

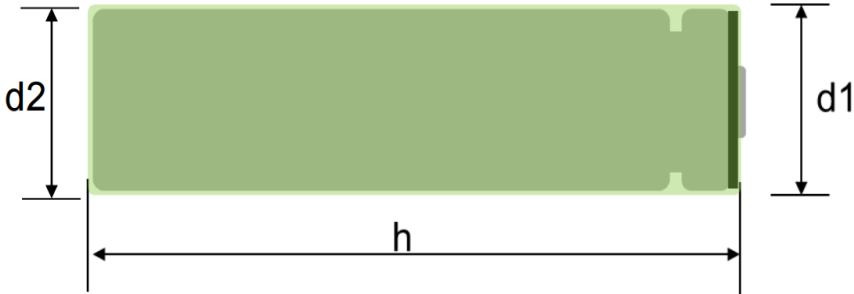
Lumenier  **NAV Lithium-Ion**
Cell Test Summary

Aug. 30 , 2023

Summary

	Item	Number/PCS	SPEC.	Value	Conclusion	Remark
Basic parameters	Height	10	≤65.30 mm	65.12	P	/
	Diameter	10	≤18.50 mm	18.32	P	/
	Weight	10	≤47.5 g	45.76	P	/
	Voltage	32	R < 10mV	R < 10mV	P	/
	ACIR	32	< 18mΩ	13.36	P	/
	DCIR	3	< 30.0mΩ	22.08	P	/
Safety performacne	Overcharge	3	No fire, no explosion	No fire, no explosion	P	/
	External Short-circuit/5mΩ	5	No fire, no explosion	No fire, no explosion	P	/
	External Short-circuit/80mΩ	5	No fire, no explosion	No fire, no explosion	P	/
	Impact/100%SOC	3	No fire, no explosion	No fire, no explosion	P	/
	Impact/50%SOC	3	No fire, no explosion	No fire, no explosion	P	/
	Low pressure	3	No fire, no explosion,no leakage	No fire, no explosion,no leakage	P	/
	Drop	3	No fire, no explosion	No fire, no explosion	P	/
	Crush	3	No fire, no explosion	No fire, no explosion	P	/
	Heating test	3	No fire, no explosion	No fire, no explosion	P	/
Drum test	5	≤125% of the initial ACIR	≤125% of the initial ACIR	P	/	
Electrical performacne	Discharge Rate Capabilities	3	10A > 2700mAh	2851	P	/
		3	20A > 2100mAh	2842	P	/
		3	30A > 1000mAh	2734	P	/
	Low temperature discharge	3	-20°C: > 2.0V for first 30s	> 2.0V for first 30s	P	/
	Storage Characteristics (60°C30天)	10	30D Retention> 80%,Recovery > 90%	30D Retention: 88.4%,Recovery: 95.8%	P	/
	Cycle life@RT4.5A/10A cycles	3	≥60%@500CL(capacity)	88.8%@500CL(capacity)	P	/
	Cycle life@RT4.5A/20A cycles	3	≥60%@300CL(capacity)	78.3%@300CL(capacity)	P	/
	Cycle life@RT4.5A/30A cycles	3	≥60%@200CL(capacity)	91.4%@200CL(capacity)	P	/

1.Basic information



Cell model		Dimensions (mm)		Weight (g)
		h	d1	
Spec.		≤65.30	≤18.50	≤47.5
30T	1#	65.08	18.33	45.68
	2#	65.09	18.30	45.72
	3#	65.18	18.36	45.61
	4#	65.09	18.34	45.77
	5#	65.12	18.31	45.78
	6#	65.09	18.32	45.80
	7#	65.03	18.30	45.81
	8#	65.20	18.31	45.90
	9#	65.15	18.30	45.64
	10#	65.16	18.35	45.90
Avg		65.12	18.32	45.76

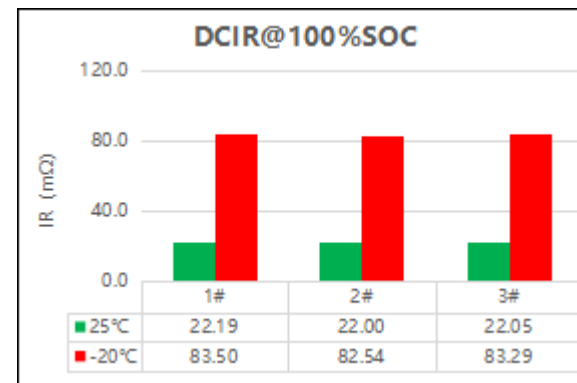
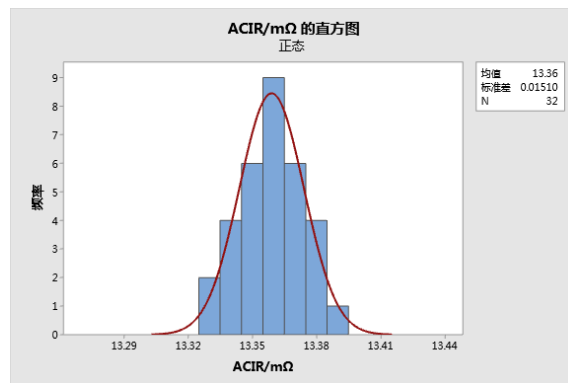
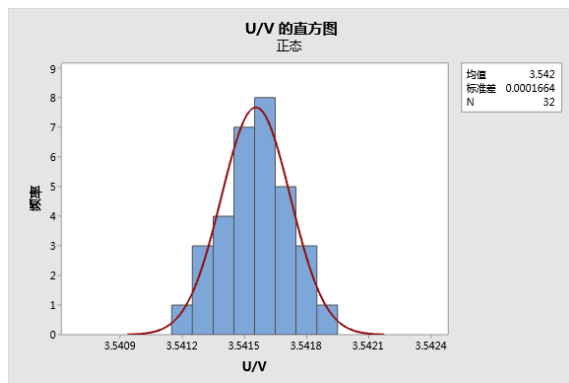
1.Basic information

Test Method

ACIR:50%SOC,1KHz

DCIR:100%SOC,10A-10S/2A-10S/10A-5S.

