Cylindrical Na-Ion Batteries

Specification

Model: NaCR32140-MP10

Nominal Capacity: 10.0 Ah

Documentarian：Donglin Fang

Reviewer：Xiaomin Wei

Approver：Wei Chen

Distribution Department：Product Center

Effective Date：2023.06.30

Documentarian		Reviewer		Approver	

HiNa Battery Technology Co., Ltd

Catalog

Product Change History Form

Versions	Changes	Date of change	Documentarian	Reviewer	Approver
A	First edition	2023-06-30	Donglin Fang	Xiaomin Wei	Wei Chen

1. Scope of Application

This product specification describes the product performance indicators of NaCR32140-MP10 Na-ion battery provided by HiNa Battery Technology Co., Ltd.

This product uses transition metal oxide cathode material system, which has excellent low temperature resistance, rate performance and resistant to over discharge characteristics.

This product mainly refers to the following standards for performance index evaluation:

GB 38031 *Safety requirements for power batteries for electric vehicles*

GB/T 31486 *Electrical performance requirements and test methods for electric vehicles with power batteries*

GB/T 31484 *The cycle life requirements and the test method evaluation for the performance indicators for electric vehicles with power batteries*

GB/T 31485—2015 *Safety requirements and test methods for electric vehicles with power batteries*

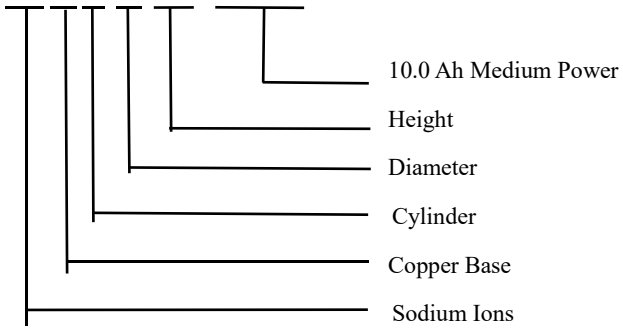
UL 1642

2. Product Type

2.1 Serial Number: Cylindrical Na-Ion Batteries

2.2 Type: Na C R 32140-MP10

Model: Na C R 32 140 - MP10



3. Battery Parameters

3.1 Basic Parameters

NO.	Content	Standards		Remarks
1	Nominal capacity @4.0~2.0 V	10.0	Ah	0.5C discharge @ 25 ℃
2	Rated voltage	3.05	V	
3	AC internal resistance	≤ 3	mΩ	AC 1 kHz, 3.2 V
4	DC internal resistance	≤ 10	mΩ	2C 30 s, 3.2 V
5	Battery weight	270 ± 5	g	
6	Battery size	Diameter: Φ33.2 ± 0.2 Height: 140 ± 0.3	mm	Form size
7	Charge cut-off voltage	3.95 4.0 3.9 3.8	V	T ≥ 45 ℃ 0 ℃ < T < 45 ℃ -10 ℃ ≤ T ≤ 0 ℃ -20 ℃ ≤ T < -10 ℃
8	Charge cut-off current	500 (0.05C) 1000 (0.1C)	mA	T > 0 ℃ T ≤ 0 ℃
9	Discharge cut-off voltage	2.0	V	Could discharge to 0 V
10	Standard continuous charge current	5000	mA	0.5C
11	Maximum continuous charge current	30000	mA	3C CC to 4 V Charge capacity > 90% Temperature rise < 20 ℃
12	Standard continuous discharge current	5000	mA	0.5C
13	Maximum continuous discharge current	30000	mA	3C CC to 2 V Discharge capacity > 90% Temperature rise < 20 ℃
14	Energy density	≥ 110	Wh/kg	

