



Product Introduction

INR18650-35M

18650-3.6V/3.5Ah

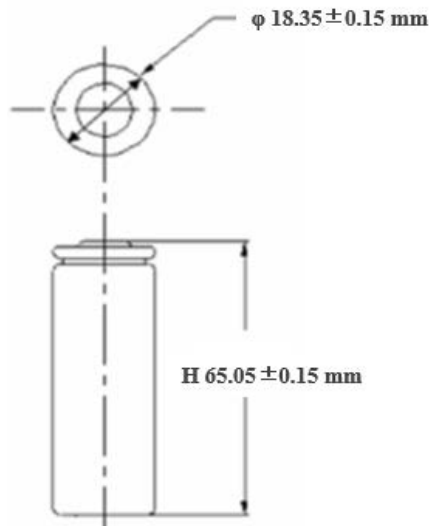
(Low temperature)

- Nominal Specification
- Electrical Characteristics
- Storage Characteristics
- Cycle Life Characteristics
- Safety Characteristics

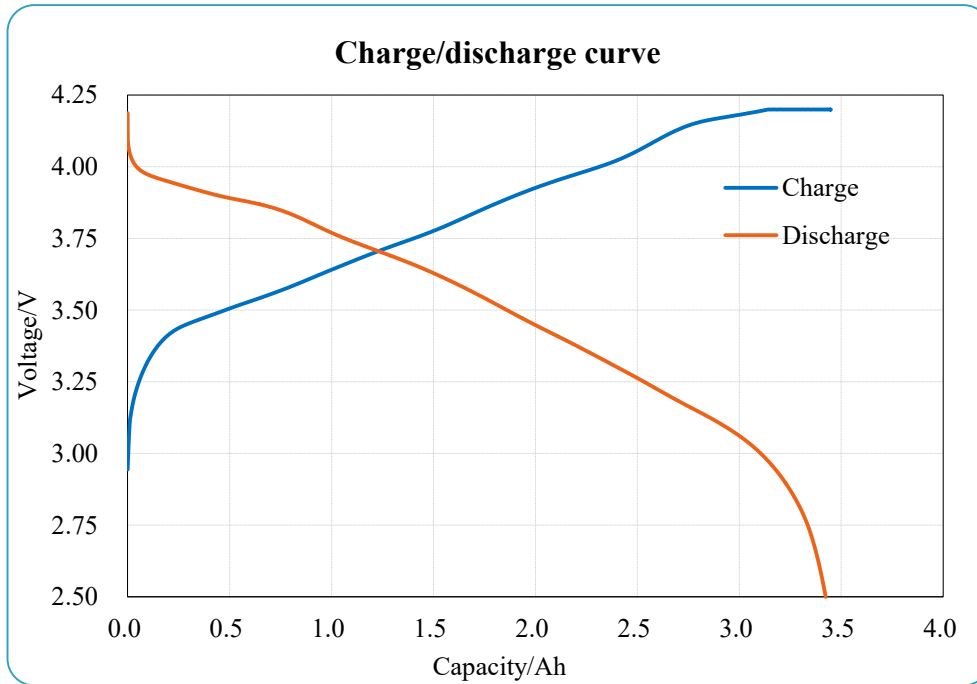


Nominal specification -- Basic characteristics

Item		Specification
Capacity	Nominal	3500mAh@ 0.2C
	Minimum	3350mAh@ 0.2C
Voltage	Nominal	3.60V
	Charge Cut-off	4.20V
	Discharge Cut-off	2.5V
Energy Density		274Wh/Kg
Dimension	Diameter	$18.35 \pm 0.15\text{mm}$
	Height	$65.05 \pm 0.15\text{mm}$
Weight		$\leq 48\text{g}$
ACR		$\leq 25\text{m}\Omega$
Charge Current	Standard	1.75A (0.5C)
	Max	3.50A (1.0C)
Discharge Current	Standard	3.50A (1.0C)
	Max	7.00A (2.0C)
Cycle life	+1.75A/-3.50A(+0.5C/-1C) (4.2V-2.75V)	600 cycle $\geq 70\%$ *1st Capacity



Nominal specification -- Standard charge/discharge curves



Standard charge/discharge:

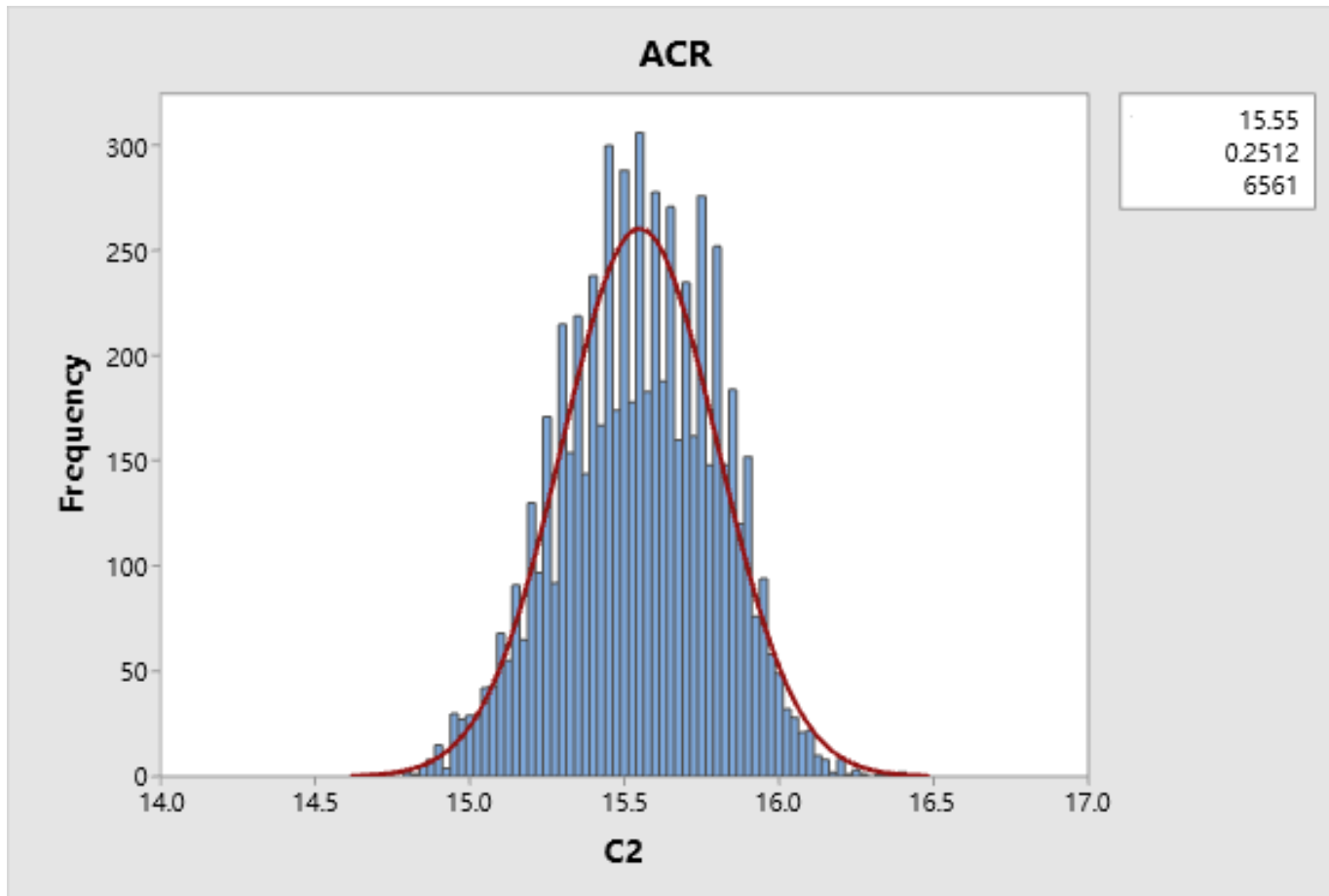
Standard charge: 0.5C CC to 4.2V, CV to 0.02C;

Rest: 10min

Standard discharge: 1C DC to 2.5V

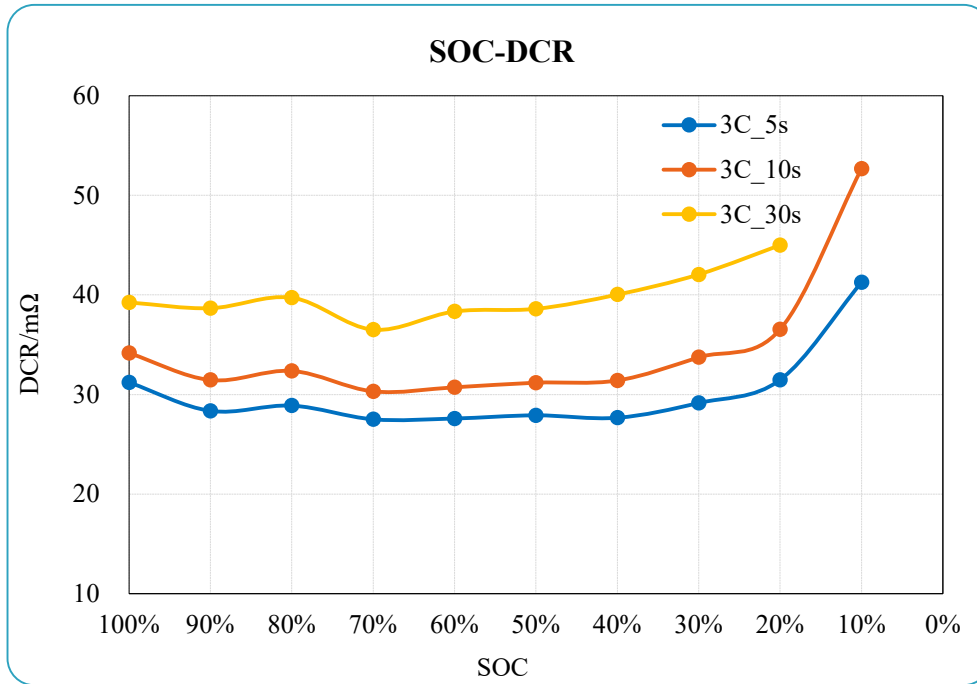
Temperature: 25°C

Item	Charge	Discharge
Current	1.75A	3.5A
Rate	0.5C	1C
Capacity/Ah	3.449	3.424
Energy/Wh	13.212	11.993