Test temperature: 25±2°C

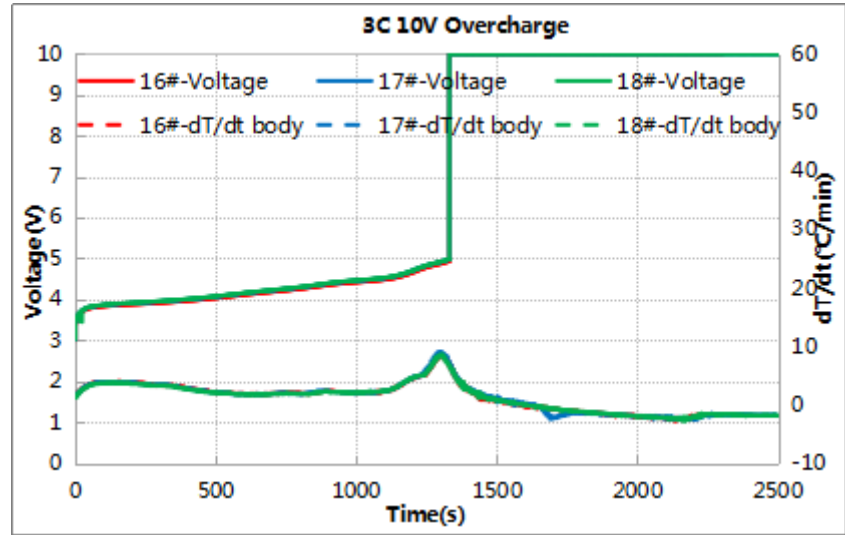
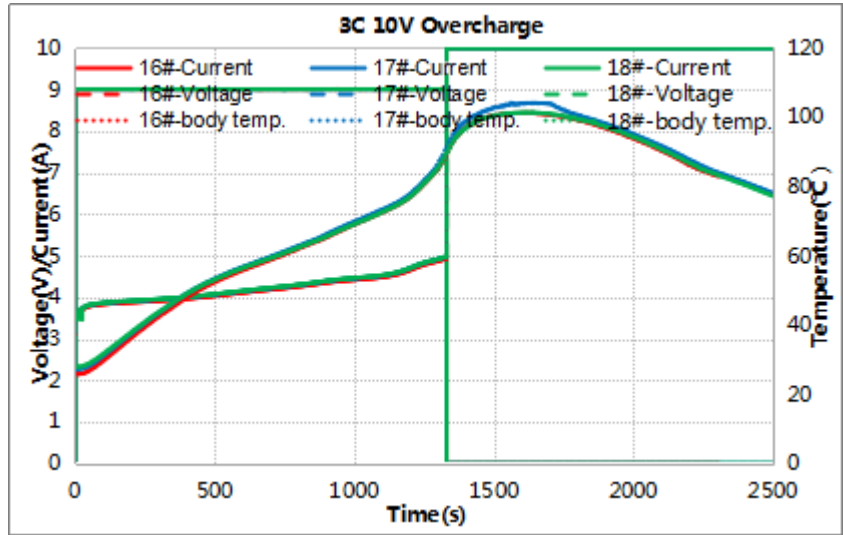


2.Overcharge @ 3C/10V

Test Method: The fully discharged cell is charged with 3C to 10V at 25±3°C.

Standard: No fire, no explosion.

No.	Highest temperature (°C)	CID open time (S)	CID open Voltage (V)	Initial cell		after test		phenomenon				
				Voltage (V)	Impedance (mΩ)	Voltage (V)	Impedance (mΩ)	CID	Leakage	Smoke	explosion	Fire
16#	101.3	1334	4.9375	2.9941	14.00	0	∞	Open	No	No	No	No
17#	104.1	1333	4.9818	2.9890	13.92	0	∞	Open	No	No	No	No
18#	101.4	1333	4.9846	2.9895	13.72	0	∞	Open	No	No	No	No



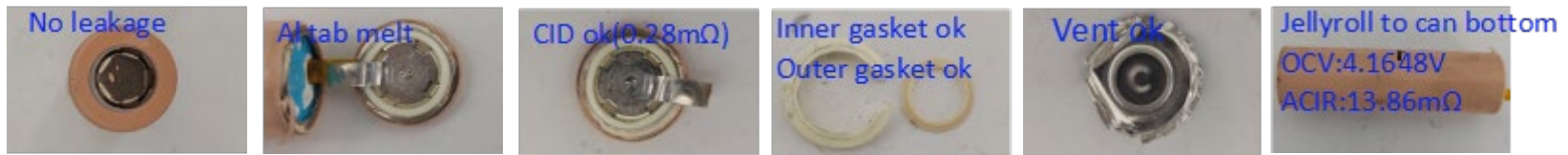
3. 5mΩ Short test @R.T.

Test Method: The fully charged cell is short-circuited by connecting with a circuit of 5mΩ at 25±3°C.

