Specification Document for Cylindrical Sodium-Ion Battery

Model: NaCR26700-MP3.0

Nominal capacity: 3.0 Ah

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Approved by: Chen Wei

Issuing Department: Product Center

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Authorized Strength		Examine and Verify		Ratify	

Liyang Zhongke Hainao Technology Co., Ltd.

Catalogue

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Product Change History Form

Edition	Change Content	Change Date	Authorized Strength	Examine and Verify	Ratify
A	First Edition Release	2023-08-04	Fang Donglin	Wei Xiaomin	Chen Wei

1. Scope of Application

This product specification document describes the performance indicators of the sodium-ion battery model NaCR26700-MP3.0 provided by Liyang Zhongke Hainao Technology Co., Ltd. The product utilizes a transition metal oxide-based cathode material system, exhibiting excellent low-temperature performance, high-rate capability, and resistance to over-discharge.

The performance indicators of this product are primarily evaluated based on the following standards:

GB 38031 "Safety Requirements for Power Batteries for Electric Vehicles"

GB/T 31486 "Electrical Performance Requirements and Test Methods for Power Batteries for Electric Vehicles"

GB/T 31484 "Evaluation of Performance Indicators for Cycle Life Requirements and Test Methods of Power Batteries for Electric Vehicles"

GB/T 31485—2015 "Safety Requirements and Test Methods for Power Batteries for Electric Vehicles"

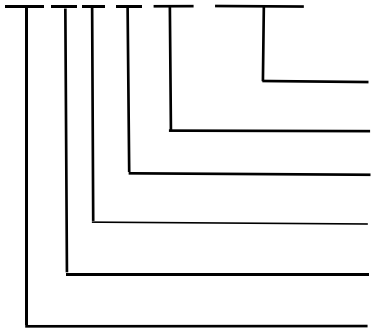
UL 1642

2. Product Type

2.1 Name: Cylindrical Sodium-Ion Battery

2.2 Model: Na C R 26700-MP3.0

Model: Na C R 26 670-MP3.0



3.0 Ah medium power

altitude

diameter

circular column

copper base

sodion

3. Battery Parameters

3.1 Essential Parameter

Order Number	Project	Standard		Remarks
1	Nominal Capacity @ 3.95 ~ 2.0 V	3.0	Ah	0.2C Discharge @25°C
2	Rated Voltage	3.0	V	
3	Interior Resistance of Communication	≤ 18	mΩ	AC 1 kHz, 3.2 V
4	Direct Current Internal Resistance	≤ 35	mΩ	2C 30 s, 3.2 V
5	Battery Weight	86 ± 3	g	
6	Battery Size	Diameter： Φ26.3±0.1 Height: 70.6 ± 0.2	mm	Outline Dimension
7	Charge Termination Voltage	3.95 3.8	V	0°C < T -10°C ≤ T ≤ 0°C
8	Current Charging Current	150 (0.05C) 300 (0.1C)	mA	T > 0°C T ≤ 0°C
9	Discharge Cutoff Voltage	2.0	V	Can Discharge to 0 V
10	Standard Continuous Charging Current	1500	mA	0.5C
11	Maximum Continuous Charging Current	6000	mA	2C CC charge to 3.95V, charge capacity> 90%, temperature rise <20 ℃
12	Standard Continuous Discharge Current	1500	mA	0.5C
13	Maximum Continuous Discharge Current	9000	mA	3C CC to 2 V discharge capacity> 90% temperature rise <20°C
14	Energy Density	≥ 100	Wh/kg	

3.2 Electrical Performance Parameters

3.2.1 Charging Performance

Project	Sub-Item	Battery Surface Temperature	Standard Charging	Quick Charge	Pulse Current Charge
Charge Function	Temperature and Charging Performance	> 70℃	Charging Is Not Allowed		
		45 ~ 70℃	0.5C	1C	Charging Is Not Allowed
		30 ~ 45℃	0.5C	2C	5C and Battery SOC ≤ 40%, Duration <8 Min
		15 ~ 30℃	0.5C	1C	3C and Battery SOC ≤ 50%, Duration <15 Minutes
		0 ~ 15℃	0.2C	0.5C	Charging Is Not Allowed
		-10 ~ 0℃	0.2C (3.8 V) 80% SOC	Charging Is Not Allowed	
	Sub-Item	Battery Surface Temperature	Size of Product	Condition	
	Multiplying Power	25℃ ± 2℃	Charging Capacity ≥ 95% of Rated Charging Capacity	2C CC to 3.95V Temperature Rise ≤ 8℃	