Item	Average	Minimum	Maximum
ACR/mΩ	15.5	14.8	16.4

ACR: 35%SOC, AC 1kHz



DCR at discharge:

Step 1. Standard charge and discharge to get the initial capacity;

Step 2. Conduct the pulse discharge test with 3C & 30s after the cell was full charged;

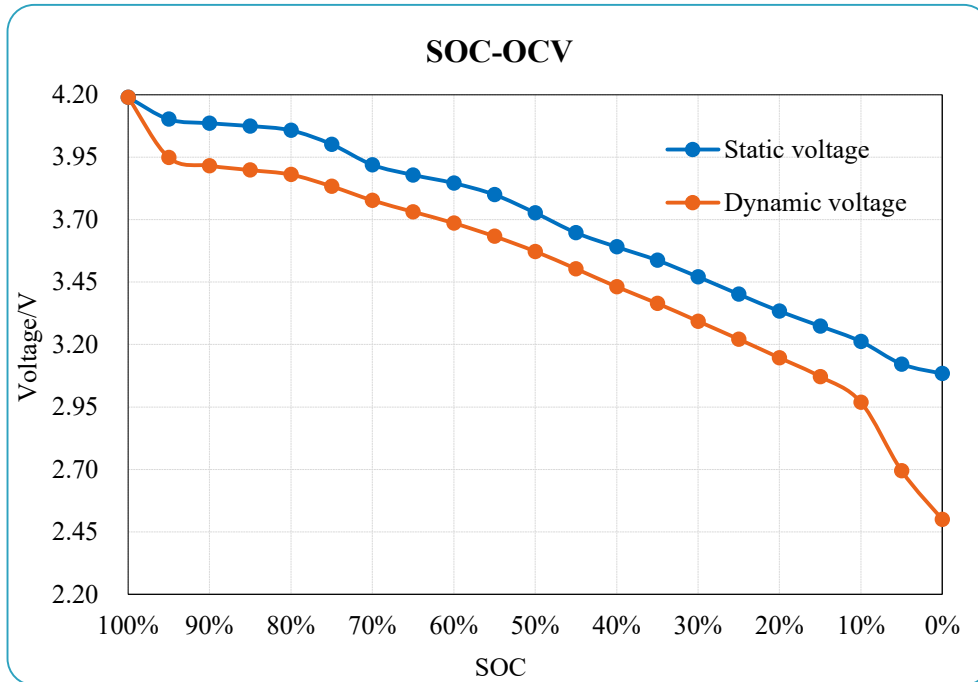
Step 3. Adjust the SOC to 90%, 80%, ... 10% by discharge with 1C and then conduct the pulse discharge test (pulse test was conducted after 1h rest from SOC adjustment)

Item	SOC	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%
DCR	3C_5s	31.2	28.4	28.9	27.5	27.6	27.9	27.7	29.1	31.5	41.3
	3C_10s	34.2	31.4	32.4	30.3	30.7	31.2	31.4	33.7	36.5	52.7
	3C_30s	39.2	38.7	39.7	36.5	38.3	38.6	40.0	42.1	45.0	NA

Calculation formula:

$$DCR = (U_i - U_o) / I$$

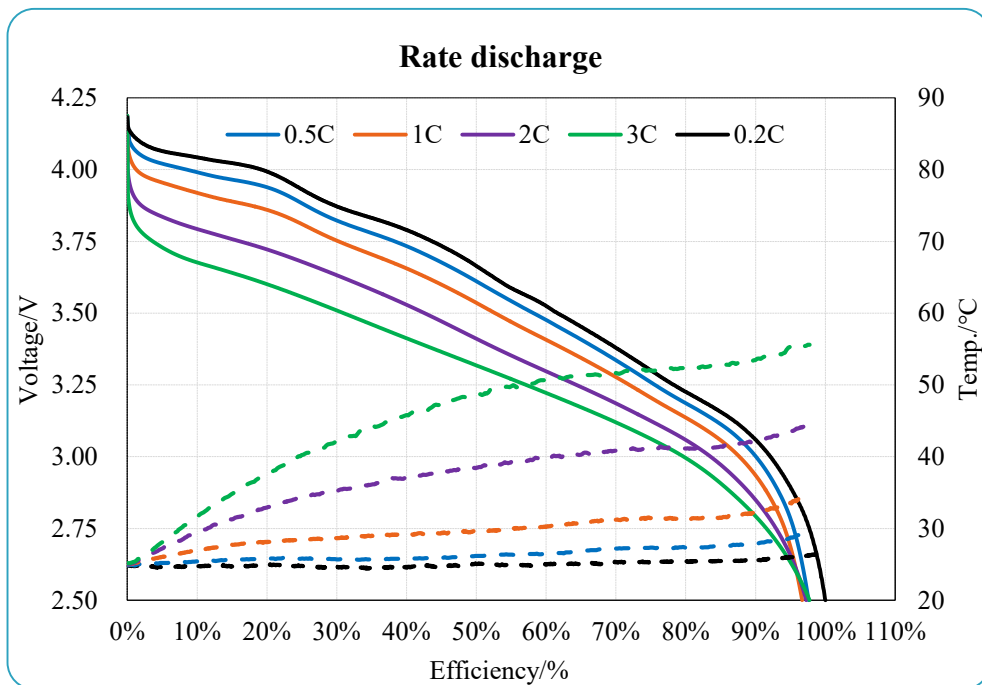
U_i : The voltage before pulse; U_o : The voltage at end of pulse; I : The pulse current



SOC-OCV at discharge direction:

- Step 1. Standard charge and discharge to get the initial capacity ' C_d ';
- Step 2. 0.5C CC to 4.2V, CV to 0.02C;
- Step 3. Rest 2 h, 1C DC to 10% C_d , 2.5V cut-off;
- Step 4. Repeat step 3 for 10 times;
- Step 5. Data collection: Record the voltage at the end of discharge from step 3 as 'dynamic voltage', and record the voltage after 2h' rest from step 3 as 'static voltage'.

Voltage/V \ SOC	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%	0%
Static	4.190	4.086	4.057	3.919	3.846	3.727	3.591	3.471	3.333	3.212	3.084
Dynamic	4.190	3.916	3.880	3.777	3.686	3.573	3.431	3.293	3.147	2.969	2.500



Rate discharge:

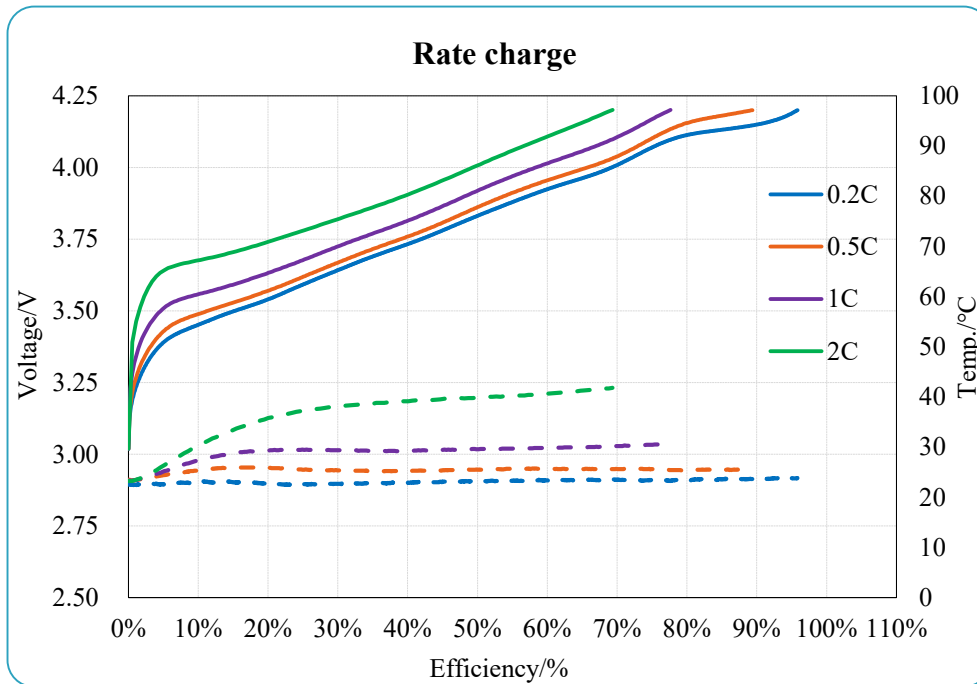
Step 1. Standard charge;

Step 2. Rest 10min;

Step 3. Discharge with various currents, 2.5V cut-off;

Discharge efficiency: Discharge cap. /Discharge cap. at 0.2C.

