

N21700CG-50E Technical Report

- Product Research & Development Center
- 2022.11



1. Basic information

2. Cell performance introduction

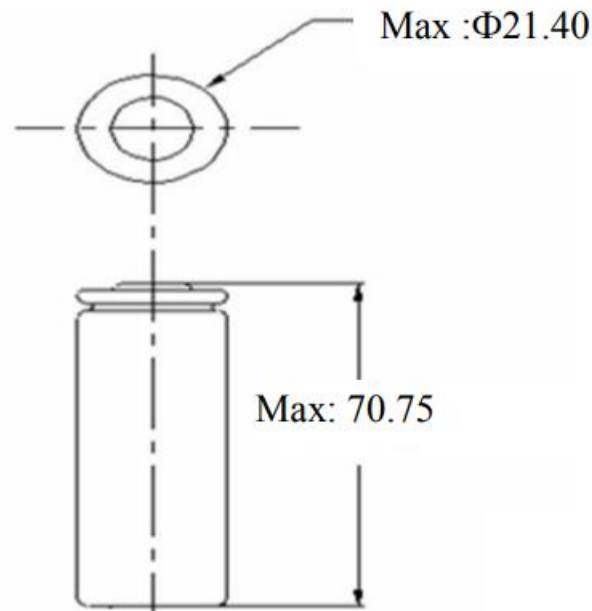
- Rate discharge
- High-low temperature discharge
- Cycle life
- Storage

3. Safety test results

1. Basic information

Items	Specifications
1.1 Cell model	N21700CG-50E
1.2 Nominal capacity	5000mAh@0.2C
1.3 Minimum capacity	4900mAh@0.2C
1.4 Internal impedance	$\leq 25\text{m}\Omega @ 1\text{kHz}$
1.5 Cell operating conditions	Temperature of charge : 0~50°C Temperature of discharge : -20~60°C
1.6 Weight	$\leq 70\text{g}$
1.7 Nominal voltage	3.60V
1.8 Charge cut-off voltage	4.20V
1.9 Discharge cut-off voltage	2.50V
1.10 Standard charge current	0.5C
1.11 Standard discharge current	0.2C
1.12 Max charge current	1C (25°C, not for cycle)
1.13 Max discharge current	3C (25°C, not for cycle)
1.14 Recommended storage temperature	-20°C ~ 25°C 60% RH max: less than 1 year -20°C ~ 45°C 60% RH max: less than 3 months -20°C ~ 60°C 60% RH max: less than 1 month

Cell physical dimension (with tube)



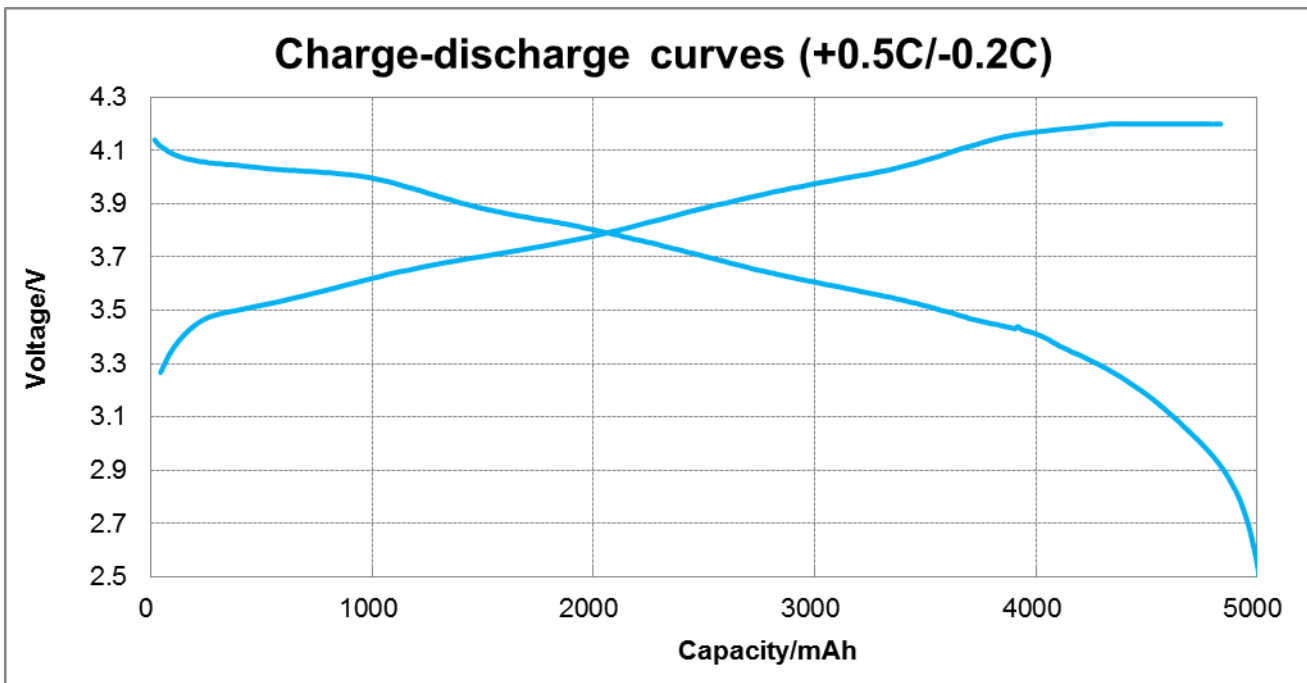
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1. Basic information