3.2.2 Discharge Performance

Project	Parameter		Performance Index		Condition
Discharge Performance	Typical Temperature and Discharge Capacity		-30℃	≥ 75%	After 12-Hour Storage, the Discharge Capacity at Standard Discharge Current Relative to the Nominal Capacity
			-20℃	≥ 85%	
			0℃	≥ 90%	
			25℃	≥ 100%	
			45℃	≥ 100%	
			60℃	≥ 95%	
	Discharge Temperature Range		-40℃ ~ 70℃		Whenever the Battery Surface Temperature Exceeds This Threshold, Operation Should Be Stopped.
	Rate discharge capability	Standard Discharge Current	0.5C	≥ 100%	25°C, Relative Capacity Under Standard Charge-Discharge Cycling
		Maximum Continuous Discharge Current	3C	≥ 90%	25°C, Relative Capacity Under Standard Charge-Discharge Cycling
		Maximum pulse discharge current (long duration)	5C	30 s	25°C <battery Surface Temperature <60°C, SOC> 50%
		Maximum pulse discharge current (short duration)	10C	3 s	The Battery Surface Temperature Ranges from 25°C to 60°C, With a State of Charge (SOC) Exceeding 50%.

3.2.3 Memory Property

Project	Sub-Item	Parameter	Performance Index		Condition
Memory Property	Short-Term	Ultra-High Temperature Storage	Conservation Rate	≥ 90%	Nuclear Volume at 25°C, Stored for 3 Days at 75°C, 100% SOC
			Recovery Rate	≥ 98%	
		High Temperature Storage	Conservation Rate	≥ 90%	Nuclear Volume at 25°C, Stored at 45°C for 7 Days, 100% SOC
			Recovery Rate	≥ 98%	
		Cryogenic Storage	Conservation Rate	≥ 95%	Nuclear Volume at 25°C, Stored at-20°C for 7 Days, 100% SOC
			Recovery Rate	≥ 98%	
	Over a Long Period of Time	High Temperature Storage	Conservation Rate	≥ 90%	Nuclear Volume at 25°C, Stored for 90 Days at 35°C, 40% SOC
			Recovery Rate	≥ 98%	
		Room Temperature Storage	Recovery Rate	≥ 98% (28 d ≥ 99%)	Storage at 25°C ± 5°C for 180 Days, 40% SOC

3.2.4 Life Span

Project	Parameter	Performance Index	Condition	Remarks
Life span	High Temperature Cycle	≥ 2000	45°C, 0.5°C, Capacity Retention Rate ≥ 70%	The optimal approach depends on operational conditions. Under high-temperature conditions, it is recommended to reduce DOD usage and avoid constant-voltage charging to prolong service life.
	Room Temperature Cycling	≥ 3000 ≥ 4000	25°C, 0.5C,2–3.95V, Capacity Retention Rate ≥ 70% 25°C, 0.5C,2–3.90 V (95% DOD), Capacity Retention Rate ≥ 70%	
	Magnification Cycle	≥ 2000	25°C, Constant Temperature and Pressure, Capacity Retention Rate ≥ 70%	
	Room Temperature Over-Discharge Characteristic Cycle	100	25°C, 0.5C,0–3.95V Cycling, Capacity Retention Rate ≥ 95%	

3.3 Security Performance

The following tests shall be conducted in equipment equipped with forced exhaust conditions and explosion-proof measures. Prior to the tests, all batteries shall be charged according to the standard charging method specified in 4.1.2 and left undisturbed for 12 hours before proceeding with the subsequent tests.

Project	Test Method	Acceptance Standard
Overdischarge	GB 38031 8.1.2	The Battery Must Not Catch Fire or Explode.
Over-Charging	GB 38031 8.1.3	The Battery Must Not Catch Fire or Explode.
External Short Circuit Test	GB 38031 8.1.4	The Battery Must Not Catch Fire or Explode.
Heat Testing	GB 38031 8.1.5	The Battery Must Not Catch Fire or Explode.
Compression Test	GB 38031 8.1.7	The Battery Must Not Catch Fire or Explode.
Heavy Load Impact Test	UL 1642-14	The Battery Must Not Catch Fire or Explode.

