



Technical Specification for Sodium-Ion
Battery Cell Products

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Technical Specification for Sodium-Ion Battery Cell Products

Battery Cell Model: NFPP71174207P-160A

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Zmartec Technology(Shenzhen) Ltd

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1 Scope of Application

This specification describes Zmartec Technology (Shenzhen) Ltd (hereinafter referred to as: Zmartec

Detailed technical specifications for the ZMARTEC square aluminum-cased sodium-ion single cell include 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 described in the specification, or if there are any 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.

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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.

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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

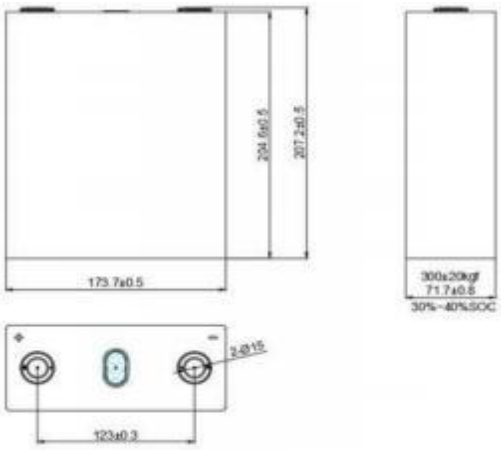
The internal liquid of the battery cell leaks to the outside of the casing.

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	71.7±0.8mm	
W	width	173.7±0.5mm	
H1	Height (excluding the pole)	204.6±0.5mm	
H	Height (total height)	207.2±0.5mm	
D	Center-to-center distance between positive and negative pole terminals	123.0±0.3mm	

5 Basic Performance

project		specs	remark
Rated capacity / Ah		160	0.5P@1.5~3.45V&25±2°C
Nominal voltage / V		2.86	
Rated energy/Wh		450	
AC internal resistance / mΩ		<0.3	50%SOC
Standard charging		0.5P (225W) to 3.45V	25±2°C
Standard discharge		0.5P (225W) to 1.5V	
Maximum charging		1P (450W) to 3.45V	
Standard discharge		1P (450W) to 1.5V	
Charging temperature / °C		0~60°C	/
Discharge temperature / °C		-40~-70°C	/
Storage temperature / °C	1 year	0~35°C	/
	1 month	-20~45°C	/
Battery cell weight / kg		4.3±0.30	/

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°C, 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°C.

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°C.

The accuracy of the device for measuring mass is ±0.1%.

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6.3 Standard charging

Charge at $25\pm 2^{\circ}\text{C}$ with a constant power of 0.5P (225W) until reaching 3.45V.

6.4 Standard discharge

Discharge at $25\pm 2^{\circ}\text{C}$ with a constant power of 0.5P (225W) until reaching 1.5V.

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	<ol style="list-style-type: none"> Put on hold for 1 minute Discharge at a constant power of 0.5P until reaching 1.5V Set aside for 30 minutes Charge at a constant power of 0.5P until reaching 3.45V Put on hold for 30 minutes Discharge at a constant power of 0.5P until reaching 1.5V Cycle 3-6, 12000 work steps end 	6000 cycles capacity Retention rate \geq 80%; 10,000 cycles capacity The quantity retention rate is \geq 70%

7.2 High and low temperature charging and discharging

Inspection Item	Detection method	Inspection instrument	detection method	Inspection Standard
High-temperature charging and discharging	random selection	Inspection cabinet/Programmable thermostat Constant humidity chamber	<ol style="list-style-type: none"> The initial energy of the battery cell is tested based on standard charging and discharging (0.5P), with the discharge energy recorded as E0. Place the battery at a constant temperature of $45\pm 2^{\circ}\text{C}$ for 5 hours, charging it at a constant power of 0.5P until it reaches 3.45V. After resting for 30 minutes, charge it at a constant power of 0.5P until it reaches 1.5V, and record the discharge energy as E1. After placing the battery in a laboratory environment for 2 hours, visually inspect the appearance of the battery cell. 	$E1 \geq 98\% E0$, Energy efficiency is $\geq 93\%$; The appearance of the battery cell shows no deformation or cracking
Low temperature charging and discharging	random selection	Inspection cabinet/Programmable thermostat Constant humidity chamber	<ol style="list-style-type: none"> The initial energy of the battery cell is tested based on standard charging and discharging (0.5P), with the discharge energy recorded as E0. Place the battery at a constant temperature of $5\pm 2^{\circ}\text{C}$ for 5 hours, maintaining a constant power of 0.5P until it reaches 3.45V. After resting for 30 minutes, discharge the battery at a constant power of 0.5P until it reaches 1.5V, and record the discharge energy as E1. After placing the battery in a laboratory environment for 2 hours, visually inspect the appearance of the battery cell. 	$E1 \geq 80\% E0$, Energy efficiency $\geq 80\%$; the appearance of the battery cell is free from deformation and bursting