◆ Charge-discharge curves

-Charge: $25\pm 2^{\circ}\text{C}$, 0.5C-4.2V CC-CV, 50mA cut off;

-Discharge: $25\pm 2^{\circ}\text{C}$, 0.2C CC to 2.5V cut off.



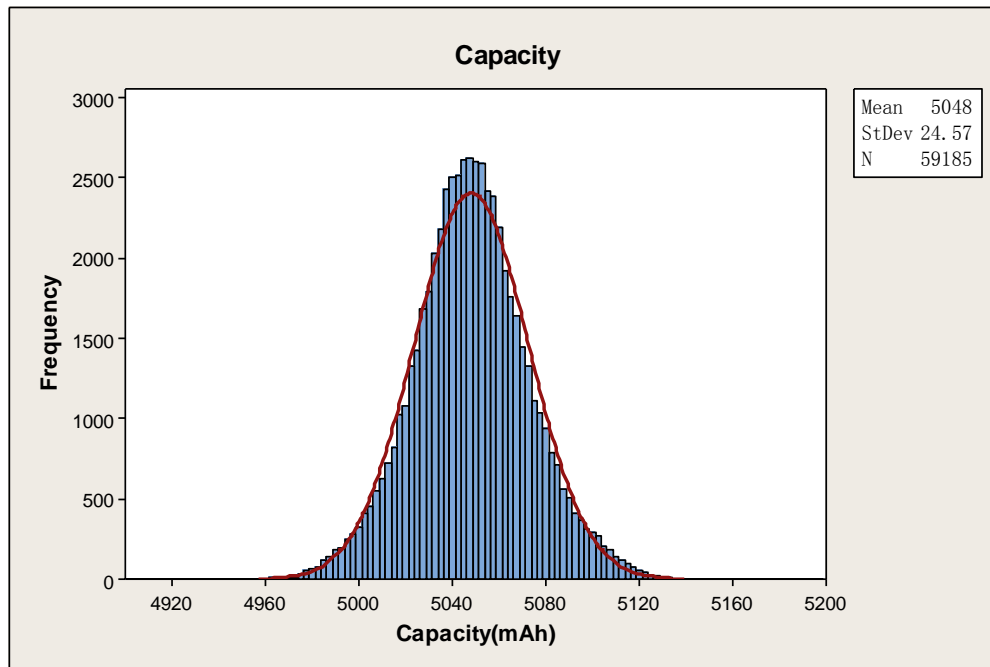
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1. Basic information

◆ Capacity

-Charge: 25±2°C, 0.5C-4.2V CC-CV, 50mA cut off;

-Discharge: 25±2°C, 0.2C CC to 2.5V cut off.



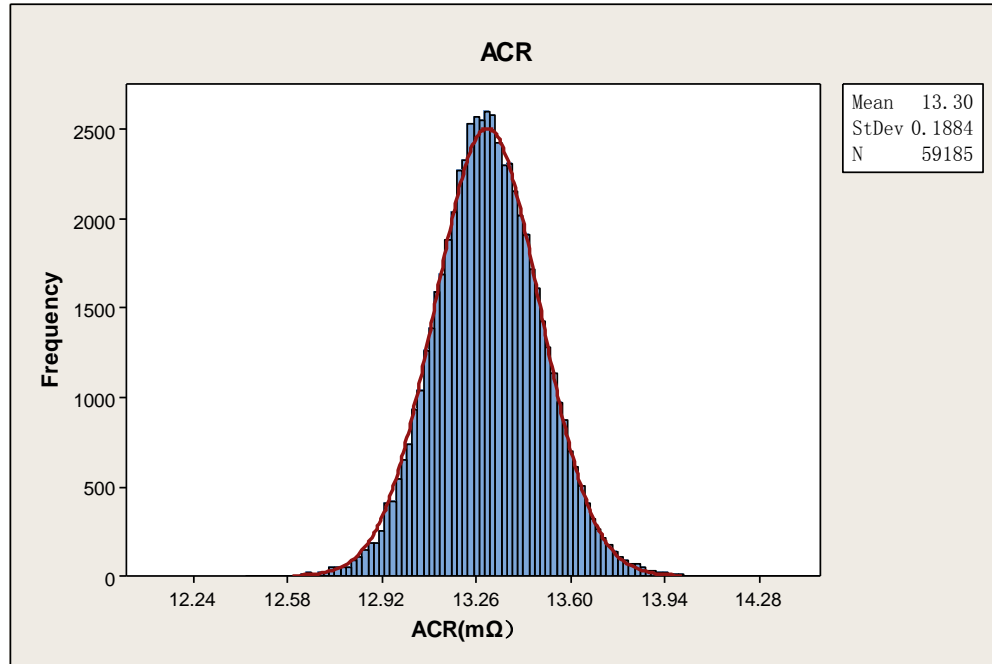
➤ Average capacity: 5048mAh @0.2C

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1. Basic information

◆ ACIR

-Condition: $25\pm 2^{\circ}\text{C}$, 30%SOC, 1kHz.