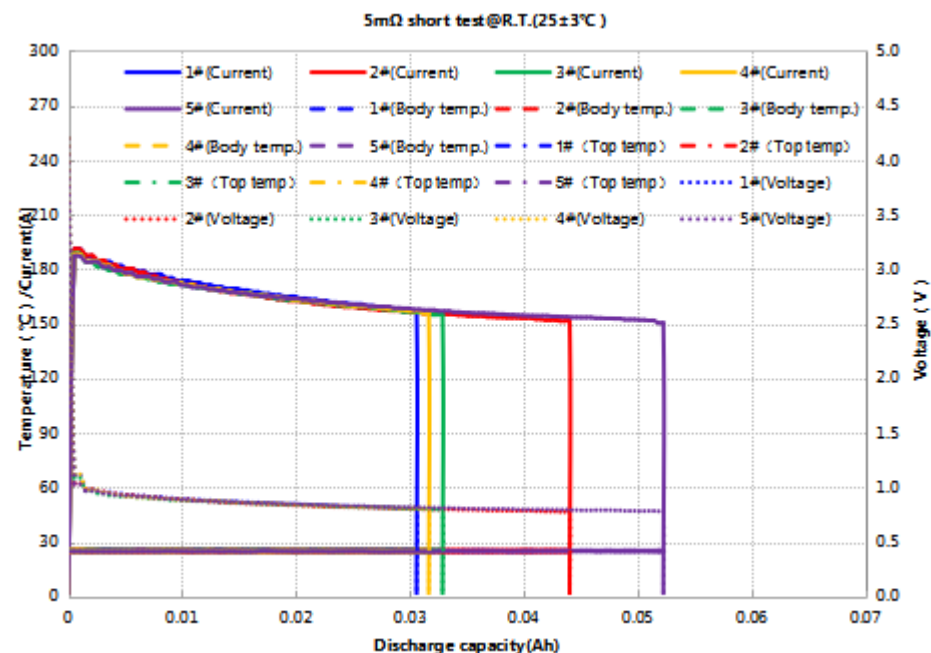
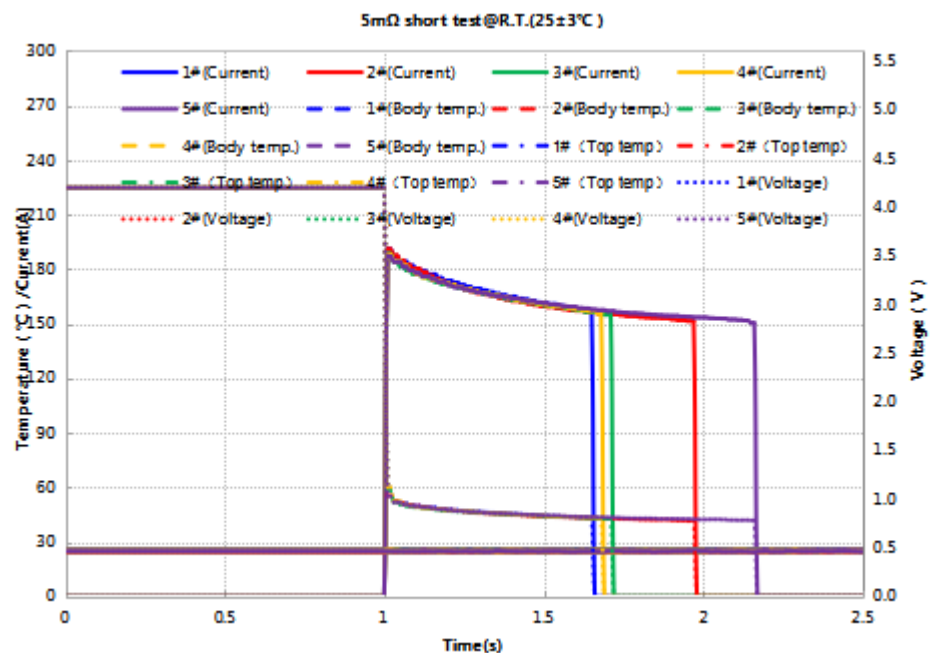
Standard: No fire, no explosion.

No.	Test conditions (mΩ)	Initial cell		After test		Highest temperature (°C)	Max current (A)	discharge time (S)	phenomenon								
		Voltage(V)	Impedance (mΩ)	Voltage(V)	Impedance (mΩ)				CID	Al tab	Inner Gasket	Outer Gasket	Vent	Leakage	Smoke	explosion	Fire
1#	5.01	4.1858	13.19	0	∞	32.0	193.14	0.67	OK	Melt	OK	OK	OK	No	No	No	No
2#		4.1850	12.92	0	∞	34.0	194.94	0.99	OK	Melt	OK	OK	OK	No	No	No	No
3#		4.1850	13.18	0	∞	31.9	191.34	0.74	OK	Melt	OK	OK	OK	No	No	No	No
4#		4.1852	13.17	0	∞	32.2	190.76	0.70	OK	Melt	OK	OK	OK	No	No	No	No
5#		4.1852	13.18	0	∞	36.4	190.97	1.18	OK	Melt	OK	OK	OK	No	No	No	No

1#



3. 5mΩ Short test @R.T.



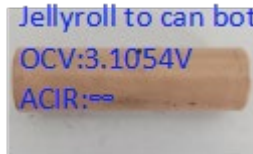
4. 80mΩ Short test@R.T.

Test Method: The fully charged cell is short-circuited by connecting with a circuit of 80mΩ at 25±3°C.