3.4 Environmental Suitability

Project	Test Method	Inspection Criteria and Instructions
Drop Test	GB/T 31485 6.2.5	The Battery Must Not Leak Liquid, Catch Fire, or Explode.
Mechanical Impact Testing	UL1642-15	Impacts During Transportation and Handling Should Not Cause Ignition, Explosion, or Leakage.
Vibration Test	UL1642-16	Vibration During Transportation Should Not Cause Leakage, Ignition, or Explosion.
Temperature Cycling Test	UL1642-18	Repeated Exposure to Extreme Temperatures Should Not Cause Ignition or Explosion.
Low Pressure Test	UL1642-19	During Transportation, It Should Not Cause Any Impact in the Cargo Hold of the Aircraft. Fire or Explosion

4. Test Method

4.1 Standard Test Conditions

4.1.1 Temperature and Humidity

Unless otherwise specified, the product testing conditions in this specification shall be: temperature 25°C ± 2°C; humidity: 65% ± 20% RH.

4.1.2 Standard Charging Method

"Standard charging" refers to the process conducted under ambient temperature conditions of 25°C ± 2°C, where the battery is first charged at a constant current of 0.2C to 3.95V, followed by constant voltage charging at 3.95V until the current decreases to ≤0.05C.

4.1.3 Standard Discharge Method

"Standard discharge" refers to the process of discharging at a constant current of 0.2C to 2.0 V under ambient temperature conditions of 25°C ± 2°C.

4.2 Electrical Performance Testing

4.2.1 Charging Performance

4.2.1.1 Temperature and Charging Performance

After the battery discharge in standard way, the battery is put into the environmental test chamber and kept at the surface temperature value for 6 hours, then the battery is charged in the rate and time of "standard charge", "fast charge" and "pulse charge".

4.2.1.2 Rate Charging

After the battery is discharged according to the standard discharge method, it is placed in an environmental test chamber at 25°C and maintained for 6 hours. Subsequently, the battery is charged at a constant current of 2C until reaching 3.95V.

4.2.2 Discharge Performance

4.2.2.1 Typical Temperature and Discharge Capacity

After charging the battery according to the standard charging method, place the battery into an environmental test chamber at the temperature specified by the performance specifications and maintain it at that temperature for 12 hours. Subsequently, discharge the battery at a rate of 0.5C until reaching 2.0 V.

4.2.2.2 Rate Discharge Capability

After charging the battery according to the standard charging method, place the battery into an environmental test chamber and set the temperature to 25°C, maintaining this temperature for 4 hours. Then discharge the battery at the rate and duration specified in Table 3.2.2 until the voltage reaches 2.0 V.

4.2.3 Memory Property

4.2.3.1 Short-Term

a) ultra-high temperature storage

Charge the battery according to the standard charging method, leave it for 30 minutes, then place the battery in an environmental test chamber set to 75°C and maintain this temperature for 3 days. Remove the battery and place it in the environment specified in 4.4.1 for 6 hours. Finally, discharge the battery according to the standard discharge method.

b) high temperature storage

Charge the battery according to the standard charging method, leave it for 30 minutes, then place the battery in an environmental test chamber and set the temperature to 45°C, maintaining this temperature for 7 days. Remove the battery and place it in the environment specified in Section 4.4.1 for 6 hours. Finally, discharge the battery according to the standard discharge method.

c) cryogenic storage

Charge the battery according to the standard charging method, leave it for 30 minutes, then place the battery in an environmental test chamber and set the temperature to-20°C, maintaining this temperature for 7 days. Remove the battery and place it in the environment specified in Section 4.4.1 for 6 hours. Finally, discharge the battery according to the standard discharge method.

4.2.3.2 Over a Long Period of Time

a) high temperature storage

The battery was charged using standard charging methods, then discharged at 0.5C for 72 minutes followed by a 30-minute rest period. Afterward, the battery was placed in an environmental test chamber at 35°C and maintained at this temperature for 90 days. The battery was then removed and exposed to the environment specified in Section 4.4.1 for 6 hours. The battery was first discharged using standard discharge methods, followed by a 30-minute rest period, then recharged using standard charging methods, and finally discharged again using standard discharge methods.

b) room temperature storage

The battery was charged using standard charging methods, then discharged at 0.5C for 72 minutes followed by a 30-minute resting period. Afterward, the battery was stored in a 25 ± 5°C environment and maintained at this temperature for 180 days. OCV and ACR measurements were collected every 30 days. The battery was subsequently removed and placed in the environment specified in Section 4.4.1 for 6 hours. First, it underwent standard discharge cycling with a 30-minute resting period, then standard charging, and finally underwent standard discharge cycling again.