3.2 Electrical Performance Parameters

3.2.1 Charge Performance

Projects	Subprojects	Battery surface temperature	Standard charge	Fast charge	Pulse charge
Charge performance	Temperature and charge performance	> 70 ℃	Charge is not allowed		
		45 ~ 70 ℃	0.5C	2C	Charge is not allowed
		30 ~ 45 ℃	0.5C	3C	5C and battery SOC ≤ 40%, time < 8 min
		15 ~ 30 ℃	0.5C	1C	3C and battery SOC ≤ 50%, time < 15 min
		0 ~ 15 ℃	0.33C	0.5C	Charge is not allowed
		-10 ~ 0 ℃	0.2C (3.9V) 80% SOC	Charge is not allowed	
		-20 ~ -10 ℃	0.1C(3.8V) 75% SOC	Charge is not allowed	
	Subprojects	Battery surface temperature	Product specifications	Conditions	
	Rate performance	25 ℃ ± 2 ℃	Charge capacity ≥ 95% rated charge capacity	2C CC to 4 V Temperature rise ≤ 8 ℃	
		25 ℃ ± 2 ℃	Charge capacity ≥ 90% rated charge capacity	3C CC to 4 V Temperature rise ≤ 15 ℃	

3.2.2 Discharge Performance

Projects	Parameters		Performance indicators		Conditions
Discharge performance	Typical temperature and discharge capability		-30 ℃	≥ 75%	Set aside for 12 h, the discharge capacity is relative to the nominal capacity under the standard discharge current
			-20 ℃	≥ 85%	
			0 ℃	≥ 90%	
			25 ℃	≥ 100%	
			45 ℃	≥ 100%	
			60 ℃	≥ 95%	
	Discharge temperature range		-30 ℃ ~ 70 ℃		Whenever the battery temperature exceeds this temperature, it should stop working
	Rate discharge capability	Standard discharge current	0.5C	≥ 100%	25 ℃, relative capacity at standard charge and discharge
		Maximum continuous discharge current	3C	≥ 90%	25 ℃, relative capacity at standard charge and discharge
		Maximum pulse discharge current (long time)	10C	30 s	25 ℃ < battery surface temperature < 60 ℃, SOC > 50%
		Maximum pulse discharge current (short time)	15C	3 s	25 ℃ < battery surface temperature < 60 ℃, and battery SOC > 50%

3.2.3 Storage Performance

Projects	Subprojects	Parameters	Performance indicators		Conditions
Storage performance	Short time	Ultra-high temperature storage	Retention rate	≥ 90%	Check capacity at 25 ℃, store at 75 ℃ for 3 days, 100% SOC
			Recovery rate	≥ 98%	
		High-temperature storage	Retention rate	≥ 90%	Check capacity at 25 ℃, store at 45 ℃ for 7 days, 100% SOC
			Recovery rate	≥ 98%	
		Low-temperature storage	Retention rate	≥ 95%	Check capacity at 25 ℃, store at -20 ℃ for 7 days, 100% SOC
			Recovery rate	≥ 98%	
	Long time	High-temperature storage	Retention rate	≥ 90%	Check at 25 ℃ and store at 35 ℃ for 90 days, 40% SOC
			Recovery rate	≥ 98%	
		Room-temperature storage	Retention rate	≥ 98% （28 d ≥ 99%）	Store at 25 ℃ ± 5 ℃ for 180 days, 40% SOC

3.2.4 Service Life

Projects	Parameters	Performance indicators	Conditions	Remarks
Service life	High-temperature cycle	≥ 1200	45 ℃, 0.5C, 2 ~ 3.95 V, capacity retention rate ≥ 70%	Depending on the operating conditions, it is recommended to reduce the DOD use at high temperature and not charge at a constant voltage to extend the service life
	Room-temperature cycle	≥ 3000	25 ℃, 0.5C, 2 ~ 4 V, capacity retention rate ≥ 70%	
	Rate cycle	≥ 1500	25 ℃, 2C non-constant voltage, capacity retention rate ≥ 70%	
	Room-temperature over discharge characteristic cycle	100	25 ℃, 0.5C, 0 ~ 4 V cycle, capacity retention rate ≥ 95%	

3.3 Security Performance

The following tests should be carried out in a device with forced exhaust conditions and explosion-proof measures, and all batteries should be charged according to the standard charge method of 4.1.2 before the experiment, and set aside for 12 h, and then carry out the following tests.