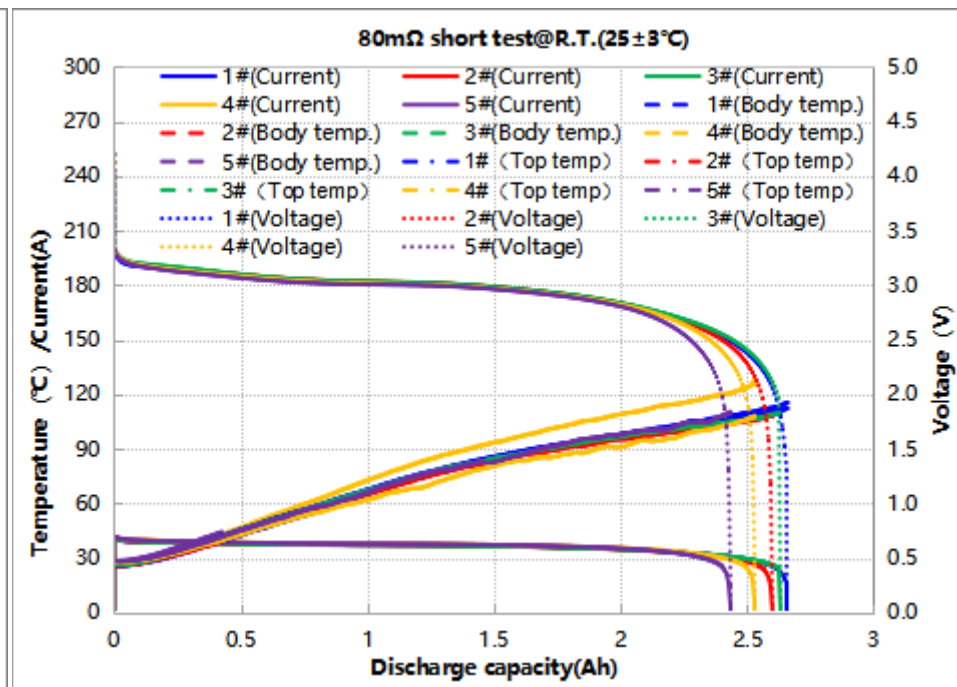
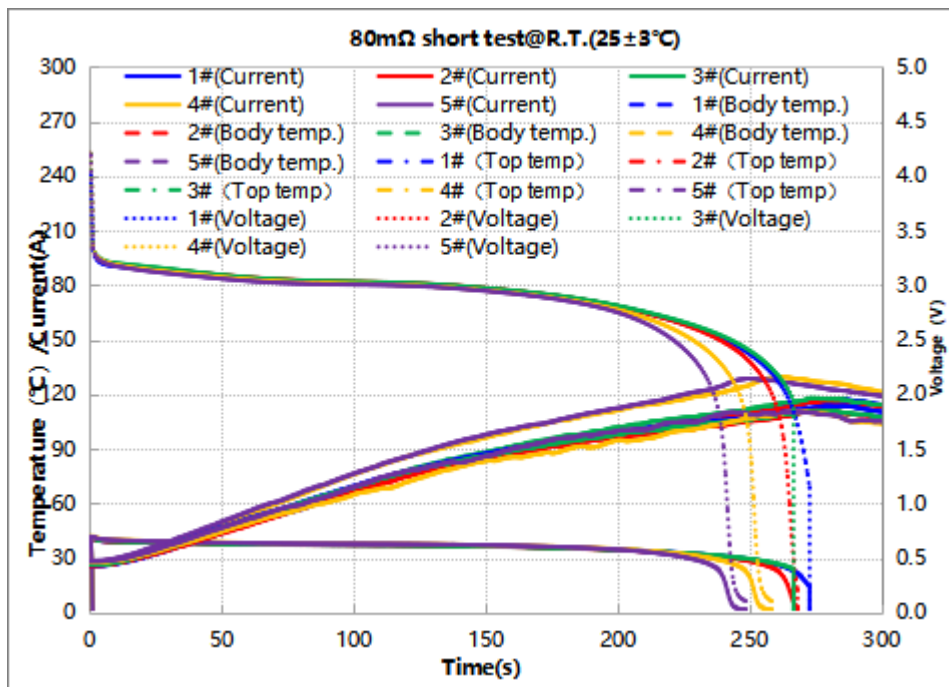
Standard: No fire, no explosion.

No.	Test conditions (mΩ)	Initial cell		After test		Highest temperature (°C)	Max current (A)	discharge time (S)	phenomenon								
		Voltage(V)	Impedance (mΩ)	Voltage(V)	Impedance (mΩ)				CID	Al tab	Inner Gasket	Outer Gasket	Vent	Leakage	Smoke	explosion	Fire
1#	80.02	4.1913	13.70	0	∞	117.5	41.13	271.75	Open	OK	OK	OK	OK	No	No	No	No
2#		4.1915	13.56	0	∞	116.0	41.47	267.42	Open	OK	OK	OK	OK	No	No	No	No
3#		4.1915	13.63	0	∞	117.9	41.73	266.24	Open	OK	OK	OK	OK	No	No	No	No
4#		4.1856	13.59	0	∞	129.5	42.15	257.81	Open	OK	OK	OK	OK	No	No	No	No
5#		4.1862	13.60	0	∞	128.7	42.08	247.72	Open	OK	OK	OK	OK	No	No	No	No

1#



4. 80mΩ Short test @R.T.



