal capacity).

(c) Use a charger specifically designed for sodium-ion batteries.

(d) Do not charge continuously beyond the standard time.

(e) Connect the positive and negative poles of the battery cell correctly, and strictly prohibit reverse charging. If the positive and negative poles of the battery cell are connected reversely, it will be impossible to charge the battery cell. Additionally, reverse charging will reduce the charging and discharging performance and safety of the battery cell, and may cause heating and leakage.

11.2.2 **discharge**

(a) The discharge temperature range of the battery cell is -40℃~55℃.

(b) The discharge cut-off voltage is 2.0V (> -20℃).

(C) It should be noted that during the long-term non-use of the battery cell, it may enter anover-discharge state due to other self-discharge characteristics. To prevent discharge, the battery cell should be charged regularly to maintain its voltage between 3.5~3.7V. Over-discharge can lead to the loss of battery cell performance and functionality.

11.2.3 Connection of battery cells

It is recommended to use laser welding to connect the battery cell with the protection circuit module or other parts.

11.2.4 Installation of battery cells

The wide side of the battery cell should be installed inside the casing, and the battery cell must not move inside the casing.

11.2.5 Storage suggestions

(a) The battery cells should be stored in an environment with a temperature range of -30~45℃, a relative humidity of <85%, and free from corrosive gases.

(b) For long-term storage, if the batteries are to be stored for an extended period (≥3 months), they should be stored in an environment with a temperature range of -20~25℃, a relative humidity of <65%, and free from corrosive gases.