Current	0.7A	1.75A	3.5A	7.0A	10.5A
Rate	0.2C	0.5C	1C	2C	3C
Capacity/Ah	3.529	3.445	3.412	3.432	3.450
Efficiency/%	100.0%	97.6%	96.7%	97.3%	97.7%
Max. temp./°C	26.8	29.8	34.3	44.5	55.6
Temp. rise/°C	1.9	4.9	9.3	19.4	30.4



Rate charge:

Step 1. Standard discharge;

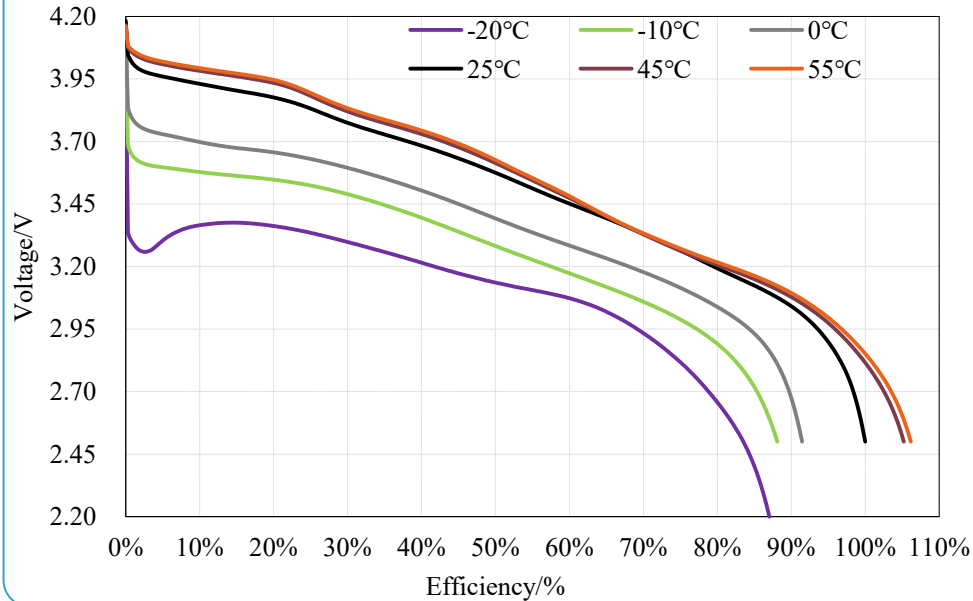
Step 2. Rest 10min;

Step 3. CC charge with various currents to 4.2V;

Charge efficiency: Charge cap. /Discharge cap. at 1C.

Discharge capacity (1C) /Ah	Current	0.7A	1.75A	3.5A	7.0A
	Rate	0.2C	0.5C	1C	2C
3.391	Charge capacity/Ah	3.250	3.031	2.634	2.352
	Efficiency/%	95.8%	89.4%	77.7%	69.3%
	Max. temp./°C	23.8	26.0	30.5	41.8
	Temp. rise/°C	0.0	2.5	7.2	18.6

H/L Temperature discharge



Discharge at H/L temperature:

Step 1. Standard charge;

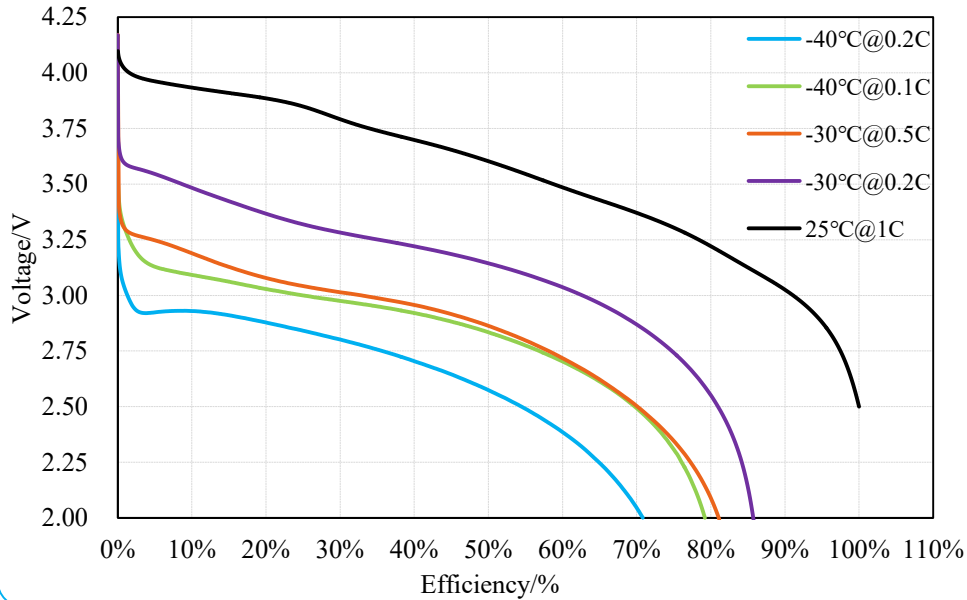
Step 2. Rest at corresponding temperature for 6h;

Step 3. 1C DC to 2.5V (2.2 V cut-off at -20°C);

Step 4. Efficiency= Discharge cap. /Discharge cap. (@25°C).

Temperature/°C	-20°C	-10°C	0°C	25°C	45°C	55°C
Rest time/h	24	5	5	5	5	5
Cut-off Voltage/V	2.2	2.5	2.5	2.5	2.5	2.5
Capacity/Ah	2.974	3.011	3.126	3.417	3.596	3.628
Efficiency	87.0%	88.1%	91.5%	100.0%	105.2%	106.2%

Discharge @-30°C@-40°C



Discharge at H/L temperature:

Step 1. Standard charge;

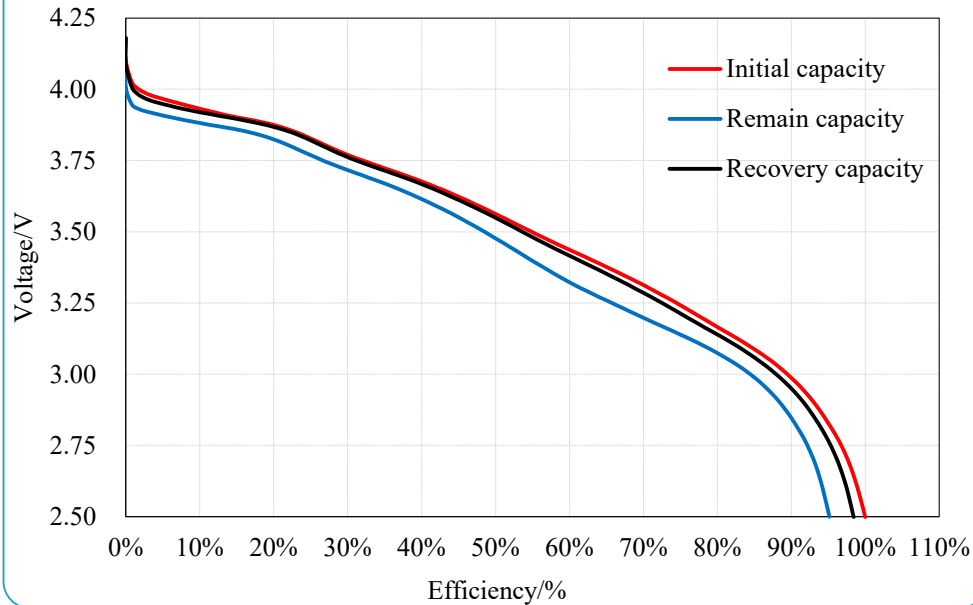
Step 2. Rest at corresponding temperature for 6h;

Step 3. Constant current discharge at various discharge rates to 2.0V at low temperatures;

Step 4. Efficiency= Discharge cap. /Discharge cap. (@25°C).

Temperature/°C	25°C	-40°C	-40°C	-30°C	-30°C
Rest time/h	5	24	24	24	24
Cut-off Voltage/V	2.5	2.0	2.0	2.0	2.0
Rate	1C	0.2C	0.1C	0.5C	0.2C
Capacity/Ah	3.429	2.429	2.716	2.782	2.965
Efficiency	100.0%	70.8%	79.2%	81.1%	86.5%

Storage at 60°C & 100%SOC_7days

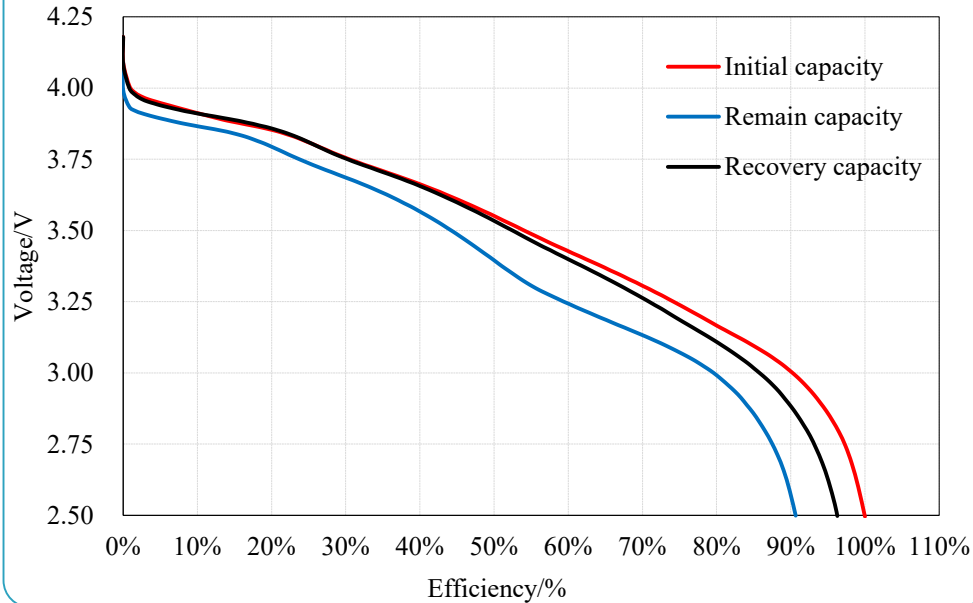


Charge retention_60°C 7days:

- Step 1. Standard charge and discharge to get the initial capacity;
- Step 2. Store the cell at 60°C for 7 days after full charged;
- Step 3. Rest 4h at 25°C after finish storage, 1C DC to 2.5V
(record **the remain capacity**);
- Step 5. Standard charge and discharge
(record **the recovery capacity**).