4.2.4 Life Span

4.2.4.1 High Temperature Cycle

a) Place the battery in an environmental test chamber at 45°C ± 2°C for 4 hours.

b) Charge the battery at a constant current of 0.5C to 3.95 V at 45°C ± 2°C, then charge at a constant voltage of 3.95 V until the current drops below 0.05C, followed by a 30-minute rest period.

c) The battery was discharged at a constant current of 0.5C to 2.0 V at 45℃ ± 2℃ and then left for 30 minutes.

d) Repeat steps b to c until the capacity falls below 70% of the initial capacity.

4.2.4.2 Room Temperature Cycling

a) Place the battery in an environmental test chamber at 25°C ± 2°C for 4 hours.

b) Charge the battery at a constant current of 0.5C to 3.95V at 25°C ± 2°C, then charge at a constant voltage of 3.95V until the current drops below 0.05C, followed by a 30-minute rest period.

c) Discharge the battery at a constant current of 0.5C to 2.0 V at 25°C ± 2°C and hold for 30 minutes.

d) Repeat steps b to c until the capacity decay reaches 70% of the initial capacity.

4.2.4.3 Magnification Cycle

a) Place the battery in an environmental test chamber at 25°C ± 2°C for 4 hours.

b) Charge the battery at a constant current of 2C to 3.95V at 25°C ± 2°C, and leave it undisturbed for 30 minutes.

c) Discharge the battery at a constant current of 2C to 2.0 V at 25°C ± 2°C and hold for 30 minutes.

d) The process is repeated until the capacity is reduced to 70% of the initial capacity.

4.2.4.4 Overdischarge Characteristic Cycle

a) Place the battery in an environmental test chamber at 25°C ± 2°C for 4 hours.

b) Charge the battery at a constant current of 0.5C to 3.95V at 25°C ± 2°C, then charge at a constant voltage of 3.95V until the current drops below 0.05C, followed by a 30-minute rest period.

c) Discharge the battery at a constant current of 0.5C to 0 V at 25°C ± 2°C and hold for 30 minutes.

d) A total of 100 steps b to c were performed during the resumption of work.

4.2.5 Safety Test

4.2.5.1 Overdischarge

The battery was discharged at a constant current of 1C until the discharge time reached 90 minutes, with observation lasting 1 hour.

4.2.5.2 Over-Charging

After standard charging procedure, the battery is charged at a constant current of 1C until reaching 4.345V or 115% State of Charge (SOC), then charging is stopped and the battery is observed for 1 hour.

4.2.5.3 External Short Circuit Test

The positive and negative terminals of the battery were externally short-circuited for 10 minutes (external circuit resistance <5 mΩ), followed by observation for 1 hour.

4.2.5.4 Heat Testing

Place the battery in an electric heating blower drying oven. The temperature is increased from room temperature to 130 ± 2°C at a rate of 5 ± 2°C/min and maintained for 30 minutes before heating is stopped. Observation is performed for 1 hour.

4.2.5.5 Compression Test

The battery is placed between the two extrusion surfaces of the extrusion equipment, with the cylindrical battery core shaft parallel to the extrusion plane. Under an extrusion speed of ≤ 2 mm/s, pressure is gradually increased until the voltage reaches 0 V, or the deformation reaches 15%, or the extrusion force reaches 100 kN or 1000 times the battery weight. The pressure is maintained for 10 minutes, followed by observation for 1 hour.

4.2.5.6 Heavy Load Impact Test

Place the battery on the impact test bench, position a φ15.8 mm steel column at the center of the battery with its longitudinal axis parallel to the plane, and allow a 9.1 kg weight hammer to fall freely from a height of 610 mm to impact the battery. The battery is permitted to deform.

4.2.6 Environmental Suitability

4.2.6.1 Drop Test

After charging the battery according to the standard charging protocol, the positive and negative terminals of the battery sample were freely dropped from a height of 1.5 m onto a concrete surface with the terminals facing downward, and the sample was observed for 1 hour.

4.2.6.2 Mechanical Impact Testing

The batteries are rigidly mounted on the testing equipment in a planar configuration. Each individual battery must withstand three impacts with equal acceleration. Impacts are applied along three mutually perpendicular directions unless the battery has only two symmetry axes. The impact direction should typically be perpendicular to the battery surface. Acceleration requirements: The minimum average acceleration must reach 75g (g-local gravitational acceleration) within the initial 3 ms, with peak acceleration ranging between 125 and 175g. The test temperature is maintained at 25 ± 5°C.