5.Other Safety Test

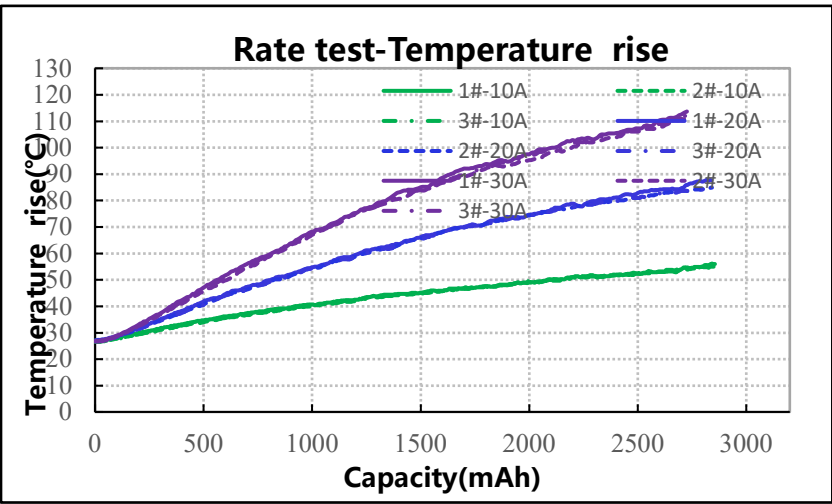
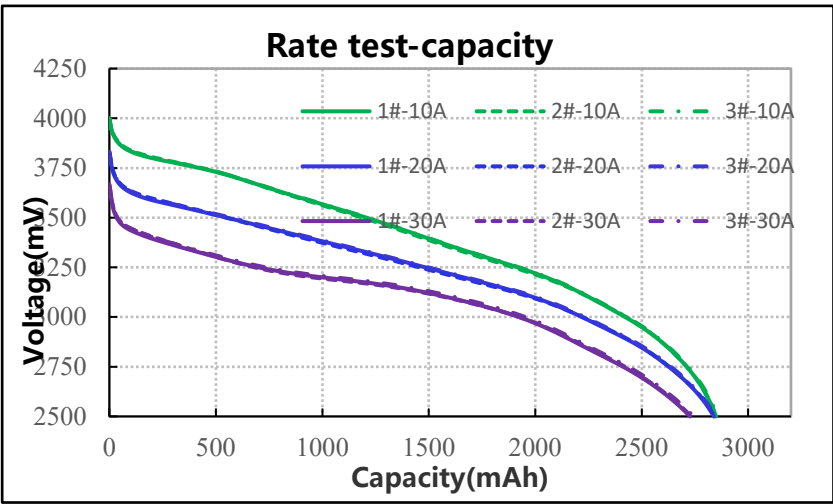
No.	Item	Test standards	Test method	standards	Conclusion	Remark
1	Impact	GB31241/ UN38.3	A 100%SOC or 50%SOC cell is to be placed on a flat smooth surface. A 15.8mm±0.2mm diameter stainless steel bar is to be placed across the center of the cell.A 9.1kg±0.1kg mass is to be dropped from a height of 610mm±25mm at the intersection of the bar	No fire, no explosion	Pass	/
2	Low pressure	UN38.3	Fully standard charged cell is to be stored at a pressure of 11.6kPa or less for at least six hours at ambient temperatere	No fire, no explosion	Pass	/
3	Drop	IEC62133	A fully charged cell is dropped three times from a height of 1.0m onto a concrete floor	No fire, no explosion	Pass	/
4	Crush	IEC62133	A fully standard charged cell is to be crushed between two flat surfaces	No fire, no explosion	Pass	/
5	Heating test	UN38.3	A fully standard charged cell is heated in a gravity convection and staged at 130±2°C for 60min	No fire, no explosion	Pass	/
6	Drum test	/	5cells,30rpm/min,120min,drum inner diameter:24cm;length (35±1)cm;wall thickness :5mm;cross-section:cotagon;material:steel	≤125% of the initial ACIR	Pass	/

6. Rate discharge

Test Method

Step1: 1.5A CC-CV to 4.2V by 0.1A cut-off, rest 10min.
 Step2: Discharge by 10A/20A/30A to 2.5V, rest 30min.
 Test temperature: 25±2°C

No.	10A				20A				30A			
	Capacity (mAh)	Median voltage (mV)	Highest Temperature(°C)	Capacity ratio	Capacity (mAh)	Median voltage (mV)	Highest Temperature(°C)	Capacity ratio	Capacity (mAh)	Median voltage (mV)	Highest Temperature(°C)	Capacity ratio
1#	2849	3423	55.6	100.0%	2839	3269	87.8	99.6%	2726	3148	113.7	95.7%
2#	2850	3415	55.4	100.0%	2842	3260	84.9	99.7%	2732	3144	111.1	95.9%
3#	2855	3423	56.2	100.0%	2846	3271	86.0	99.7%	2743	3155	112.5	96.1%
Avg	2851	3420	55.7	100.0%	2842	3267	86.2	99.7%	2734	3149	112.4	95.9%



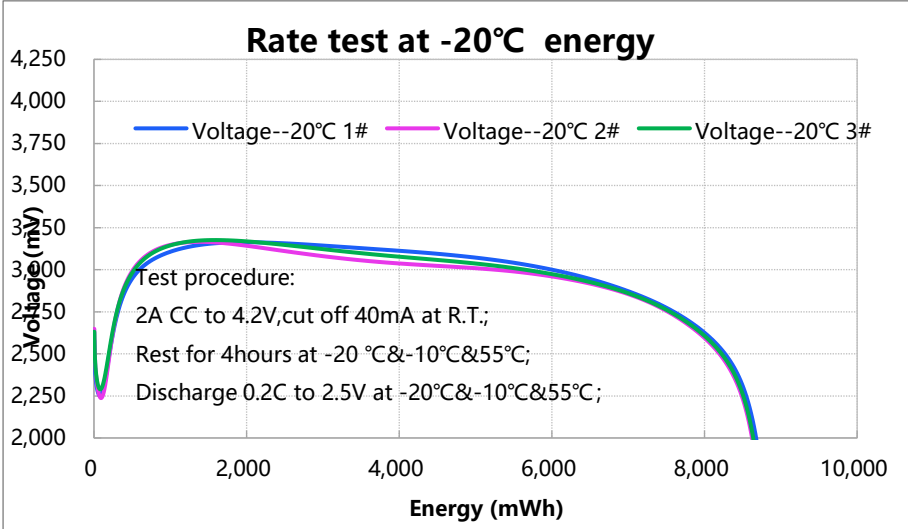
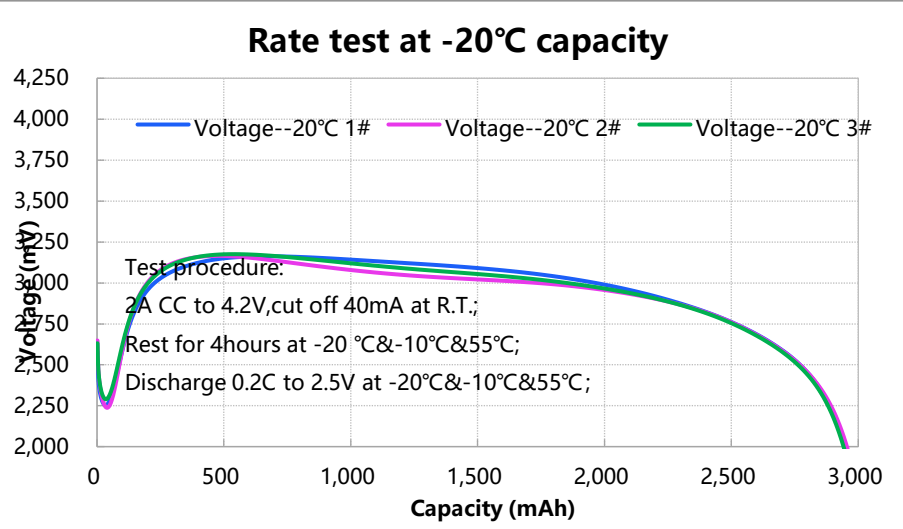
7.Low temperature discharge