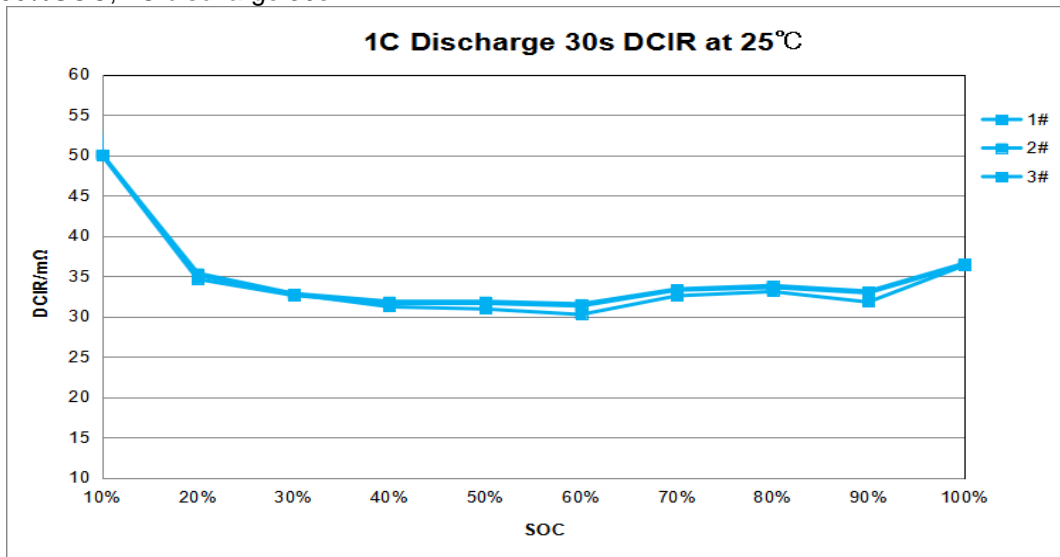
➤ Average ACIR: 13.30mΩ @30%SOC.

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1. Basic information

◆ DCIR

-Condition: 25±2°C, 50%SOC, 1C discharge 30s.



NO.	DCIR/mΩ at different SOC									
	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%
1#	36.4	32.9	33.6	33.3	31.3	31.6	31.6	32.6	34.6	50.0
2#	36.6	33.1	33.8	33.4	31.6	31.9	31.9	32.9	35.4	50.0
3#	36.3	31.8	33.1	32.6	30.2	30.9	31.2	32.8	35.1	50.1

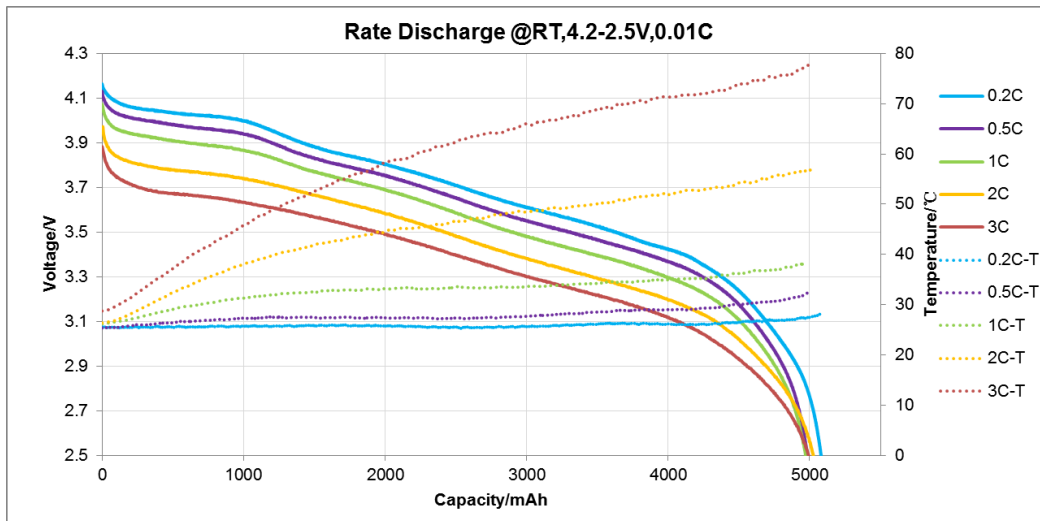
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2. Cell performance introduction

◆ Rate discharge at 25°C

-Charge: 25±2°C, 0.5C-4.2V, CC-CV, 0.01C cut off;

-Discharge: 0.2C/0.5C/1C/2C/3C to 2.5V cut off.