60°C_7days	Before storage			After storage				Retention	
No.	Resistance /mΩ	Voltage /V	Capacity /Ah	Resistance /mΩ	Voltage /V	Remain capacity/Ah	Recovery capacity/Ah	Remain capacity	Recovery capacity
1#	15.6	4.174	3.459	17.1	4.108	3.292	3.390	95.2%	98.0%
2#	15.7	4.175	3.450	17.3	4.109	3.285	3.400	95.0%	98.3%
3#	15.5	4.174	3.459	17.0	4.110	3.299	3.407	95.4%	98.5%

Storage at 60°C & 100%SOC_30days



Charge retention_60°C 30days:

Step 1. Standard charge and discharge to get the initial capacity;

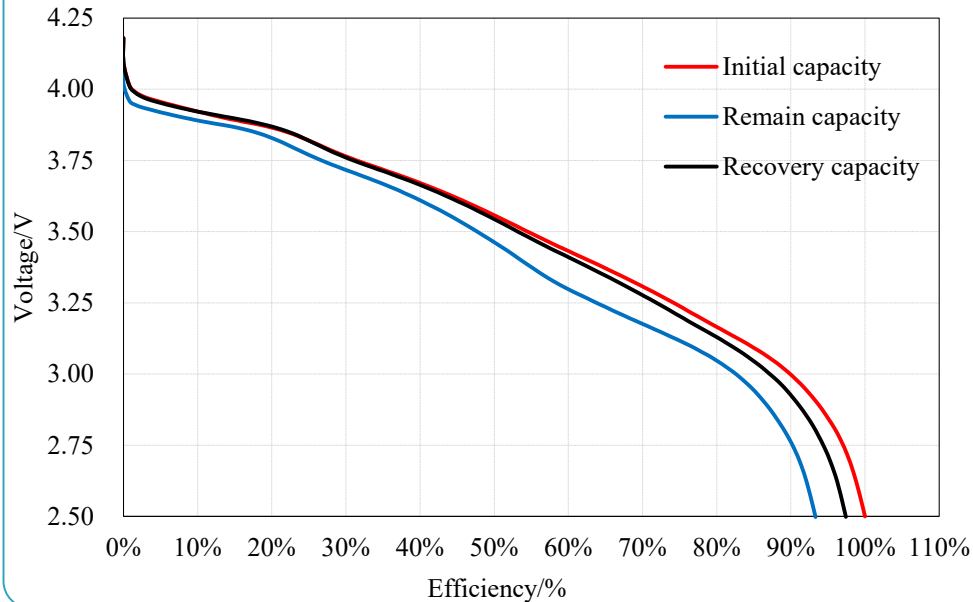
Step 2. Store the cell at 60°C for 30 days after full charged;

Step 3. Rest 4h at 25°C after finish storage, 1C DC to 2.5V
(record **the remain capacity**);

Step 5. Standard charge and discharge
(record **the recovery capacity**).

60°C_30days	Before storage			After storage				Retention	
No.	Resistance /mΩ	Voltage /V	Capacity /Ah	Resistance /mΩ	Voltage /V	Remain capacity/Ah	Recovery capacity/Ah	Remain capacity	Recovery capacity
4#	15.3	4.173	3.407	17.5	4.093	3.089	3.280	90.7%	96.3%
5#	15.3	4.173	3.406	17.5	4.092	3.081	3.286	90.4%	96.5%
6#	15.4	4.173	3.426	17.6	4.093	3.099	3.294	90.5%	96.1%

Storage at 45°C & 100%SOC_30days

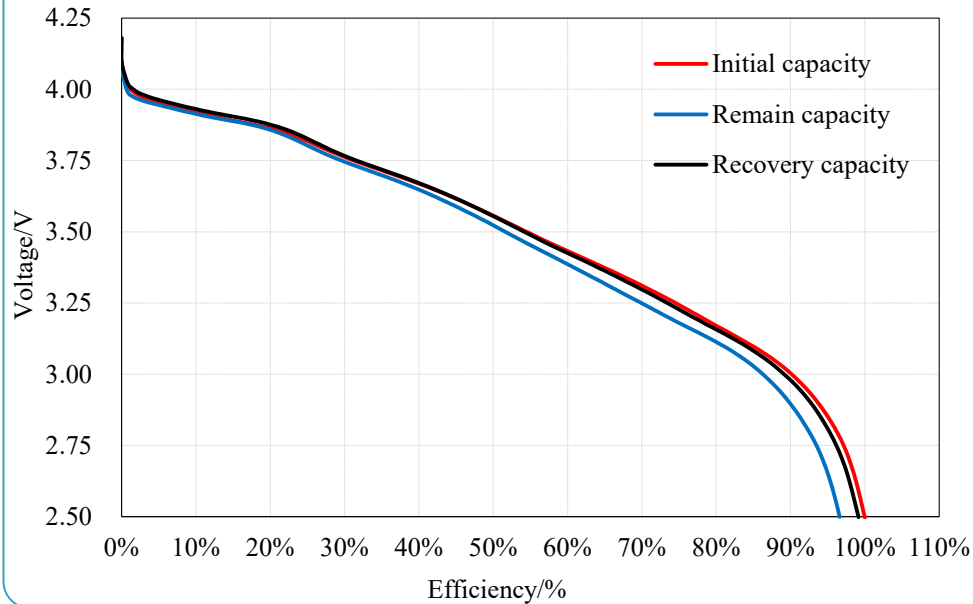


Charge retention_45°C 30days:

- Step 1. Standard charge and discharge to get the initial capacity;
- Step 2. Store the cell at 45°C for 30 days after full charged;
- Step 3. Rest 4h at 25°C after finish storage, 1C DC to 2.5V
(record **the remain capacity**);
- Step 5. Standard charge and discharge
(record **the recovery capacity**).

45°C_30days	Before storage			After storage				Retention	
No.	Resistance /mΩ	Voltage /V	Capacity /Ah	Resistance /mΩ	Voltage /V	Remain capacity/Ah	Recovery capacity/Ah	Remain capacity	Recovery capacity
7#	15.5	4.174	3.428	16.1	4.113	3.199	3.340	93.3%	97.4%
8#	15.3	4.175	3.417	15.9	4.113	3.192	3.342	93.4%	97.8%
9#	15.5	4.174	3.420	16.0	4.114	3.199	3.346	93.5%	97.8%

Storage at 25°C & 100%SOC_30days



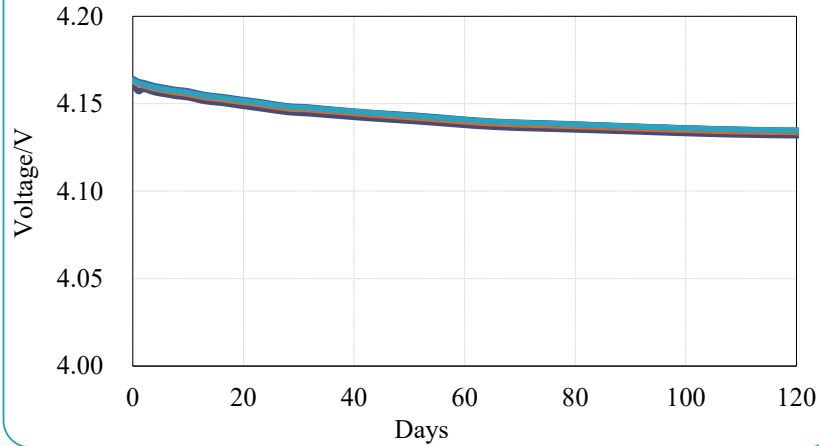
Charge retention_25°C 30days:

- Step 1. Standard charge and discharge to get the initial capacity;
- Step 2. Store the cell at 25°C for 30 days after full charged;
- Step 3. Rest 4h at 25°C after finish storage, 1C DC to 2.5V
(record **the remain capacity**);
- Step 5. Standard charge and discharge
(record **the recovery capacity**).