Test Method

Step1: 1.5A CC-CV to 4.2V by 0.1A cut-off@25±2°C

Step2: -20°C rest 4h discharge by 20A to 2.0V.

Test temperature: -20°C

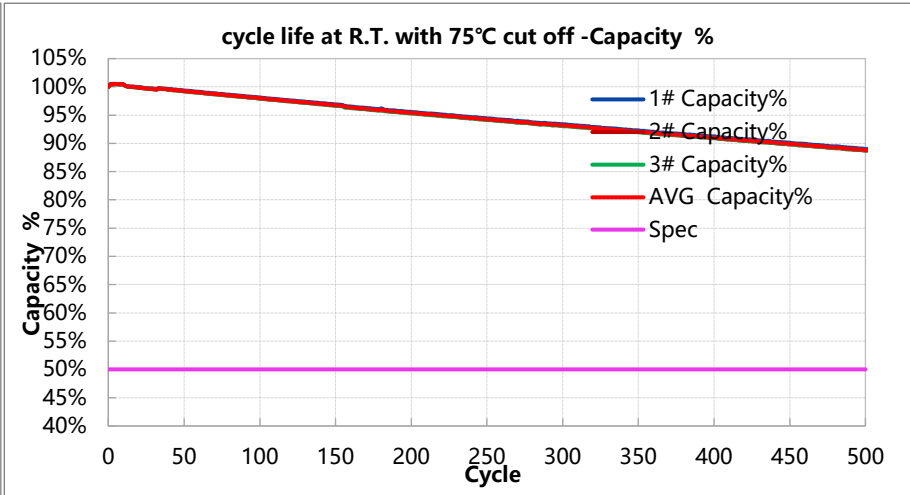
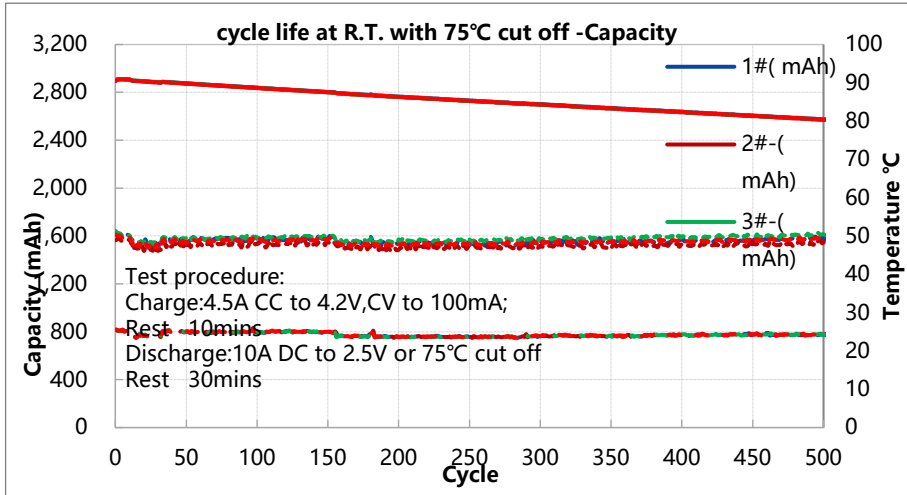


8.Cycle life-4.5A/10A,75°C cut off,RT

Test Method

Step1: 4.5A CC-CV to 4.2V by 0.1A cut-off, rest 10 min.
 Step2: Discharge by 10A to 2.5V or 75°C cut off,rest 30min.
 Test temperature: 25±2°C

4.5A/10A循环 (75°C截止)											
No.	初始放电容量 (mAh)	初始放电能量 (mWh)	第100次放电容量 (mAh)	第100次放电能量 (mWh)	第200次放电容量 (mAh)	第200次放电能量 (mWh)	第500次放电容量 (mAh)	第500次放电能量 (mWh)	第100次容量保持率 (%)	第200次容量保持率 (%)	第500次容量保持率 (%)
1#	2893	9722	2839	9552	2764	9265	2574	8572	98.1%	95.5%	89.0%
2#	2896	9729	2835	9538	2761	9251	2569	8555	97.9%	95.3%	88.7%
3#	2899	9742	2838	9551	2762	9260	2572	8570	97.9%	95.3%	88.7%
Avg	2896	9731	2837	9547	2762	9259	2572	8566	98.0%	95.4%	88.8%