No.	Discharge capacity/mAh and capacity ratio									Temperature rise/°C at cell surface				
	0.2C	0.5C	1C	2C	3C	0.5C/0.2C	1C/0.2C	2C/0.2C	3C/0.2C	0.2C	0.5C	1C	2C	3C
1#	5041	4984	4971	5026	4993	98.87%	98.61%	99.70%	99.70%	3.3	7.4	13.4	32.2	48.7
2#	5037	4966	4959	5022	5002	98.59%	98.45%	99.70%	99.31%	2.9	6.7	12.8	31.6	49.5
3#	5040	4968	4962	5025	5006	98.57%	98.46%	99.70%	99.34%	3.4	7.2	13.0	32.8	51.2

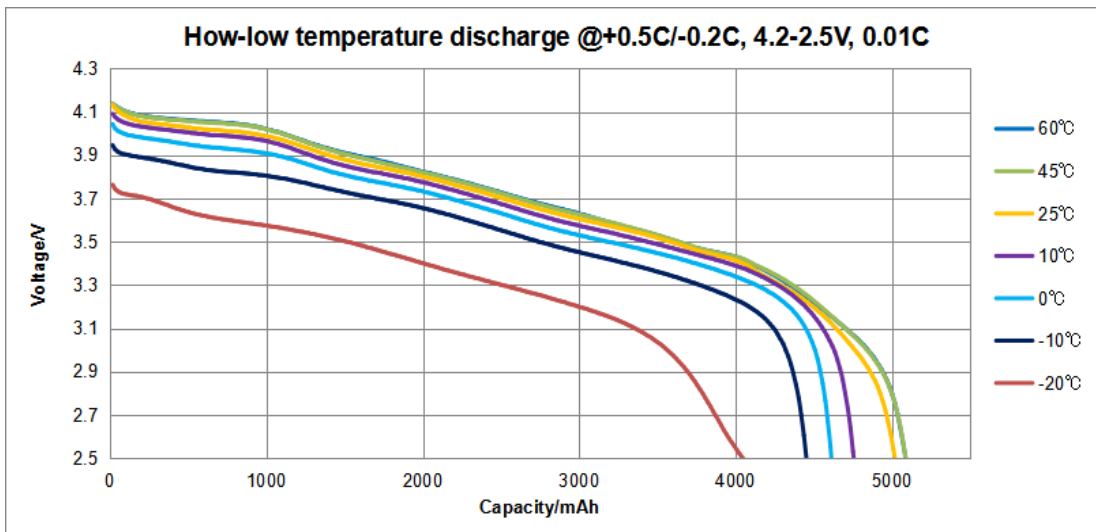
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2. Cell performance introduction

◆ High-low temperature discharge

-Charge: $25 \pm 2^\circ\text{C}$, 0.5C-4.2V CC-CV, 0.01C cut off;

-Discharge: $25^\circ\text{C}/60^\circ\text{C}/45^\circ\text{C}/10^\circ\text{C}/0^\circ\text{C}/-10^\circ\text{C}/-20^\circ\text{C}$, 0.2C to 2.5V cut off.



No.	Discharge capacity/mAh							Discharge capacity ratio (vs. 25°C)						
	60°C	45°C	10°C	0°C	-10°C	-20°C	25°C	60°C	45°C	10°C	0°C	-10°C	-20°C	
1#	5122	5121	4789	4645	4483	4079	5053	101.36%	101.34%	94.76%	91.91%	88.72%	80.71%	
2#	5116	5114	4783	4636	4479	4046	5047	101.36%	101.32%	94.77%	91.85%	88.74%	80.17%	
3#	5120	5117	4784	4637	4481	4053	5039	101.60%	101.54%	94.93%	92.02%	88.92%	80.42%	