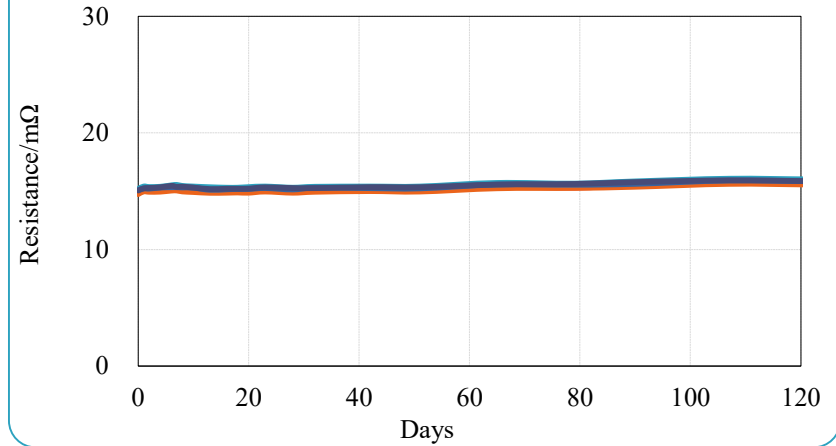
25°C_30days	Before storage			After storage				Retention	
No.	Resistance /mΩ	Voltage /V	Capacity /Ah	Resistance /mΩ	Voltage /V	Remain capacity/Ah	Recovery capacity/Ah	Remain capacity	Recovery capacity
10#	15.4	4.173	3.440	15.5	4.150	3.324	3.411	96.6%	99.1%
11#	15.4	4.174	3.450	15.5	4.150	3.325	3.414	96.4%	99.0%
12#	15.3	4.174	3.452	15.4	4.152	3.324	3.414	96.3%	98.9%