4.2.6.3 Vibration Test

The battery shall withstand vibrations with an amplitude of 0.8 mm, at a frequency ranging from 10 to 55 Hz with a rate of 1 Hz/min, and undergo one cycle within 90 to 100 minutes. The vibration shall be applied along three mutually perpendicular directions. For batteries with only two symmetry axes, testing shall be conducted along directions perpendicular to each axis.

4.2.6.4 Temperature Cycling Test

The battery is placed in a temperature test chamber and subjected to the following cycles:

a) Rise to 70 ± 3°C within 30 minutes and maintain at this temperature for 4 hours.

b) Cool to 20 ± 2°C within 30 minutes and maintain at this temperature for 2 hours.

c) Cool to-40 ± 3℃ within 30 minutes and maintain at this temperature for 4 hours.

d) Rise to 20 ± 2°C within 30 minutes;

e) Repeat the above cycle 9 times;

f) After 10 cycles, the battery was stored at room temperature (20 ± 5°C) for 7 days prior to testing.

4.2.6.5 Low Pressure Test

The sample batteries were stored for 6 hours under absolute pressure of 11.6 KPa and temperature of 20 ± 5°C.

5. Instructions and Precautions

5.1 Battery Usage Instructions

5.1.1 Temperature Gradient Charging Scheme

	SOC	Temperature Gradient (cell Surface Temperature)					
		-10℃ ~ 0℃	0℃ ~ 10℃	10℃ ~ 20℃	20℃ ~ 45℃	45℃ ~ 55℃	55℃ ~ 70℃
Maximum Charging Factor Rate	100%	/	0.05	0.05	0.05	0.05	/
	90%	0.05	0.20	0.75	0.50	0.50	0.50
	80%	0.20	0.50	0.75	2.00	1.00	0.50
	70%	0.20	0.50	0.75	2.00	1.00	0.50
	60%	0.20	0.50	0.75	2.00	1.00	0.50
	50%	0.20	0.50	0.75	2.00	1.00	0.50
	40%	0.20	0.50	0.75	2.00	1.00	0.50
	30%	0.20	0.50	0.75	2.00	1.00	0.50
	20%	0.20	0.50	0.75	2.00	1.00	0.50
	10%	0.20	0.50	0.75	0.75	0.50	0.50
	0%	0.20	0.50	0.50	0.50	0.50	0.50

5.1.2 Transport

The battery is transported at a state of charge (SOC) of 30% to 50%, packaged in boxes for shipping. During transportation, avoid severe vibrations, impacts, or compression, protect from sunlight and rain exposure, and do not invert the battery.

During loading and unloading, products should be handled gently to avoid dropping, rolling, or heavy pressure.

5.1.3 Memory

Batteries stored for over 6 months should be kept in a dry and well-ventilated environment, maintained at a state of charge (SOC) between 20% and 50%, and subjected to one charge-discharge cycle every 6 months.

5.2 Safety Regulations

The misuse of sodium-ion rechargeable batteries may cause battery damage or personal injury. Before using sodium-ion batteries, please carefully read the following safety guidelines:

Note 1: If customers need to operate the battery under conditions other than those specified in this document, please consult Haina Company for relevant matters first.

Note 2: Hydrosodium Corporation shall not be liable for any accidents resulting from the use of this battery beyond the conditions specified in this document.

5.2.1 Battery Protection Measures

a) Do not put batteries in fire or heat them.

b) Do not short-circuit or overcharge the battery.

c) Avoid excessive mechanical impact on the battery.

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

e) Do not reverse the positive and negative terminals of the battery.

f) Do not disassemble or repair the battery.

g) Do not cause significant damage or deformation to the battery.

h) Do not touch a leaking battery directly.

i) Keep batteries out of reach of children.

j) Do not puncture, hammer, or step on the battery.

k) Do not bump or throw batteries.

6. Revision Statement

To continuously improve product quality and performance characteristics, the Company reserves the right to revise product specifications and maintenance features without prior notice to users.

7. Any Other Business

Matters not mentioned in this specification shall be confirmed by our company, which reserves the right to provide final interpretation of the content herein.

8. Appendix

8.1 Battery Size

(Battery color and coding information are subject to the actual product)