Projects	Test methods	Inspection standards
Over discharge	GB 38031 8.1.2	The battery should not fire or explode
Over charge	GB 38031 8.1.3	The battery should not fire or explode
External short-circuit test	GB 38031 8.1.4	The battery should not fire or explode
Heating test	GB 38031 8.1.5	The battery should not fire or explode
Extrusion test	GB 38031 8.1.7	The battery should not fire or explode
Heavy impact test	UL 1642-14	The battery should not fire or explode

3.4 Environmental adaptability

Projects	Test methods	Inspection standards and instructions
Drop test	GB/T 31485 6.2.5	The battery should not leak, fire and explode
Mechanical impact test	UL1642-15	When subjected to impact during transportation and operation, it should not cause fire, explosion or leakage
Vibration test	UL1642-16	When subjected to vibration during transportation, it should not cause leakage, fire or explosion
Temperature cycle test	UL1642-18	Repeated exposure to high and low temperatures should not cause fire or explosion
Low atmospheric pressure test	UL1642-19	During transportation, being in the cargo hold of the aircraft should not cause fire or explosion

4. Test Methods

4.1 Standard Test Conditions

4.1.1 Temperature and Humidity

If there are no special requirements, the product test conditions on this specification are temperature 25 °C ± 2 °C; Humidity: 65% ± 20% RH.

4.1.2 Standard Charge Method

"Standard charge" means that under the condition that the ambient temperature is 25 ℃ ± 2 ℃, it is first charged at a constant current 0.5C to 4.0 V, and then charged at 4.0 V constant voltage to the current to less than 0.05C.

4.1.3 Standard Discharge Method

"Standard discharge" means that under the condition that the ambient temperature is 25 ℃ ± 2 ℃, the constant current is 0.5C to discharge to 2.0 V.

4.2 Electrical Performance Tests

4.2.1 Charge Performance

4.2.1.1 Temperature and Charge Performance

After the battery is discharged according to the standard discharge method, the battery is placed in the environment test chamber and the surface temperature value of the battery is set according to the regulations and maintained for 6 h, and then charges according to the rate and time of 'Standard Charge', 'Fast Charge' and 'Pulse Charge'.

4.2.1.2 Rate

After the battery is discharged according to the standard discharge method, the battery is placed in the environment test chamber to set at 25 ℃ and kept 6 h, and then the battery is charged to 4.0 V at 2C/3C constant current respectively.

4.2.2 Discharge Performance

4.2.2.1 Typical Temperature and Discharge Capability

After the battery is charged according to the standard charge method, the battery is placed in the environment test chamber to set the temperature specified by the performance index and kept it at the temperature for 12 h, and then discharge to 2.0 V at 0.5C.

4.2.2.2 Rate Discharge Capability

After the battery is charged according to the standard charge method, the battery is placed in the environmental test chamber and set to 25 °C and maintained at this temperature for 4 h, then discharge to a voltage of 2.0 V at the rate and time listed in Table 3.2.2.

4.2.3 Storage Performance

4.2.3.1 Short Term

a) Ultra-high Temperature Storage

The battery is charged according to the standard charge method, set aside for 30 min, put the battery into the environmental test chamber and set it to 75 °C and keep the temperature for 3 days, take out the battery and put it in the environment specified in 4.4.1 for 6 h, and discharge the battery according to the standard discharge mode.

b) High-temperature Storage

The battery is charged according to the standard charge method, set aside for 30 min, put the battery into the environmental test chamber and set it to 45 °C and keep the temperature for 7 days, take out the battery and put it in the environment specified in 4.4.1 for 6 h, and discharge the battery according to the standard discharge mode.

c) Low-temperature Storage

The battery is charged according to the standard charge method, set aside for 30 min, put the battery into the environmental test chamber and set it to -20 °C and keep the temperature for 7 days, take out the battery and put it in the environment specified in 4.4.1 for 6 h, and discharge the battery according to the standard discharge mode.