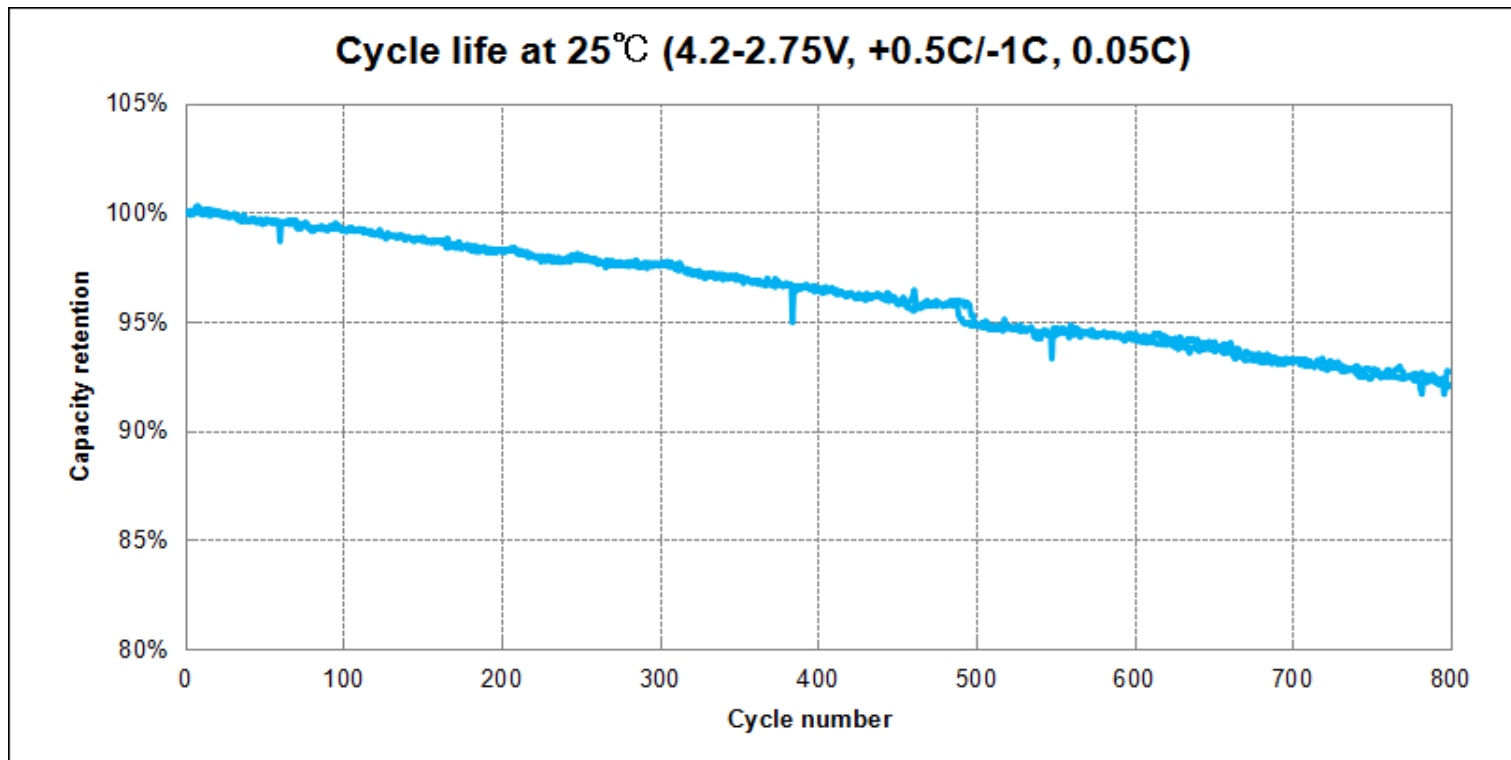
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2. Cell performance introduction

◆ Cycle life at 25°C

-Charge: 0.5C-4.2V CC-CV, 0.05C cut off, rest for 10min;

-Discharge: 1C to 2.75V cut off, rest for 20min.



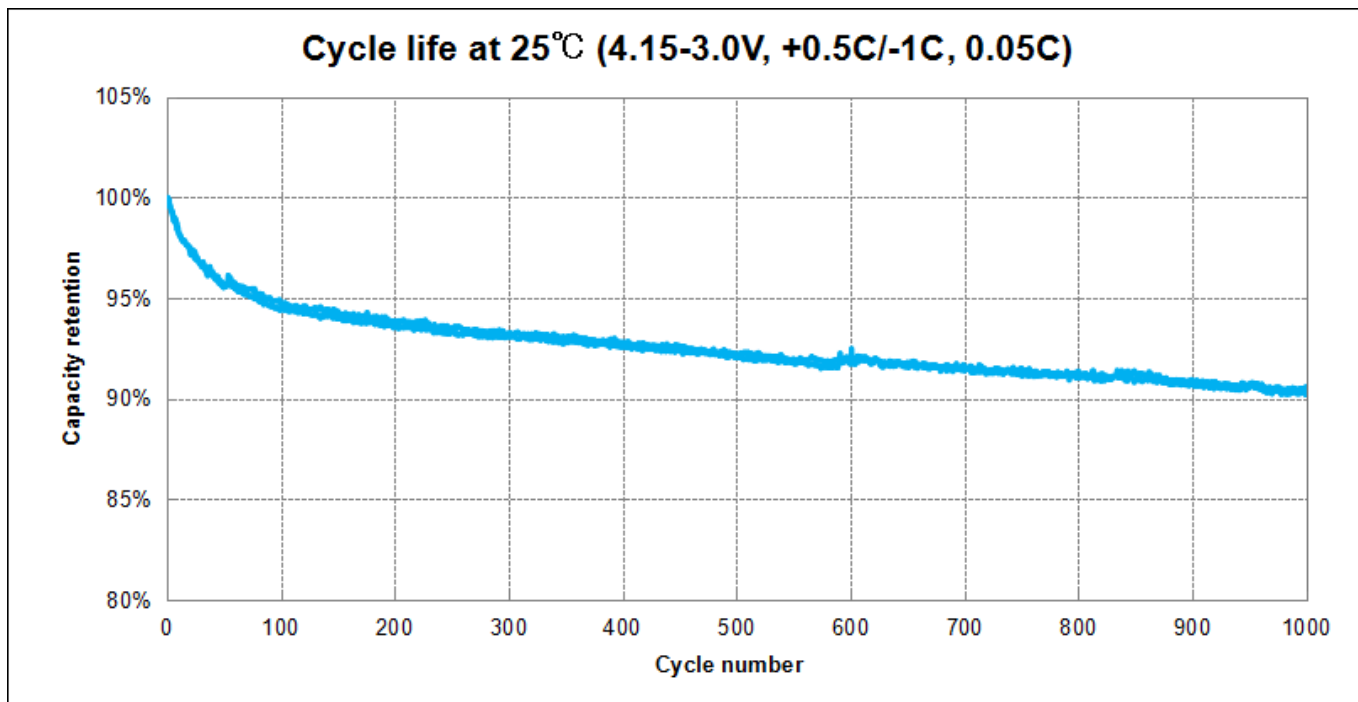
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2. Cell performance introduction

