

N21700CG-50E Technical Report

- Product Research & Development Center
- 2023.5



1. Basic information

2. Cell performance introduction

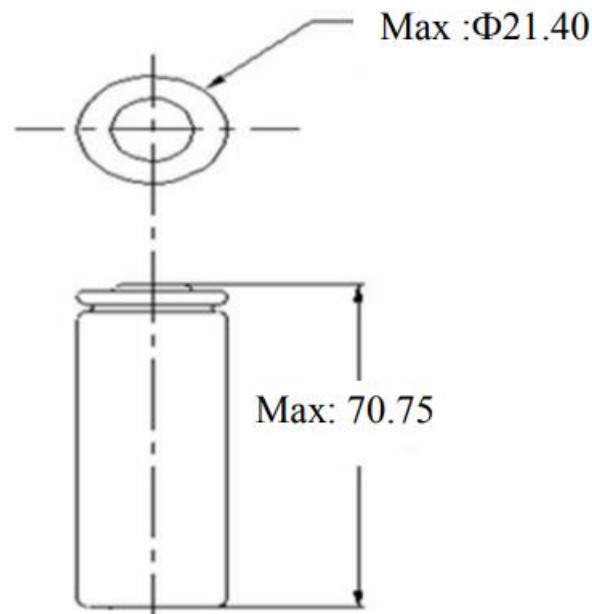
- Rate discharge
- High-low temperature discharge
- Cycle life
- Storage

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)