Storage- 100%SOC

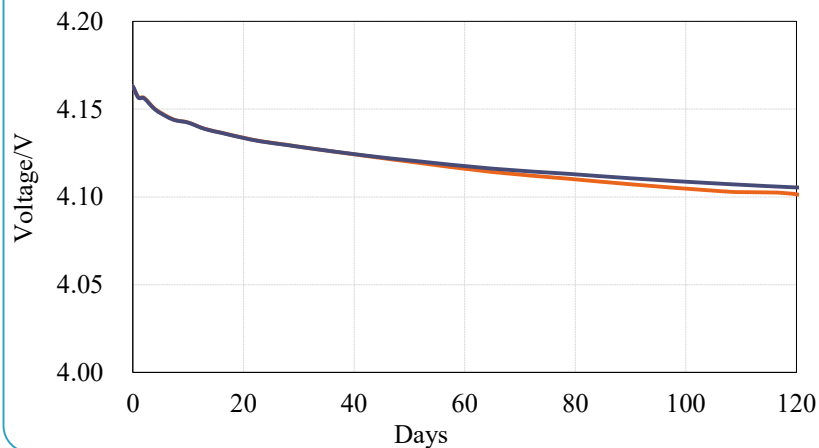
Storage at 25°C_100%SOC



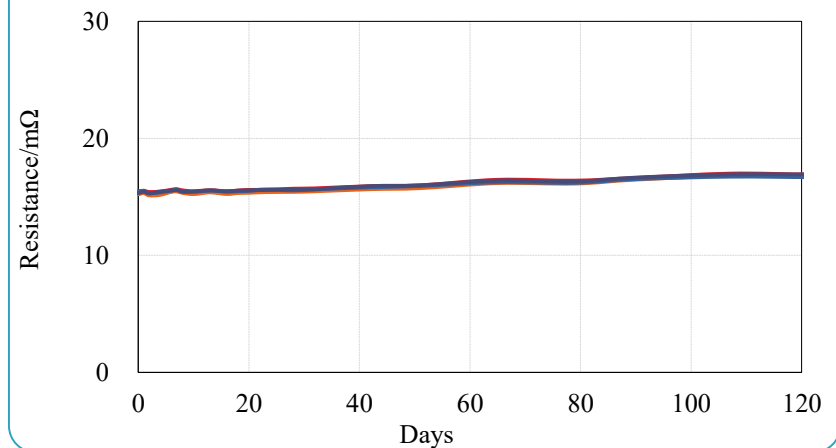
Storage at 25°C_100%SOC



Storage at 45°C_100%SOC

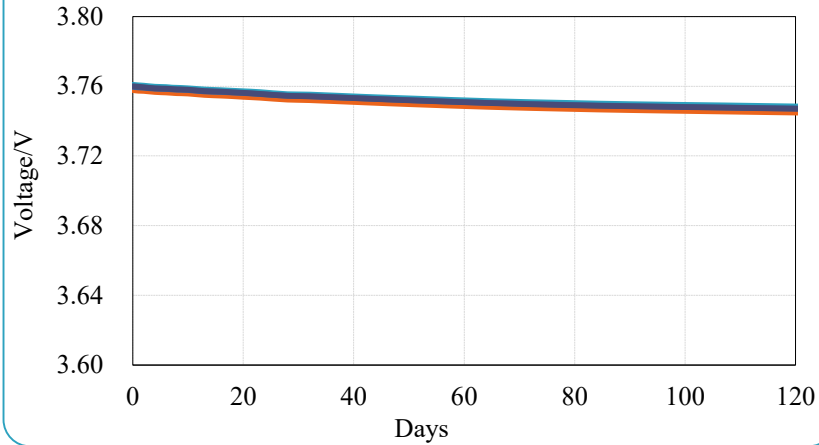


Storage at 45°C_100%SOC

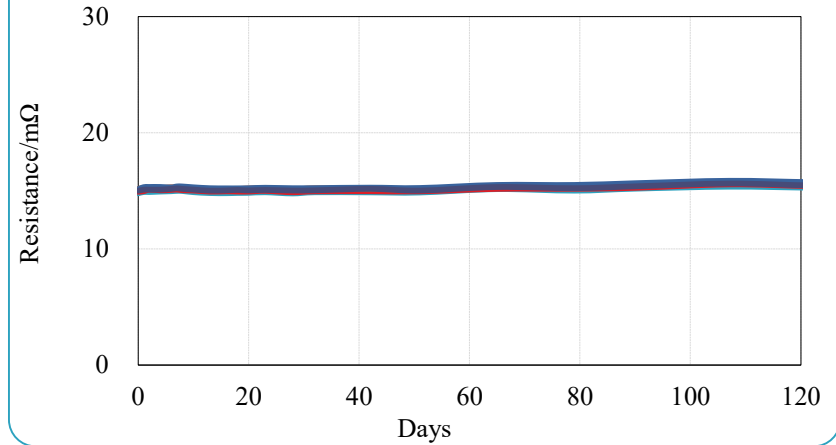


Storage- 50%SOC

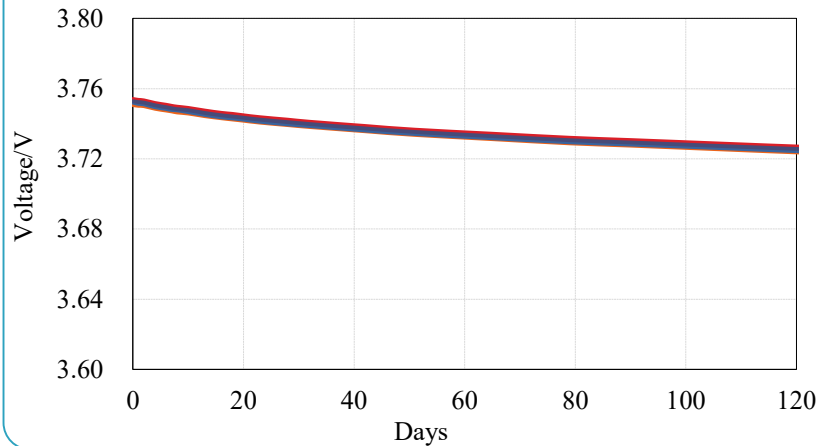
Storage at 25°C_50%SOC



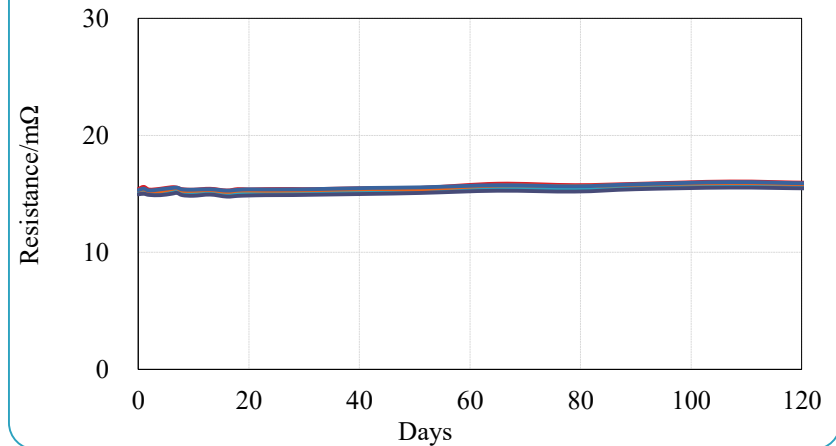
Storage at 25°C_50%SOC



Storage at 45°C_50%SOC

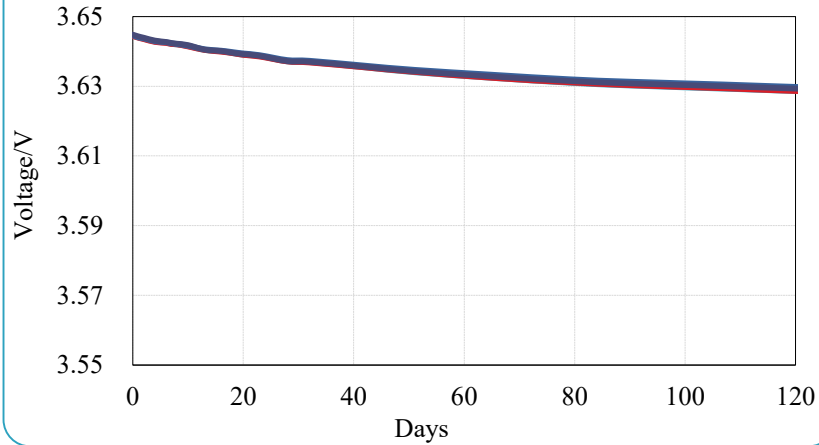


Storage at 45°C_50%SOC

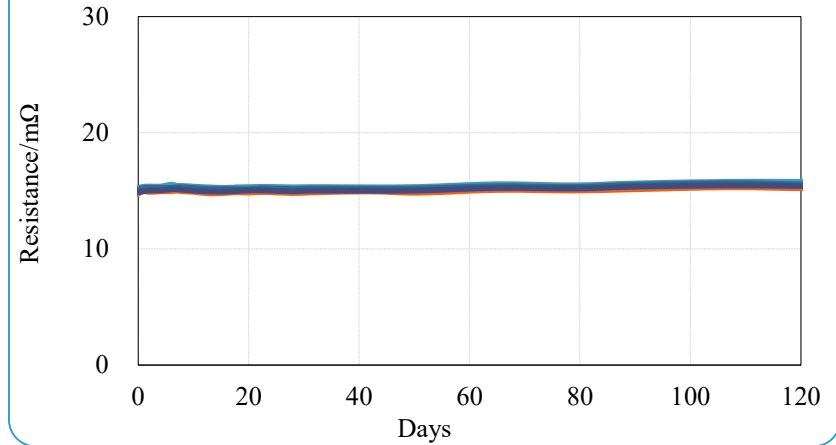


Storage- 35%SOC

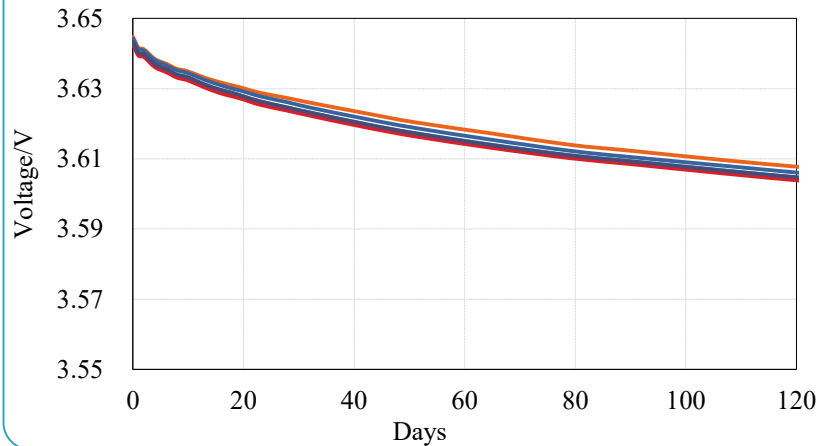
Storage at 25°C_35%SOC



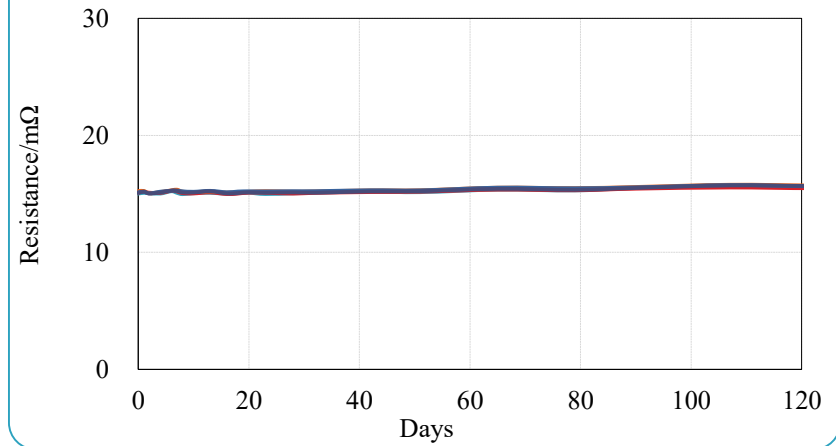
Storage at 25°C_35%SOC



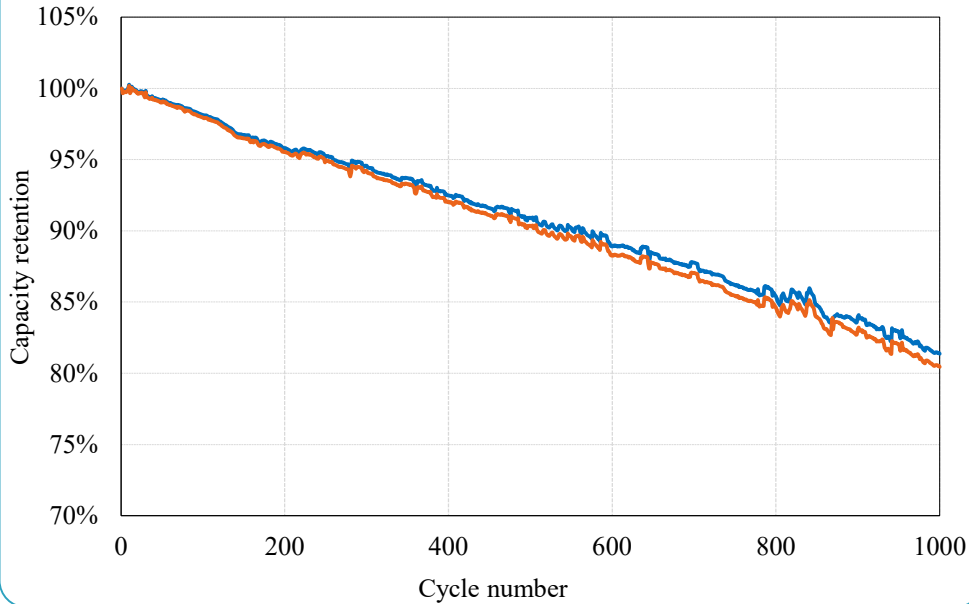
Storage at 45°C_35%SOC



Storage at 45°C_35%SOC



25°C cycle life, +0.5C/-1C, 4.2V-2.75V



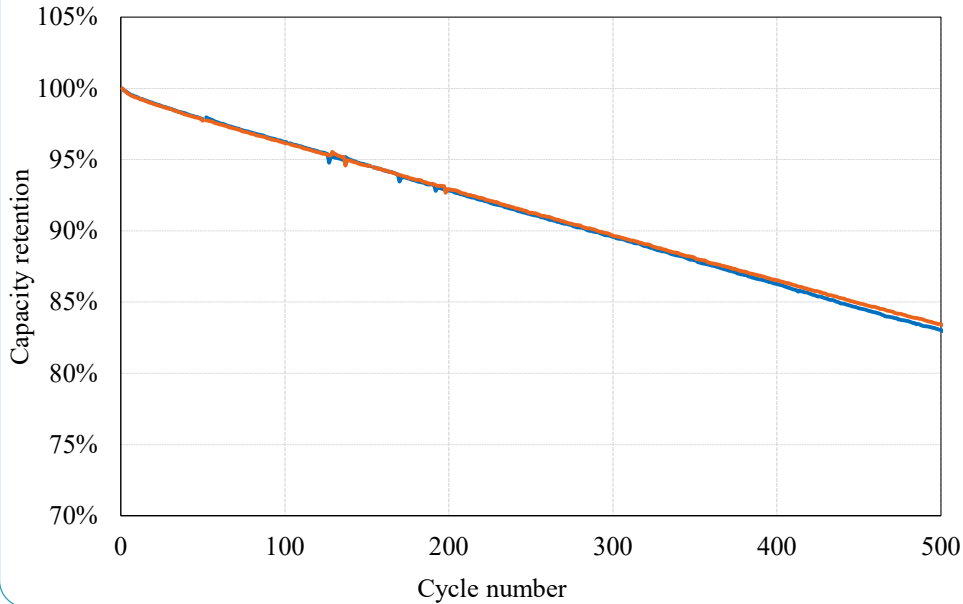
Temperature: 25°C

Charge: 0.5C CC to 4.2V, CV to 0.1C;

Discharge: 1C DC to 2.75V.

No.	Voltage range	1st cycle		200 th cycle		500 th cycle		1000 th cycle	
		Capacity /Ah	Retention /%	Capacity /Ah	Retention /%	Capacity /Ah	Retention /%	Capacity /Ah	Retention /%
1#	4.2-2.75V	3.371	100.0%	3.231	95.8%	3.065	90.9%	2.745	81.4%
2#	4.2-2.75V	3.377	100.0%	3.226	95.6%	3.051	90.4%	2.718	80.5%

45°C cycle life, +0.5C/-1C, 4.2V-2.75V

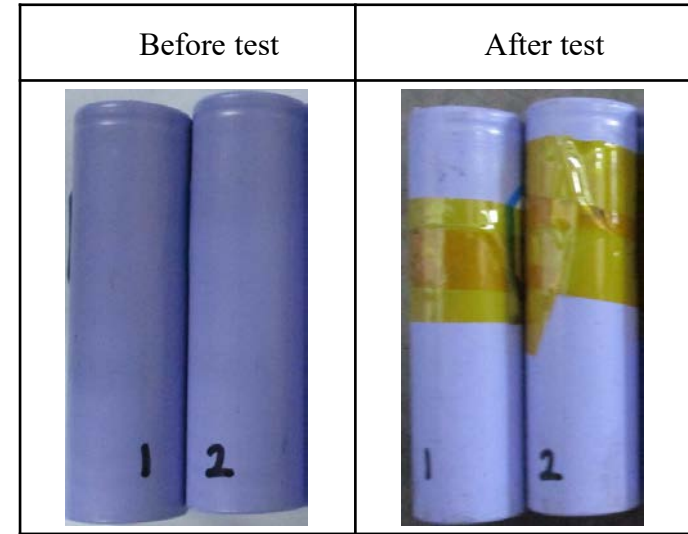
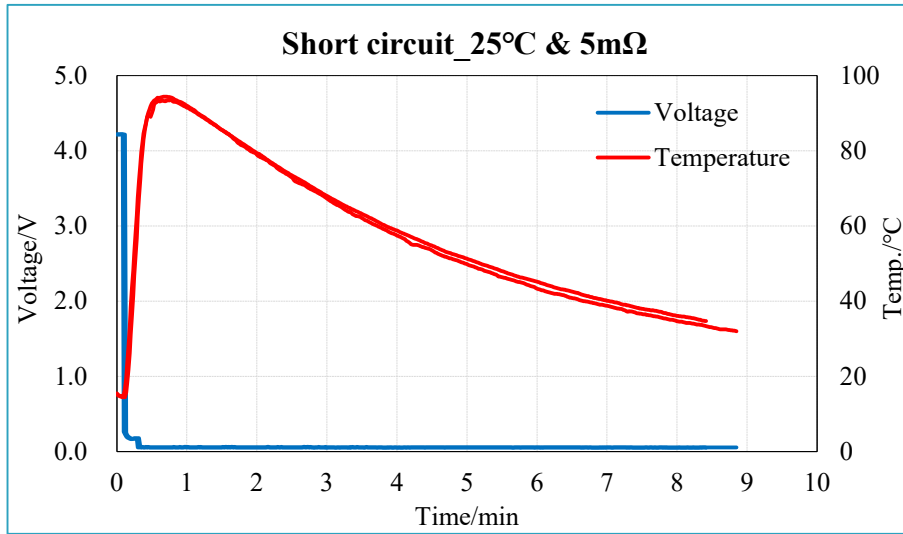


Temperature: 45°C

Charge: 0.5C CC to 4.2V, CV to 0.1C;

Discharge: 1C DC to 2.75V.