7.3 Charge retention and capacity recovery

Inspection Item	Detection method	Inspection instrument	detection method	Inspection Standard
Normal temperature charge retention and capacity recovery	random selection	Inspection cabinet/blast oven	<ol style="list-style-type: none"> The initial energy of the battery cell is tested based on standard charging and discharging (0.5P), and the energy is recorded as E0. At an ambient temperature of $25\pm 2^{\circ}\text{C}$, charge at a constant power of 0.5P until 3.45V. Under the environment of temperature $25\pm 2^{\circ}\text{C}$, it is placed at a constant temperature for 30 days, and then Under an environment of $25\pm 2^{\circ}\text{C}$, discharge at 0.5P until the terminal voltage reaches 1.5V, and record the discharge energy as E1. Charge at a constant power of 0.5P at an environment temperature of $25\pm 2^{\circ}\text{C}$ until 3.45V. Under an environment of $25\pm 2^{\circ}\text{C}$, discharge at 0.5P until the terminal voltage reaches 1.5V, and record the energy as E2. 	E1 \geq 95% E0 E2 \geq 97% E0
High-temperature charge retention and capacity recovery	random selection	Inspection cabinet/blast oven	<ol style="list-style-type: none"> The initial energy of the battery cell is tested based on standard charging and discharging (0.5P), and the energy is recorded as E0. Charge at a constant power of 0.5P under an environment temperature of $45\pm 2^{\circ}\text{C}$ until 3.45V. Place it at a constant temperature of $45\pm 2^{\circ}\text{C}$ for 30 days, then place it at a constant temperature of $25\pm 2^{\circ}\text{C}$ for 5 hours, and discharge it at 0.5P until the terminal voltage reaches 1.5V. The discharge energy is recorded as E1. Charge at a constant power of 0.5P to 3.45V in an environment with a temperature of $25\pm 2^{\circ}\text{C}$, and then let it sit for 30 minutes. Under an environment of $25\pm 2^{\circ}\text{C}$, discharge at 0.5P until the terminal voltage reaches 1.5V, and record the energy as E2. 	E1 \geq 95% E0 E2 \geq 95% E0

7.4 Safety performance test

Inspection Item	Detection method	Inspection instrument	detection method	Inspection Standard
overcharge	random selection	Test cabinet/explosion-proof box/test fixture	<ol style="list-style-type: none"> The battery cell is placed in an explosion-proof box and charged to 3.45V at 0.5P. Install the test fixture with a pre-tightening force of $300\pm 20\text{kgf}$. Charge it to 5.175V with a constant current of 76A, or stop charging after 1 hour. Observe for 1 hour. 	"No fire, no explosion, not at the explosion-proof valve or pressure relief point." Cracks occur in the external position