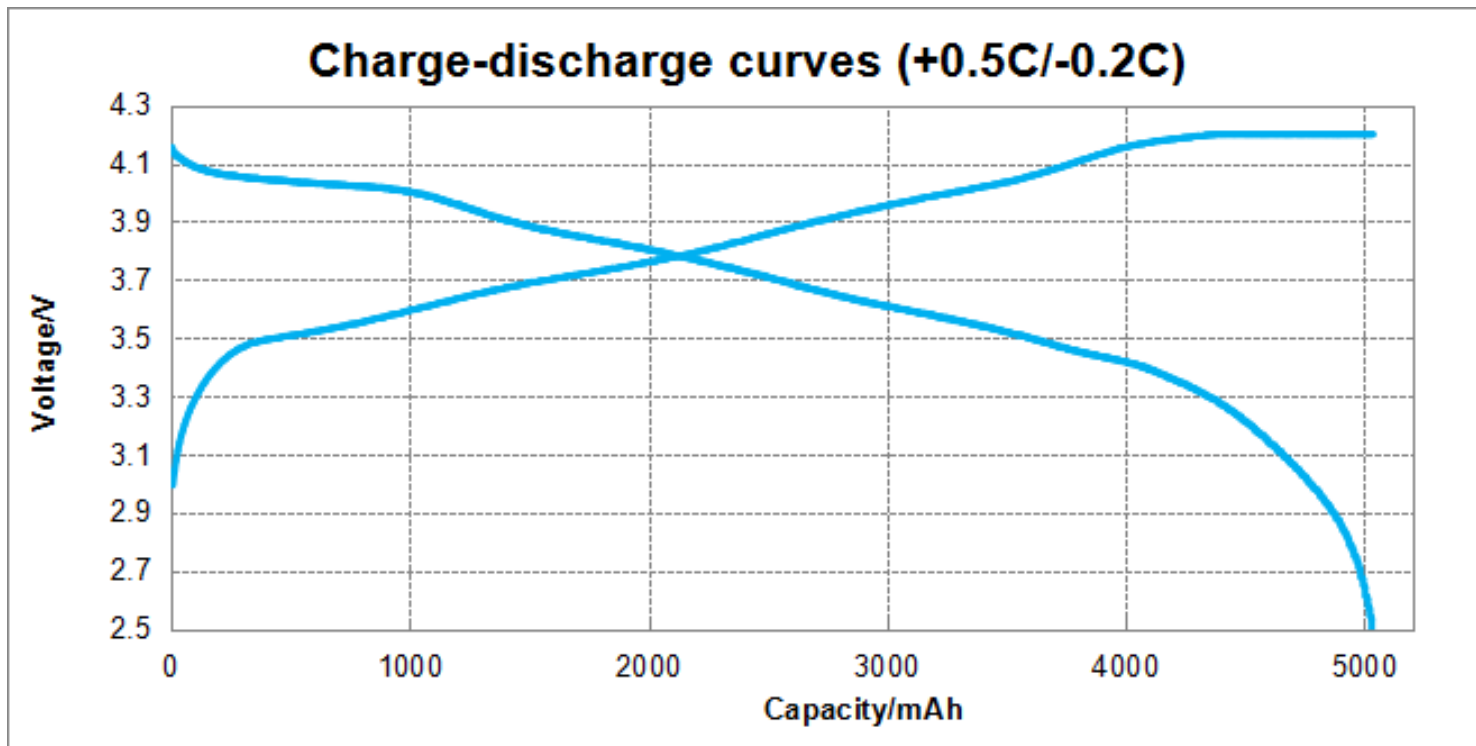
Confidential

1. Basic information

◆ Charge-discharge curves

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

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



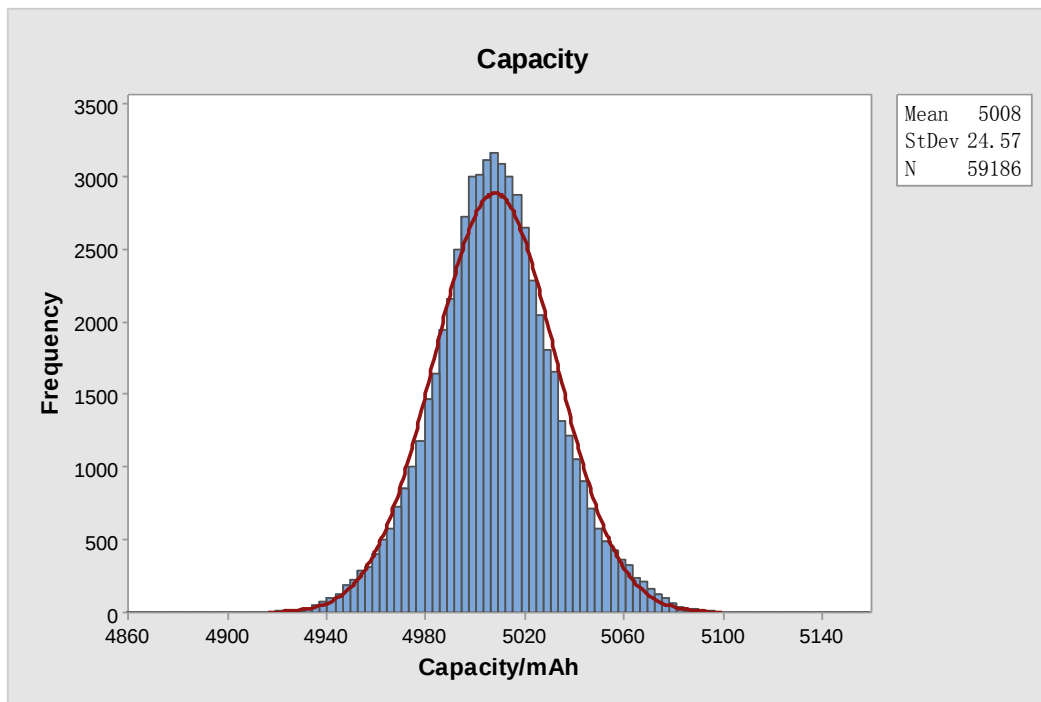
Confidential

1. Basic information

◆ Capacity

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

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



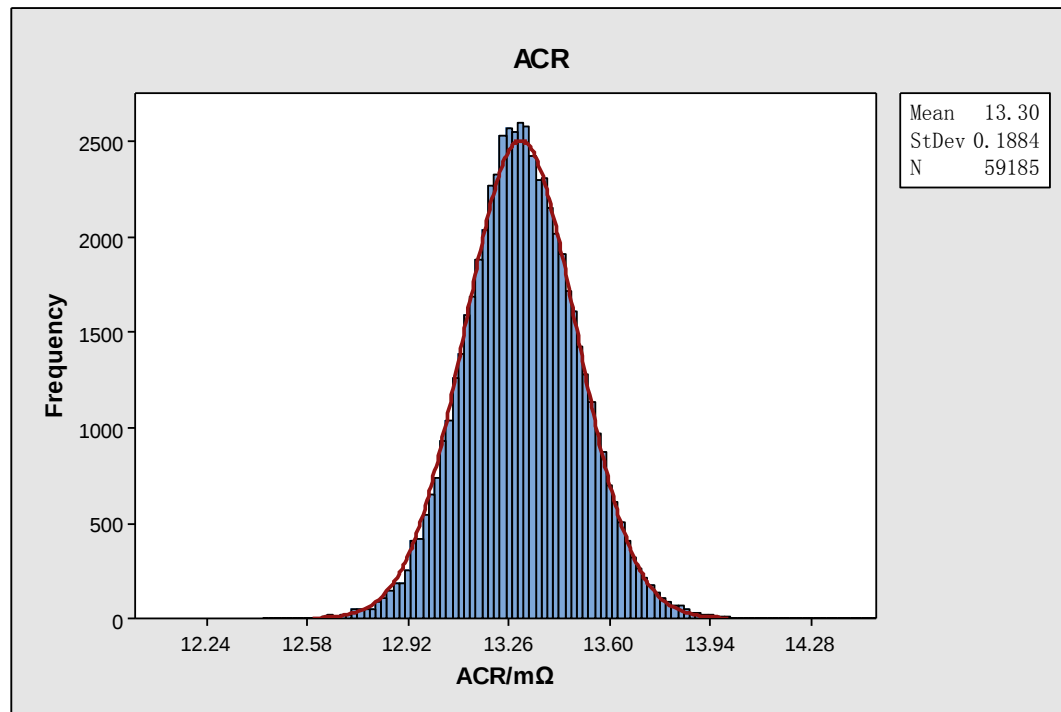
➤ Average capacity: 5008mAh @0.2C

Confidential

1. Basic information

◆ ACIR

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



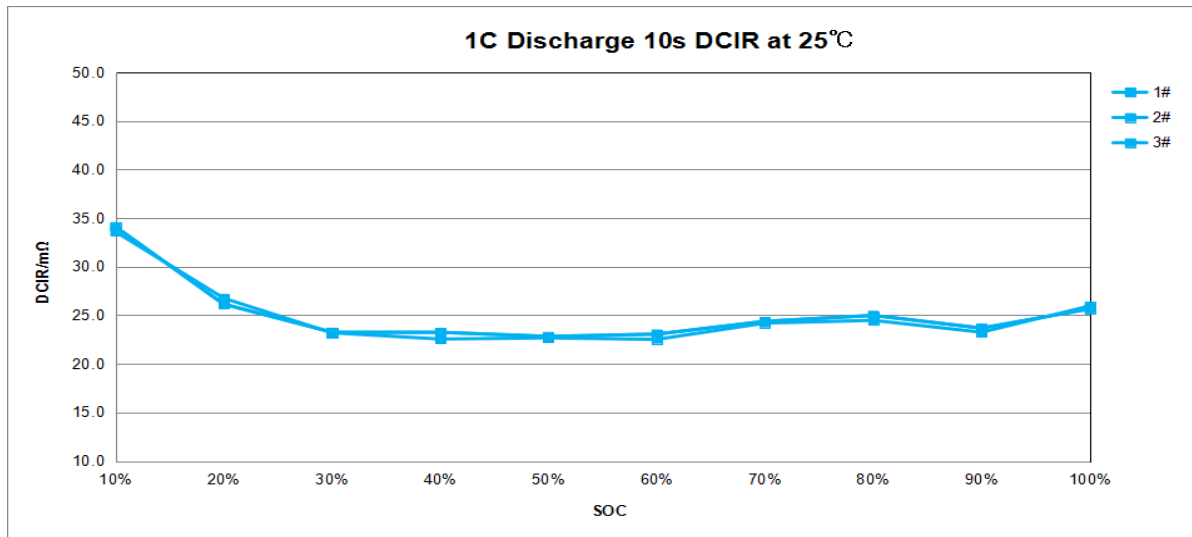
➤ Average ACIR: 13.30mΩ @30%SOC.

Confidential

1. Basic information

◆ DCIR