◆ Cycle life at 25°C

-Charge: 0.5C-4.15V CC-CV, 0.05C cut off, rest for 10min;

-Discharge: 1C to 3.0V cut off, rest for 20min.



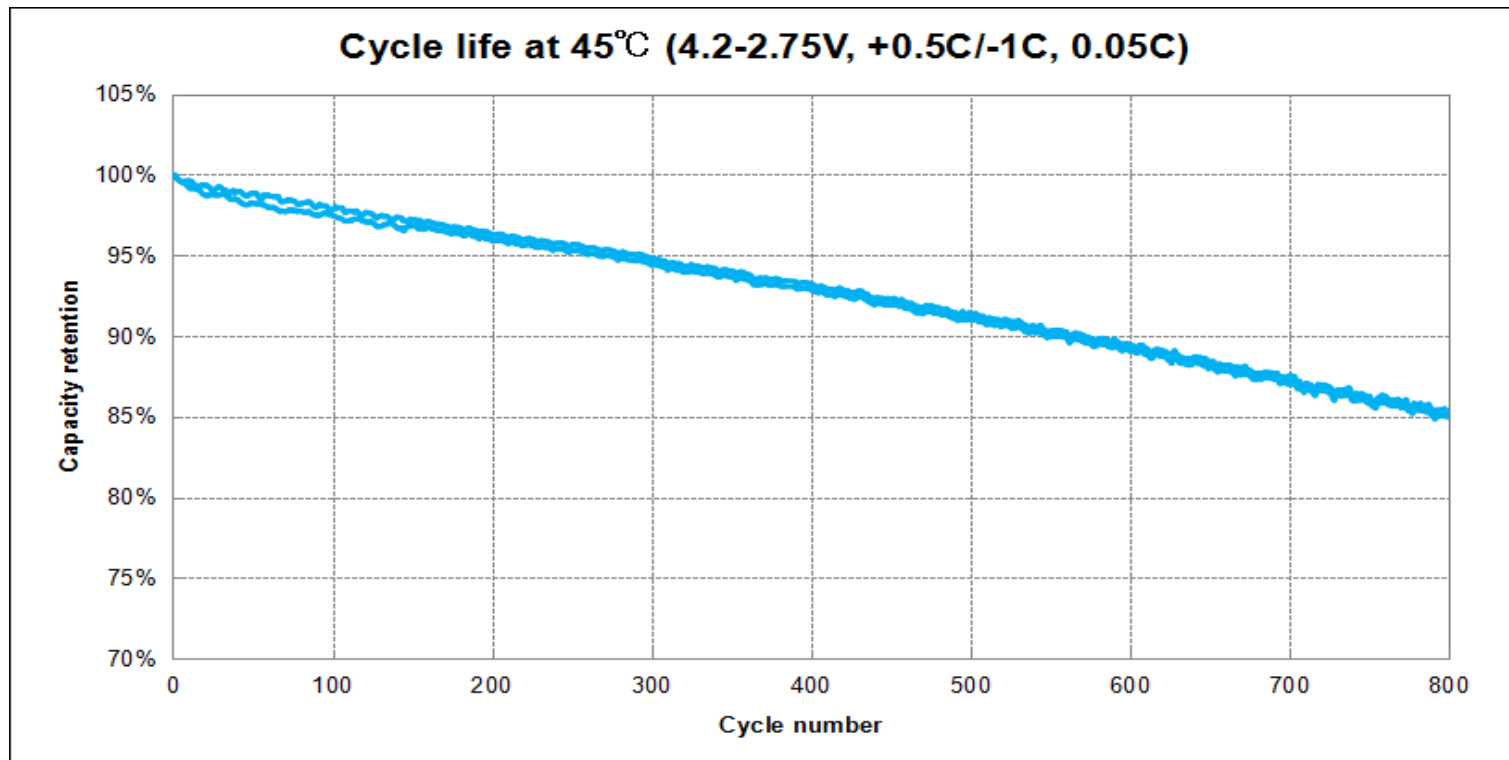
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2. Cell performance introduction

◆ Cycle life at 45°C

-Charge: 0.5C-4.2V CC-CV, 0.05C cut off, rest for 10min;

-Discharge: 1C to 2.75V cut off, rest for 20min.