4.2.3.2 Long Term

a) High-temperature Storage

The battery is charged according to the standard charge method, discharged at 0.5C for 72 min, set aside for 30 min, put the battery into the environment test chamber and set it to 35 °C and keep the temperature for 90 days, take out the battery and put it in the environment specified in 4.4.1 for 6 h, first discharge the battery according to the standard discharge mode, set aside for 30 min, then charge the battery according to the standard charge method, and finally discharge the battery according to the standard discharge method.

b) Room-temperature Storage

The battery is charged according to the standard charge method, discharged at 0.5C for 72 min, set aside for 30 min, put the battery into a 25 ± 5 ℃ environment and keep the temperature for 180 days, and collect the battery OCV and ACR every 30 days, take out the battery and put it in the environment specified in 4.4.1 for 6 h, first discharge the battery according to the standard discharge

mode, set aside for 30 min, then charge the battery according to the standard charge method, and finally discharge the battery according to the standard discharge method.

4.2.4 Life

4.2.4.1 High-temperature Cycle

a) Put the battery into an environmental test chamber at 45 °C ± 2 °C and set aside for 4 h;

b) Charge the battery at 45 °C ± 2°C at 0.5C constant current to 3.95 V, constant voltage 3.95 V to a current less than 0.05C and set aside for 30 min;

c) Discharge the battery to 2.0 V at 0.5C constant current at 45 °C ± 2 °C and set aside for 30 min;

d) Repeat steps b~c until the capacity is less than 70% of the initial capacity.

4.2.4.2 Room-temperature Cycle

a) Put the battery into an environmental test chamber at 25 °C ± 2 °C and set aside for 4 h;

b) Charge the battery at 25 °C ± 2°C at 0.5C constant current to 4.0 V, constant voltage 4.0 V to a current less than 0.05C and set aside for 30 min;

c) Discharge the battery to 2.0 V at 0.5C constant current at 25 °C ± 2 °C and set aside for 30 min;

d) Repeat steps b~c until the capacity decays to 70% of the initial capacity.

4.2.4.3 Rate Cycle

a) Put the battery into an environmental test chamber at 25 °C ± 2 °C and set aside for 4 h;

b) Charge the battery at 25 °C ± 2°C at 2C constant current to 4.0 V, and set aside for 30 min;

c) Discharge the battery to 2.0 V at 2C constant current at 25 °C ± 2 °C and set aside for 30 min;

d) Repeat steps b~c until the capacity decays to 70% of the initial capacity.

4.2.4.4 Over-discharge Characteristic Cycle

a) Put the battery into an environmental test chamber at 25 °C ± 2 °C and set aside for 4 h;

b) Charge the battery at 25 °C ± 2°C at 0.5C constant current to 4.0 V, constant voltage 4.0 V to a current less than 0.05C, and set aside for 30 min;

c) Discharge the battery to 0 V at 0.5C constant current at 25 °C ± 2 °C and set aside for 30 min;

d) Repeat steps b~c for a total of 100 times.

4.2.5 Security Test

4.2.5.1 Over Discharge

The battery is discharged at a current of 1C until the discharge time reaches 90 min, and observes for 1 hour.

4.2.5.2 Over Charge

After the battery is charged according to the standard charge standard, the battery is charged to 4.4 V or 115% SOC at a constant current of 1C and then stops charge and observes for 1 hour.

4.2.5.3 External Short-circuit Test

The positive and negative terminals of the battery are short-circuited externally for 10 min (external line resistance < 5 mΩ) and observes for 1 hour.

4.2.5.4 Heating Test

Put the battery in an electric blower drying chamber, and the temperature is raised from room temperature to 130 °C ± 2 °C at a

rate of 5 °C ± 2 °C/min and held for 30 min before stopping heating and observing for 1 hour.