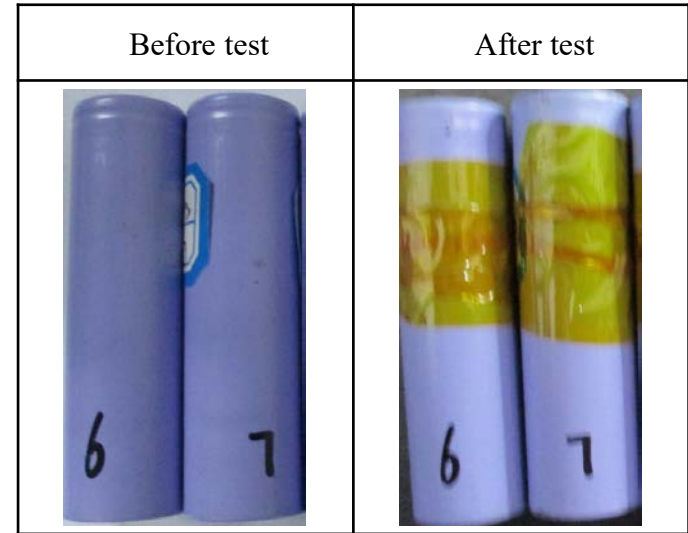
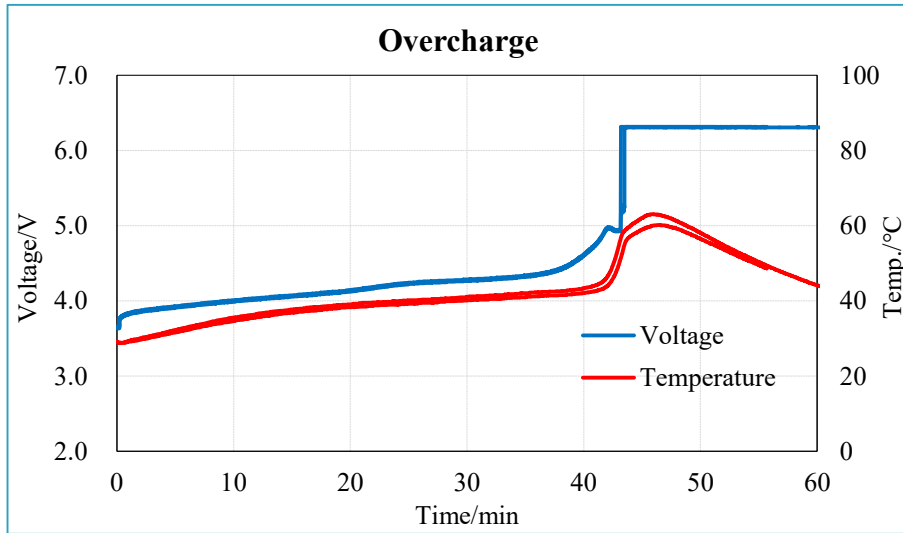
No.	Voltage range	1st cycle		100 th cycle		300 th cycle		500 th cycle	
		Capacity /Ah	Retention /%	Capacity /Ah	Retention /%	Capacity /Ah	Retention /%	Capacity /Ah	Retention /%
1#	4.2-2.75V	3.354	100.0%	3.229	96.3%	3.007	89.7%	2.787	83.1%
2#	4.2-2.75V	3.351	100.0%	3.224	96.2%	3.008	89.8%	2.797	83.5%



Test method: At $25 \pm 5^\circ\text{C}$, the fully charged cell is short circuited by connecting positive and negative terminal by a wire which resistance $\leq 5\text{m}\Omega$ for 10min.

Standard: No fire, No explosion

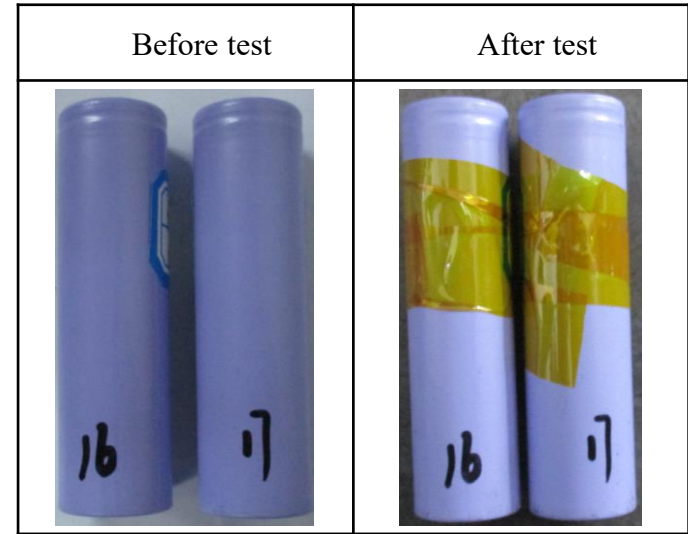
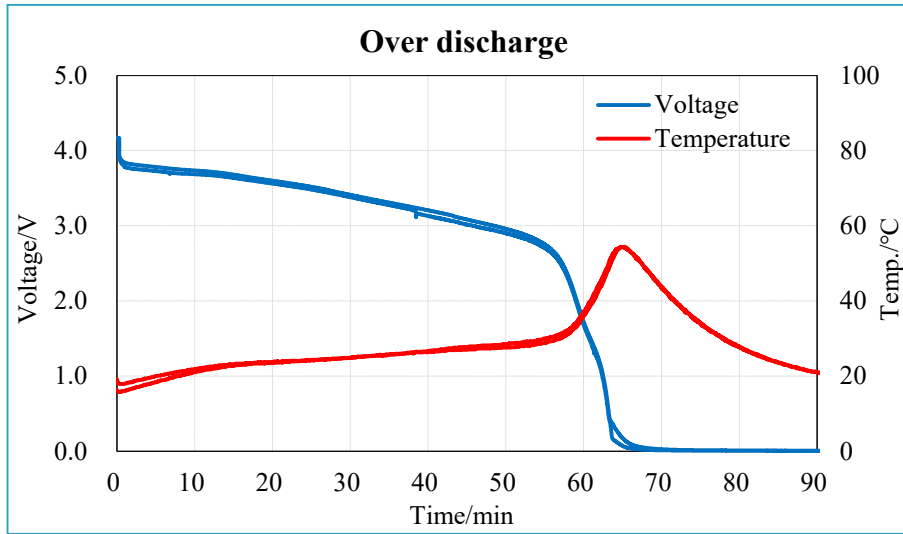
Data records						
No.	Cell status before testing				Max Temp. /°C	Test results OK/NG
	Capacity/Ah	Resistance/mΩ	Voltage/V	Weight/g		
1#	3.439	15.5	4.172	46.3	94.4	OK
2#	3.455	15.9	4.172	46.8	93.5	OK



Test method: At $25 \pm 5^\circ\text{C}$, the fully charged cell is charged at 1C current to 1.5 times of the cut-off voltage.