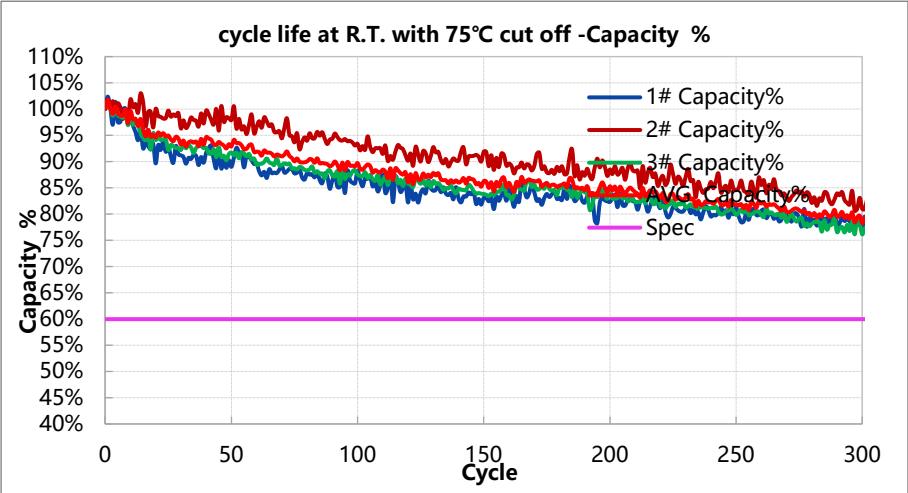
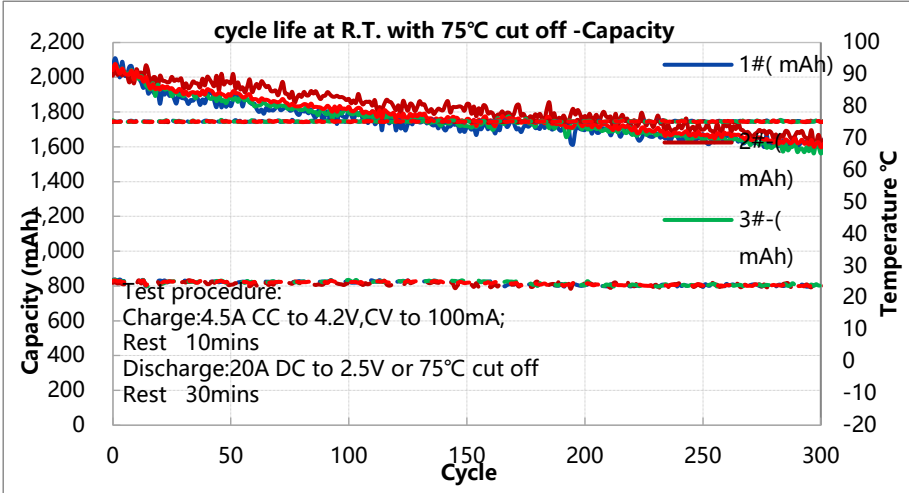


9.Cycle life-4.5A/20A,75°C cut off,RT

Test Method

Step1: 4.5A CC-CV to 4.2V by 0.1A cut-off, rest 10 min.
 Step2: Discharge by 20A to 2.5V or 75°C cut off,rest 30min.
 Test temperature: 25±2°C

4.5A/20A循环 (75°C截止)											
No.	初始放电容量 (mAh)	初始放电能量 (mWh)	第100次放电容 量 (mAh)	第100次放电能 量 (mWh)	第200次放电容 量 (mAh)	第200次放电能 量 (mWh)	第300次放电容 量 (mAh)	第300次放电能 量 (mWh)	第100次容量保 持率 (%)	第200次容量保 持率 (%)	第300次容量保 持率 (%)
1#	2061	6917	1819	6030	1697	5568	1600	5206	88.3%	82.3%	77.7%
2#	2008	6623	1875	6107	1777	5741	1626	5235	93.4%	88.5%	81.0%
3#	2051	6981	1795	5818	1746	5475	1562	5026	87.5%	85.1%	76.1%
Avg	2040	6840	1830	5985	1740	5595	1596	5156	89.7%	85.3%	78.3%