4.2.5.5 Extrusion Test

The battery is placed between the two extrusion surfaces of the extrusion equipment, the cylindrical battery mandrel is parallel to the extrusion plane, and the pressure is gradually increased to the voltage reaches OV or the deformation reaches 15% or the extrusion force reaches 100 kN or 1000 times the battery weight at an extrusion speed of ≤ 2 mm/s, and the pressure is maintained for 10 min, observes for 1 hour.

4.2.5.6 Heavy Impact Test

Put the battery on the impact table, place a φ15.8 mm steel column in the center of the battery, the longitudinal axis of the steel column is parallel to the plane, let the 9.1 kg hammer fall freely from the height of 610 mm, impact the battery. The battery is allowed to deform.

4.2.6 Environmental Adaptability

4.2.6.1 Drop Test

After the battery is charged according to the standard charge system, the positive and negative terminals of the battery sample are held downwards and freely dropped to the concrete floor from a height of 1.5 m and observes for 1 hour.

4.2.6.2 Mechanical Impact Test

The battery is fixed to the test equipment in a flat rigid mounting manner. Each single cell should withstand 3 equal accelerations. Each cell bears the impact in three directions perpendicular to each other, unless the battery has only two axes of symmetry. The direction of each impact should usually be straight to the surface of the monomer battery. Acceleration requirements: The minimum average acceleration within the initial 3 ms should reach 75 g (g-local gravitational acceleration), and the peak acceleration should be between 125-175 g. The test temperature is 25 ± 5 °C.

4.2.6.3 Vibration Test

The battery should be subjected to an amplitude of 0.8 mm vibration, and the vibration frequency should change at a rate of 1 Hz/min in the range of 10-55 Hz, and cycle once within 90-100 min. The battery vibrates in 3 directions perpendicular to each other. For cells with only two axes of symmetry, the cells should be tested in a direction perpendicular to each axis.

4.2.6.4 Temperature Cycle Test

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

a) Heat up to 70 ± 3 °C within 30 min, keep warm for 4 h;

b) Cool down to 20 ± 2 °C within 30 min and keep warm for 2 h;

c) Cool down to -40 ± 3 °C within 30 min and keep warm for 4 h;

d) Rise the temperature to 20 ± 2 °C within 30 min;

e) Repeat the cycle 9 more times;

f) After 10 cycles, the battery is left at room temperature of 20 ± 5 °C for 7 days to be tested.

4.2.6.5 Low Atmospheric Pressure Test

The sample cells are stored for 6 hours at an absolute pressure of 11.6 Kpa and a temperature of 20 ± 5 °C.

5. Instructions and Precautions

5.1 Battery Instructions

5.1.1 Temperature Gradient Charge Scheme

	SOC	Temperature gradient						
		-20 ℃ ~ -10 ℃	-10 ℃ ~ 0 ℃	0 ℃ ~ 10 ℃	10 ℃ ~ 20 ℃	20 ℃ ~ 45 ℃	45 ℃ ~ 55 ℃	55 ℃ ~ 70 ℃
Maximum charge rate	100%	/	/	0.05	0.05	0.05	0.05	/
	90%	/	0.05	0.20	0.75	0.50	0.50	0.50
	80%	0.05	0.20	0.50	0.75	3.00	1.00	0.50
	70%	0.10	0.20	0.50	0.75	3.00	1.00	0.50
	60%	0.10	0.20	0.50	0.75	3.00	1.00	0.50
	50%	0.10	0.20	0.50	0.75	3.00	1.00	0.50
	40%	0.10	0.20	0.50	0.75	3.00	1.00	0.50
	30%	0.10	0.20	0.50	0.75	3.00	1.00	0.50
	20%	0.10	0.20	0.50	0.75	3.00	1.00	0.50
	10%	0.10	0.20	0.50	0.75	0.75	0.50	0.50
	0%	0.10	0.20	0.50	0.50	0.50	0.50	0.50

5.1.2 Transport

Battery transportation state of charge is 30% ~ 50% SOC, the battery is packed into a box for transportation, in the process of transportation should prevent severe vibration, impact or extrusion, to prevent sun and rain, must not be inverted.