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2. Cell performance introduction

◆ Storage at 25°C (100%SOC, 28d)

-Step1 (charge): 0.5C-4.2V CC-CV, 0.01C cut-off @25°C, rest for 5min;

-Step2 (discharge): 0.2C to 2.5V cut-off @25°C, rest for 5min;

-Step3: perform 3cycles to check capacity (original capacity);

-Step4: perform Step1 and store for 28d@25°C;

-Step5: perform Step2 (Residual capacity) ;

-Step6: perform Step1 and Step2 (Recovery capacity).

No.	Initial status			Status after storage					
	Voltage /V	IR /mΩ	Discharge capacity /mAh	Voltage /V	IR /mΩ	Residual capacity /mAh	Retention rate	Recovery capacity /mAh	Recovery rate
1#	4.175	12.7	5020	4.138	12.5	4951	98.6%	5017	99.9%
2#	4.178	12.9	5018	4.140	12.4	4946	98.6%	5023	100.1%
3#	4.178	12.6	5023	4.140	12.6	4958	98.7%	5020	99.9%

2. Cell performance introduction

◆ Storage at 60°C (100%SOC, 28d)

-Step1 (charge): 0.5C-4.2V CC-CV, 0.01C cut-off @25°C, rest for 5min;

-Step2 (discharge): 0.2C to 2.5V cut-off @25°C, rest for 5min;

-Step3: perform 3cycles to check capacity (original capacity);

-Step4: perform Step1 and store for 28d@60°C;

-Step5: rest for 5h @25°C and perform Step2 (Residual capacity) ;

-Step6: perform Step1 and Step2 (Recovery capacity).

No.	Initial status			Status after storage					
	Voltage /V	IR /mΩ	Discharge capacity /mAh	Voltage /V	IR /mΩ	Residual capacity /mAh	Retention rate	Recovery capacity /mAh	Recovery rate
1#	4.185	12.9	5025	4.105	13.1	4700	93.5%	4945	98.4%
2#	4.187	13.1	5028	4.105	12.9	4708	93.6%	4950	98.4%
3#	4.185	13.2	5030	4.106	13.0	4713	93.7%	4963	98.7%

3. Safety test results

◆ Results in summary

Test items	Assessment	Test standard
➤ Short-circuit test at 25°C	OK	UL1642
➤ Short-circuit test at 55°C	OK	UL1642
➤ Over charge test	OK	UN38.3
➤ Forced discharge test	OK	IEC62133
➤ Heating test	OK	GB31241
➤ Crush test	OK	UL1642
➤ Vibration test	OK	UL1642
➤ Drop test	OK	IEC62133
➤ Low pressure test	OK	UL1642
➤ Thermal cycling test	OK	UL1642

✓ Phenomena code

Level	C0	C1	C2	C3	C4	C5	C6	C7	C8
Criteria	No change	Bulge	Leak	Smoking	Spark	Temperature > 150 °C	Rupture	Fire	Explosion

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3. Safety test results

◆ Short circuit test at 25°C

-Preparation: cell is standard charged at 25°C;

-Test: cell is short-circuited with a wire of $80\text{m}\Omega \pm 20\text{m}\Omega$ at 25°C.

-Pass criteria: no fire, no explode.

No.	Test phenomenon	Initial OCV /V	OCV after test /V	Resistance before test /mΩ	Resistance after test /mΩ	Max temperature of cell surface /°C	Result
1#	C0	4.189	--	12.9	--	123.3	Passed
2#	C0	4.191	--	13.2	--	127.4	Passed
3#	C0	4.190	--	13.1	--	122.0	Passed

◆ Short circuit test at 55°C

-Preparation: cell is standard charged at 25°C;

-Test: cell is short-circuited with a wire of $80\text{m}\Omega \pm 20\text{m}\Omega$ at 55°C.

-Pass criteria: no fire, no explode.

No.	Test phenomenon	Initial OCV /V	OCV after test /V	Resistance before test /mΩ	Resistance after test /mΩ	Max temperature of cell surface /°C	Result
1#	C0	4.190	--	12.7	--	121.6	Passed
2#	C0	4.190	--	12.9	--	120.8	Passed
3#	C0	4.189	--	13.0	--	122.9	Passed

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3. Safety test results

◆ Overcharge test

-Preparation: cell is standard discharged at 25°C;

-Test: cell is CC charged at 2C until voltage reaches 8.4V until charge time is ≥ 24 h.