10.Cycle life-4.5A/30A,75°C cut off,RT

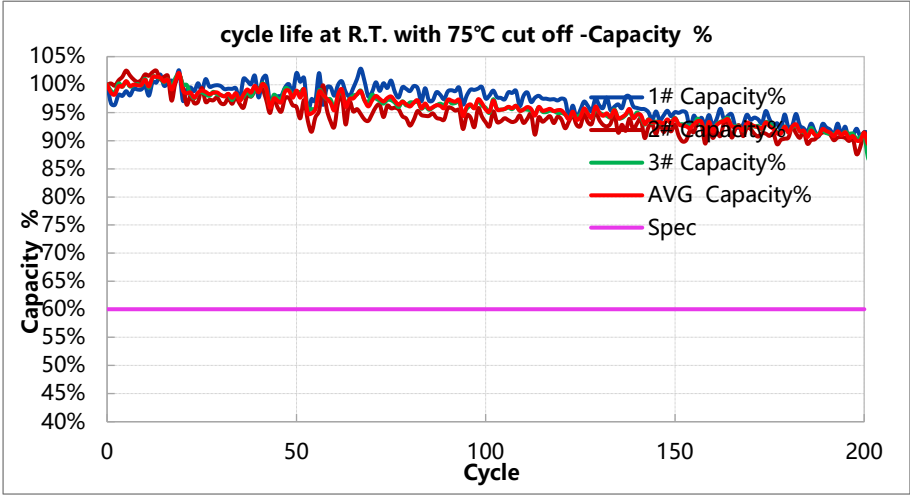
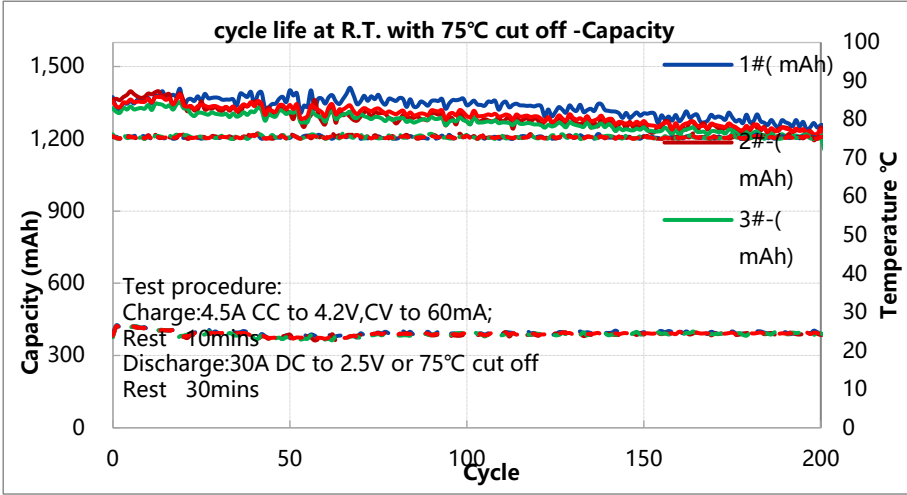
Test Method

Step1: 4.5A CC-CV to 4.2V by 0.1A cut-off, rest 10 min.

Step2: Discharge by 30A to 2.5V or 75°C cut off,rest 30min.

Test temperature: 25±2°C

4A/30A循环 (75°C截止)								
No.	初始放电容量 (mAh)	初始放电能量 (mWh)	第100次放电容量 (mAh)	第100次放电能量 (mWh)	第200次放电容量 (mAh)	第200次放电能量 (mWh)	第100次容量保持率 (%)	第200次容量保持率 (%)
1#	1372	4478	1339	4251	1256	3884	97.5%	91.6%
2#	1363	4441	1272	4049	1247	3887	93.3%	91.5%
3#	1326	4078	1272	3858	1209	3559	95.9%	91.2%
Avg	1354	4333	1294	4053	1238	3777	95.6%	91.4%



11.High temperature storage@60°C 30D

Test Method

Step1: 1.5A CC-CV to 4.2V by 0.06A cut-off, rest 10 min.

Step2: Discharge with 1.5A to 2.5V, record initial capacity.

Step3: 1.5A CC-CV to 4.2V by 0.06A cut-off, 60°C storage 30 days.

Step4: Discharge with 1.5A to 2.5V, record retention capacity. repeat step1 to step2 for 3 cycles and record recovery capacity.

Test temperature: 60±2°C

No.	Before high temperature storage			7days		14days		21days		Stored at 60°C for 30 days					
	Discharge capacity (mAh)	Voltage V0(V)	Internal resistance (mΩ)	Voltage V1(V)	Internal resistance (mΩ)	Voltage V1(V)	Internal resistance (mΩ)	Voltage V1(V)	Internal resistance (mΩ)	Voltage V1(V)	Internal resistance (mΩ)	Retention Discharge capacity (mAh)	Retention Ratio	Recovery capacity after three cycles (mAh)	Recovery Ratio
1#	2894	4.1740	13.57	4.1158	12.78	4.1024	14.10	4.0972	13.91	4.0907	15.00	2556	88.3%	2770	95.7%
2#	2865	4.1728	13.42	4.1154	12.58	4.1020	13.85	4.0970	13.61	4.0903	14.84	2539	88.6%	2757	96.2%
3#	2883	4.1742	13.44	4.1165	12.54	4.1030	13.75	4.0980	13.48	4.0909	14.81	2551	88.5%	2762	95.8%
4#	2887	4.1739	13.56	4.1165	12.63	4.1031	13.77	4.0982	13.50	4.0910	14.86	2558	88.6%	2769	95.9%
5#	2890	4.1740	13.69	4.1164	12.79	4.1032	13.93	4.0983	13.64	4.0911	15.06	2554	88.4%	2766	95.7%
6#	2883	4.1742	13.69	4.1165	12.80	4.1031	13.92	4.0981	13.68	4.0909	15.04	2549	88.4%	2760	95.7%
7#	2897	4.1737	13.61	4.1159	12.76	4.1026	13.87	4.0976	13.67	4.0905	15.02	2558	88.3%	2774	95.8%
8#	2918	4.1731	13.33	4.1129	12.46	4.1000	13.78	4.0948	13.67	4.0884	14.79	2571	88.1%	2791	95.6%
9#	2895	4.1744	13.63	4.1163	12.71	4.1027	13.98	4.0973	13.91	4.0906	14.99	2554	88.2%	2767	95.6%
10#	2929	4.1717	13.39	4.1131	12.64	4.1006	13.82	4.0954	13.82	4.0896	14.73	2581	88.1%	2808	95.9%
Max	2929	4.1744	13.69	4.1165	12.80	4.1032	14.10	4.0983	13.91	4.0911	15.06	2581	88.6%	2808	96.2%
Min	2865	4.1717	13.33	4.1129	12.46	4.1000	13.75	4.0948	13.48	4.0884	14.73	2539	88.1%	2757	95.6%
R	64	0.0027	0.36	0.0036	0.34	0.0032	0.35	0.0035	0.43	0.0027	0.33	42	0.5%	51	0.6%
Avg	2894	4.1736	13.53	4.1155	12.67	4.1023	13.88	4.0972	13.69	4.0904	14.91	2557	88.4%	2772	95.8%