Standard: No fire, No explosion

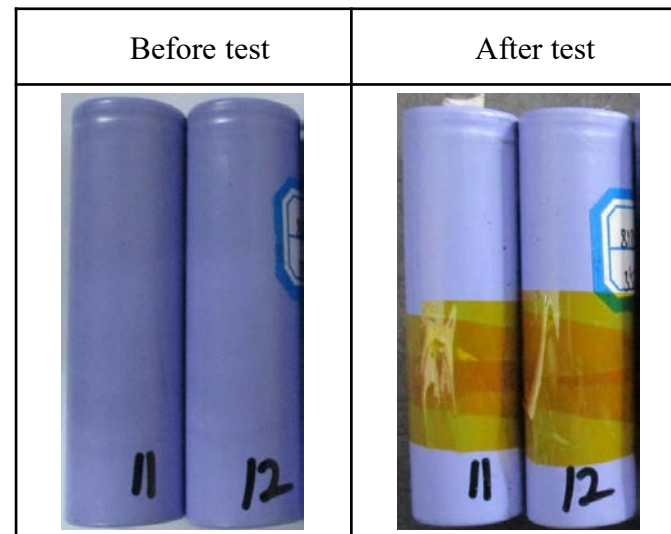
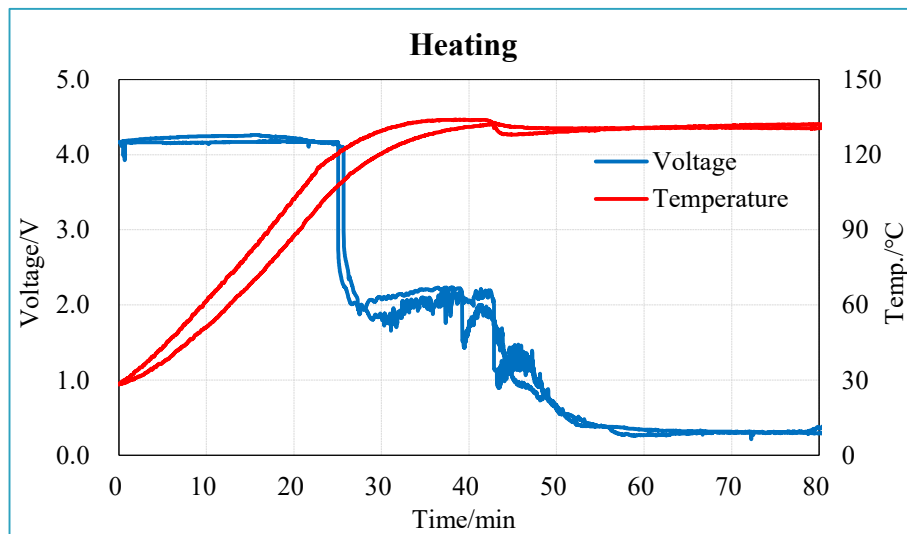
Data records						
No.	Cell status before testing				Max Temp. /°C	Test results OK/NG
	Capacity/Ah	Resistance/mΩ	Voltage/V	Weight/g		
3#	3.450	15.6	4.171	46.4	60.2	OK
4#	3.448	15.4	4.173	46.4	63.1	OK



Test method: At $25 \pm 5^\circ\text{C}$, the fully charged cell is discharged at 1C current for 90min.

Standard: No fire, No explosion, no leakage

Data records						
No.	Cell status before testing				Max Temp. /°C	Test results OK/NG
	Capacity/Ah	Resistance/mΩ	Voltage/V	Weight/g		
5#	3.462	15.4	4.175	46.9	54.5	OK
6#	3.448	15.8	4.172	46.2	54.5	OK



Test method: At $25 \pm 5^\circ\text{C}$, the fully charged cell is put into the temperature box, which is heated to 130°C by $5^\circ\text{C}/\text{min}$, and the heating is kept for 30 min.

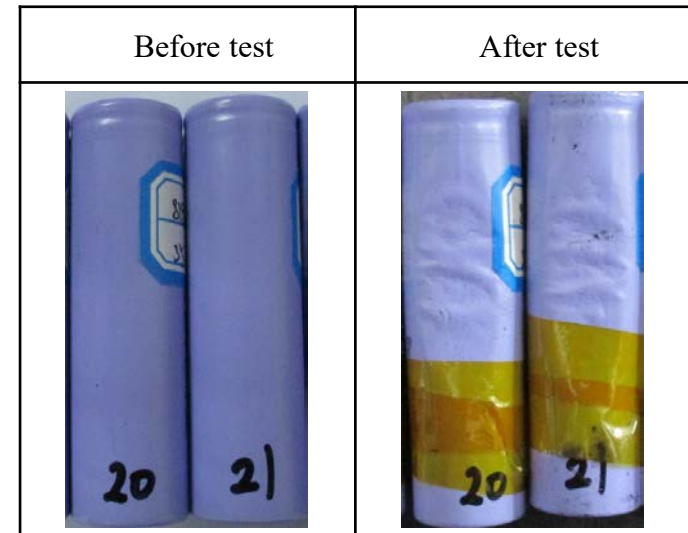
Standard: No fire, No explosion

Data records						
No.	Cell status before testing				Max Temp. /°C	Test results OK/NG
	Capacity/Ah	Resistance/mΩ	Voltage/V	Weight/g		
7#	3.448	15.9	4.170	46.3	134.8	OK
8#	3.439	15.8	4.172	46.1	132.2	OK

Test method:

At $25 \pm 5^{\circ}\text{C}$, the fully charged cell is extruded by the semi-cylindrical with a radius of 75mm perpendicular to the direction of the cell, stop the extrusion when the cell shape variable reaches 30%.

Standard: No fire, No explosion

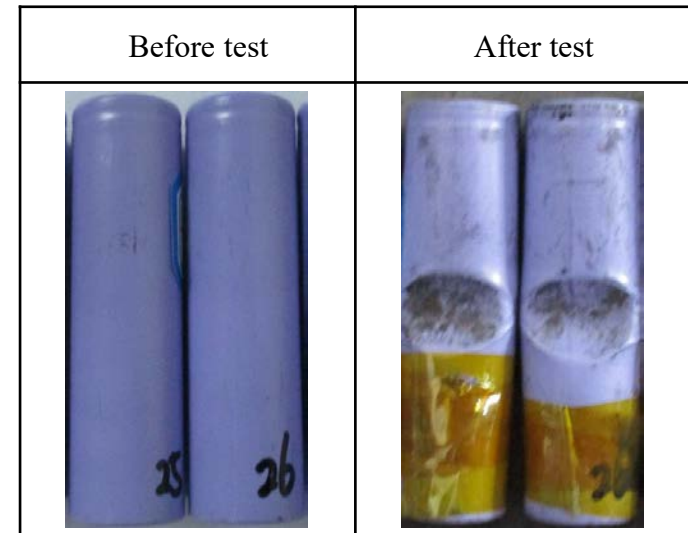


Data records					
No.	Cell status before testing				Test results OK/NG
	Capacity/Ah	Resistance/mΩ	Voltage/V	Weight/g	
9#	3.436	15.8	4.181	46.1	OK
10#	3.447	15.9	4.180	46.5	OK

Test method:

At $25 \pm 5^\circ\text{C}$, the fully charged cell is placed on the platform, and a metal rod with a diameter of $15.8\text{mm} \pm 0.2\text{mm}$ was horizontally placed on the upper surface of the geometric center of the cell, and a weight of $9.1\text{kg} \pm 0.1\text{kg}$ was used to impact the cell's surface with the metal rod from a height of $610\text{mm} \pm 25\text{mm}$ in a free fall.

Standard: No fire, No explosion

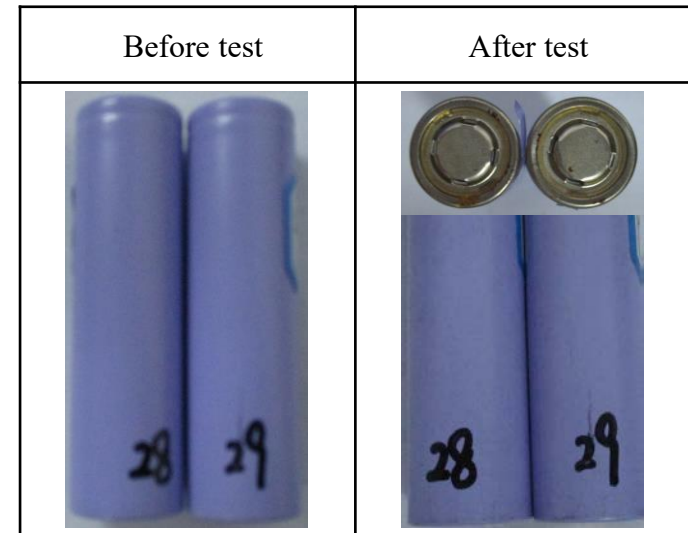


Data records					
No.	Cell status before testing				Test results OK/NG
	Capacity/Ah	Resistance/mΩ	Voltage/V	Weight/g	
11#	3.462	15.9	4.181	46.9	OK
12#	3.452	15.4	4.180	46.7	OK

Test method:

At $25 \pm 5^{\circ}\text{C}$, the fully charged cell is dropped by the positive and negative terminal down from a height of 1.0m onto the cement floor.

Standard: No fire, No explosion, No leakage

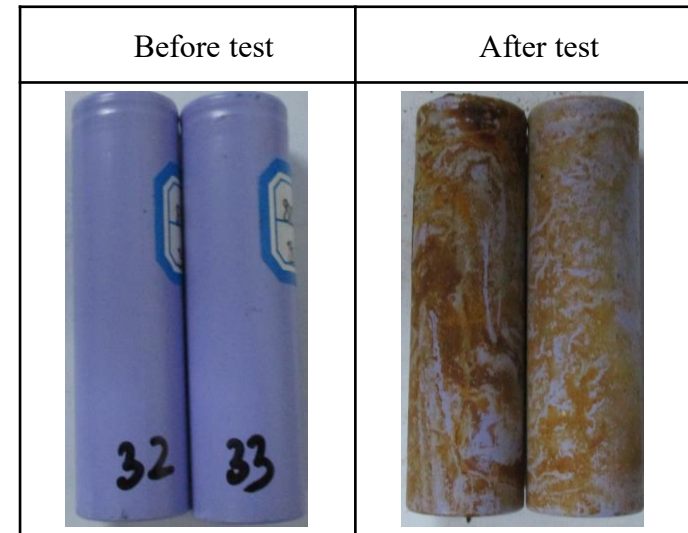


Data records					
No.	Cell status before testing				Test results OK/NG
	Capacity/Ah	Resistance/mΩ	Voltage/V	Weight/g	
13#	3.451	15.5	4.182	46.7	OK
14#	3.459	15.3	4.181	46.8	OK

Test method:

At $25 \pm 5^{\circ}\text{C}$, the fully charged cell is completely immersed in 3.5wt% NaCl solution for 2h

Standard: No fire, No explosion



Data records					
No.	Cell status before testing				Test results OK/NG
	Capacity/Ah	Resistance/mΩ	Voltage/V	Weight/g	
15#	3.449	15.3	4.180	46.4	OK
16#	3.461	15.4	4.181	46.9	OK