over-discharge	random selection	Test cabinet/explosion-proof box/test fixture	<ol style="list-style-type: none"> The battery cell is placed in an explosion-proof box and charged to 3.45V at 0.5P. Install the test fixture with a preload of 300 ± 20kgf, discharge for 90 minutes at 76A current, or stop discharging when the voltage reaches 0V, and observe for 1 hour. 	It should not emit smoke, catch fire, explode, or leak liquid, and should not be released at locations other than the explosion-proof valve or pressure relief point
short circuit	random selection	Test cabinet/explosion-proof Box/temperature recorder	<ol style="list-style-type: none"> The battery cell is placed in an explosion-proof box and charged to 3.45V at 0.5P. Short-circuit the positive and negative terminals of the battery cell externally for 10 minutes using an external circuit with a resistance of less than $1m\Omega$, then observe it for 1 hour. During the test, monitor the temperature change of the battery cell using a thermometer with continuous recording function. 	No fire, no explosion, and no rupture should occur at locations other than the explosion-proof valve or pressure relief point
fall	random selection	Falling platform	<ol style="list-style-type: none"> The battery cell maintains a constant power output of 0.5P until it reaches 3.45V. 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, and no rupture should occur at locations other than the explosion-proof valve or pressure relief point
heat	random selection	high temperature chamber	<ol style="list-style-type: none"> The battery cell operates at a constant power of 0.5P until it reaches 3.45V. Place the battery cell in a high-temperature chamber, adjust the temperature of the chamber to rise at $5^{\circ}\text{C}/\text{min}$ to $130^{\circ}\text{C} \pm 2^{\circ}\text{C}$, maintain it for 30 minutes, then stop heating and observe for 1 hour. 	No fire, no explosion, and no rupture should occur at locations other than the explosion-proof valve or pressure relief point
extrude	random selection	Extruder/multimeter	<ol style="list-style-type: none"> The battery cell maintains a constant power of 0.5P until it reaches 3.45V. Compress the surface between the two largest areas of the cell using a semi-cylinder with a radius of 75mm (the length of the cylinder exceeds the size of the cell) at a speed of 5 ± 1m/s. Cease compression when the cell voltage indicates 0V, the deformation reaches 30%, or the compressive force attains 200kN. Observe for 1 hour. 	No leakage, no smoke, no fire, no explosion, and no rupture should occur at locations other than the explosion-proof valve or pressure relief point

low pressure	random selection	Inspection cabinet/vacuum chamber	<ol style="list-style-type: none"> 1. The battery cell maintains a constant power output of 0.5P until it reaches 3.45V. 2. Install the test fixture with a pre-tightening force of 300 ± 20kgf, place the battery cell into the low-pressure chamber, adjust the pressure to 11.6kpa, let it stand at room temperature for 6 hours, and then remove it for observation for 1 hour. 	It shall not catch fire, explode, or rupture at locations other than the explosion-proof valve or pressure relief point
thermal runaway	random selection	Detection cabinet/explosion-proof box/heating device/temperature recorder	<ol style="list-style-type: none"> 1. Charge at a constant power of 0.5P until reaching 3.45V; 2. Assemble a planar heating device and install a temperature sensor on the side away from heat conduction. 3. Continue charging with a constant current of 76A; 4. Activate the heating device and continuously heat the test object at a power of 650W. When thermal runaway occurs or the temperature at the monitoring point reaches 300°C, or the continuous charging time reaches 4 hours, stop charging and turn off the heating device 5. Observe for 1 hour and record the test results. 6. Whether thermal runaway has occurred should be determined based on the following conditions: <ol style="list-style-type: none"> a) Fire and explosion; b) The temperature rise rate at the monitoring point is $\geq 3^\circ\text{C/s}$ for three consecutive times. 	It shall not catch fire, explode, or rupture at locations outside the explosion-proof valve or pressure relief point. In the event of thermal runaway, the surface temperature shall be $>90^\circ\text{C}$

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.

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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 Instructions for using the battery cell

11.2.1 charge

- (a) The charging temperature range for the battery cell is 0°C~45°C. When the temperature is below 10°C, charging must be done with a small current (no more than 0.2C). Charging is prohibited when the temperature is below 0°C.
- (b) The battery cell operates at a constant power of 0.5P up to 3.45V. (P: Nominal Energy).

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- (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 reverse charging is strictly prohibited. If the positive and negative poles of the battery cell are connected reversely, the battery cell will not be able to be charged. Additionally, reverse charging will reduce the charging and discharging performance and safety of the battery cell, and can lead to heating and leakage.

11.2.2 discharge

- (a) The discharge temperature range of the battery cell is $-40^{\circ}\text{C}\sim 60^{\circ}\text{C}$.
- (b) The discharge cut-off voltage is 1.5V.
- (c) It should be noted that during long-term non-use, the battery cell may enter an over-discharged state due to its self-discharge characteristics. To prevent discharge, the battery cell should be charged regularly to maintain its voltage between 2.0~2.5V. 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 $-20^{\circ}\text{C}\sim 45^{\circ}\text{C}$, 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 $15^{\circ}\text{C}\sim 25^{\circ}\text{C}$, a relative humidity of $<65\%$, and free from corrosive gases.