In the process of loading and unloading, the product should be handled lightly to prevent falling, tumbling and heavy pressure.

5.1.3 Storage

Long-term storage of batteries for more than 6 months must be placed in a dry, ventilated place, storage state of charge of 20% ~ 50% SOC, and every 6 months to carry out a charge and discharge cycle of the battery.

5.2 Safety Rules

Abuse of Na-ion rechargeable batteries may cause battery damage or personal injury, please read the following safety rules carefully before using Na-ion batteries:

Note 1: If the customer needs to operate the battery under conditions other than this document, please consult HiNa Battery Company first.

Note 2: HiNa Battery Company is not responsible for accidents arising from the use of the battery outside the conditions stated in this document.

5.2.1 Battery Precautions

a) Do not throw the battery into fire or heat;

b) Do not short-circuit and overcharge the battery;

c) Do not subject the battery to excessive mechanical impact;

d) Do not immerse the battery in water or seawater, or make it moisture-absorbing;

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

f) Do not disassemble or repair the battery;

g) Do not cause visible damage or deformation to the battery;

h) Do not direct contact with leaking batteries;

i) Keep the battery away from children;

j) Do not pierce, hammer or step on the battery;

k) Do not hit or throw the battery.

6. Revision Statement

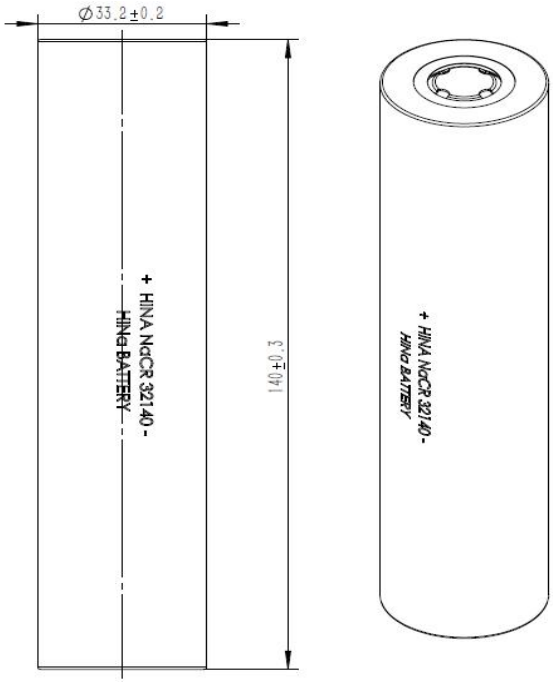
Due to the continuous improvement of product quality and characteristics, the company has the right to revise the product specifications and maintenance characteristics, and the user will not be notified in advance after revision.

7. Other Notes

The matters that are not mentioned in this specification must be confirmed by the company, and the company reserves the right of final interpretation of the contents stated in this specification.

8. Appendix

8.1 Battery Size



8.2 SOC-OCV

25 ℃ discharge 0.5C			25 ℃ charge 0.5C	
SOC	OCV		SOC	OCV
100%	3.978		0%	2.235
95%	3.850		5%	2.403
90%	3.750		10%	2.553
85%	3.669		15%	2.690
80%	3.597		20%	2.791
75%	3.528		25%	2.853
70%	3.456		30%	2.884
65%	3.378		35%	2.909
60%	3.297		40%	2.978
55%	3.213		45%	3.060
50%	3.129		50%	3.142
45%	3.048		55%	3.225
40%	2.964		60%	3.309
35%	2.877		65%	3.390
30%	2.847		70%	3.468
25%	2.815		75%	3.539
20%	2.762		80%	3.606
15%	2.662		85%	3.676
10%	2.523		90%	3.752
5%	2.369		95%	3.841
0%	2.235		100%	3.938

8.3 Packaging Method

Each box is loaded with 40pcs batteries, and the RoHS logo and finished battery identification card are posted on the outside of the box, as shown in the figure.