-Pass criteria: no fire, no explode.

No.	Test phenomenon	Initial OCV /V	OCV after test /V	Resistance before test /mΩ	Resistance after test /mΩ	Max temperature of cell surface /°C	Result
1#	C0	2.953	0.983	13.8	--	84.6	Passed
2#	C0	2.958	0.970	13.4	--	87.4	Passed
3#	C0	2.958	0.958	13.6	--	87.7	Passed

◆ Forced discharge test

-Preparation: cell is standard discharged at 25°C;

-Test: cell is subjected to a reverse charge at 1C for 90min.

-Pass criteria: no fire, no explode.

No.	Test Phenomenon	Initial OCV /V	OCV after test /V	Resistance before test /mΩ	Resistance after test /mΩ	Max temperature of cell surface /°C	Result
1#	C0	2.959	--	13.3	14.4	71.2	Passed
2#	C0	2.963	--	13.1	13.6	78.2	Passed
3#	C0	2.961	--	13.5	13.9	70.3	Passed

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3. Safety test results

◆ Heating test

-Preparation: cell is standard charged at 25°C;

-Test: cell is heated to 130°C at a rate of 5°C/min and kept at 130°C for 30min.

-Pass criteria: no fire, no explode.

No.	Test phenomenon	Initial OCV /V	OCV after test /V	Resistance before test /mΩ	Resistance after test /mΩ	Max temperature of cell surface /°C	Result
1#	C0	4.184	0.934	12.4	--	132.2	Passed
2#	C0	4.184	0.909	12.9	--	132.2	Passed
3#	C0	4.185	0.949	12.6	--	131.0	Passed

◆ Crush test

-Preparation: cell is standard charged at 25°C;

-Test: cell is crushed between two flat surfaces till crushing force is approximately 13KN by a hydraulic ram with a 32mm diameter piston.

-Pass criteria: no fire, no explode.

No.	Test Phenomenon	Initial OCV /V	OCV after test /V	Resistance before test /mΩ	Resistance after test /mΩ	Max temperature of cell surface /°C	Result
1#	C0	4.185	--	12.7	--	29.4	Passed
2#	C0	4.187	--	12.8	--	30.1	Passed
3#	C0	4.184	--	12.6	--	30.1	Passed

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3. Safety test results

◆ Vibration test

-Preparation: cell is standard charged at 25°C;

-Test: cell is vibrated with frequency between 10Hz and 55Hz for 90~100min, amplitude 0.8mm.

-Pass criteria: no leak, no fire, no explode, the maximum mass loss $\leq 0.1\%$.

No.	Test phenomenon	Initial OCV /V	OCV after test /V	Resistance before test /mΩ	Resistance after test /mΩ	Cell weight before test /g	Cell weight after test /g	Result
1#	C0	4.184	4.182	12.5	12.7	66.733	66.733	passed
2#	C0	4.185	4.183	12.4	12.6	66.862	66.862	passed
3#	C0	4.185	4.183	12.4	12.7	66.709	66.709	passed

◆ Drop test

-Preparation: cell is standard charged at 25°C;

-Test: cell is dropped from 1m height onto cement floor.

-Pass criteria: no fire, no explode.

No.	Test phenomenon	Initial OCV /V	OCV after test /V	Resistance before test /mΩ	Resistance after test /mΩ	Weight before test /g	Weight after test /g	Result
1#	C0	4.184	4.182	12.6	12.8	66.675	66.675	Passed
2#	C0	4.184	4.183	12.4	12.5	66.584	66.584	Passed
3#	C0	4.184	4.183	12.3	12.4	66.790	66.790	Passed

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3. Safety test results

◆ Low pressure test

-Preparation: cell is standard charged at 25°C;

-Test: cell is kept at 11.6kPa for 6h.

-Pass criteria: no leak, no fire, no explode, the maximum mass loss $\leq 0.1\%$.

No.	Test phenomenon	Initial OCV /V	OCV after test /V	Resistance before test /mΩ	Resistance after test /mΩ	Weight before test /g	Weight after test /g	Result
1#	C0	4.187	4.182	12.4	12.4	66.762	66.762	Passed
2#	C0	4.188	4.183	12.6	12.6	66.431	66.431	Passed
3#	C0	4.189	4.185	12.4	12.4	66.559	66.559	Passed

◆ Thermal cycling test

-Preparation: cell is standard charged at 25°C;

-Test: cell is cycled between 70°C/4 h and -40°C/4h alternately for 10 times.

-Pass criteria: no leak, no fire, no explode.

No.	Test phenomenon	Initial OCV /V	OCV after test /V	Resistance before test /mΩ	Resistance after test /mΩ	Weight before test /g	Weight After test /g	Result
1#	C0	4.189	4.129	13.5	14.1	66.652	66.652	Passed
2#	C0	4.187	4.129	13.6	13.8	66.565	66.565	Passed
3#	C0	4.189	4.129	13.2	13.4	66.688	66.688	Passed

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Thank you !



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