-Condition: $25\pm 2^{\circ}\text{C}$, 50%SOC, 1C discharge 10s.



NO.	DCIR/mΩ at different SOC									
	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%
1#	25.9	23.2	24.5	24.2	22.5	22.7	22.5	23.2	26.7	33.6
2#	25.6	23.7	25.0	24.4	23.1	22.8	23.2	23.3	26.1	34.1
3#	25.7	23.8	25.0	24.5	23.4	22.9	23.5	23.3	26.1	34.1

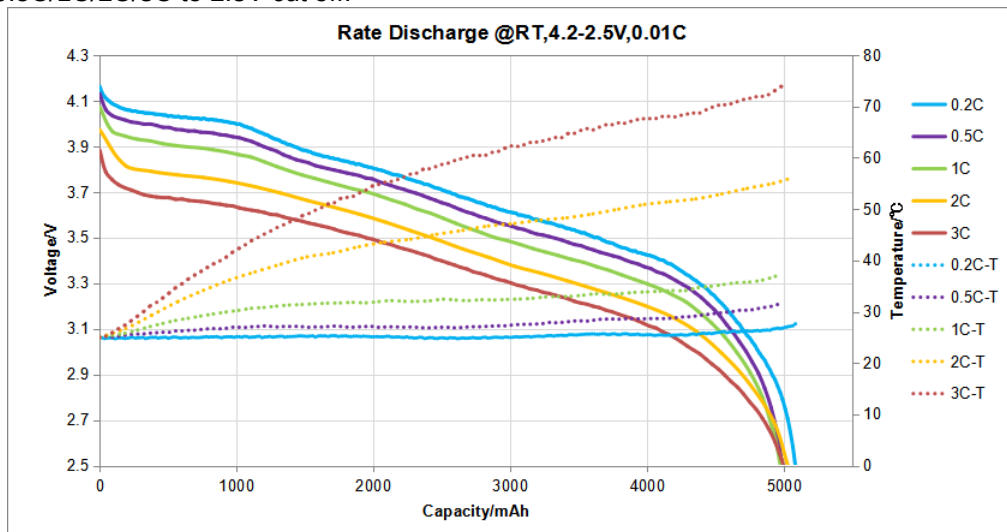
Confidential

2. Cell performance introduction

◆ Rate discharge at 25°C

-Charge: $25 \pm 2^\circ\text{C}$, 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	98.9%	98.6%	99.7%	99.1%	3.3	7.4	13.4	32.2	48.7
2#	5037	4966	4959	5022	5002	98.6%	98.5%	99.7%	99.3%	2.9	6.7	12.8	31.6	49.5
3#	5040	4968	4962	5025	5006	98.6%	98.5%	99.7%	99.3%	3.4	7.2	13.0	32.8	51.2

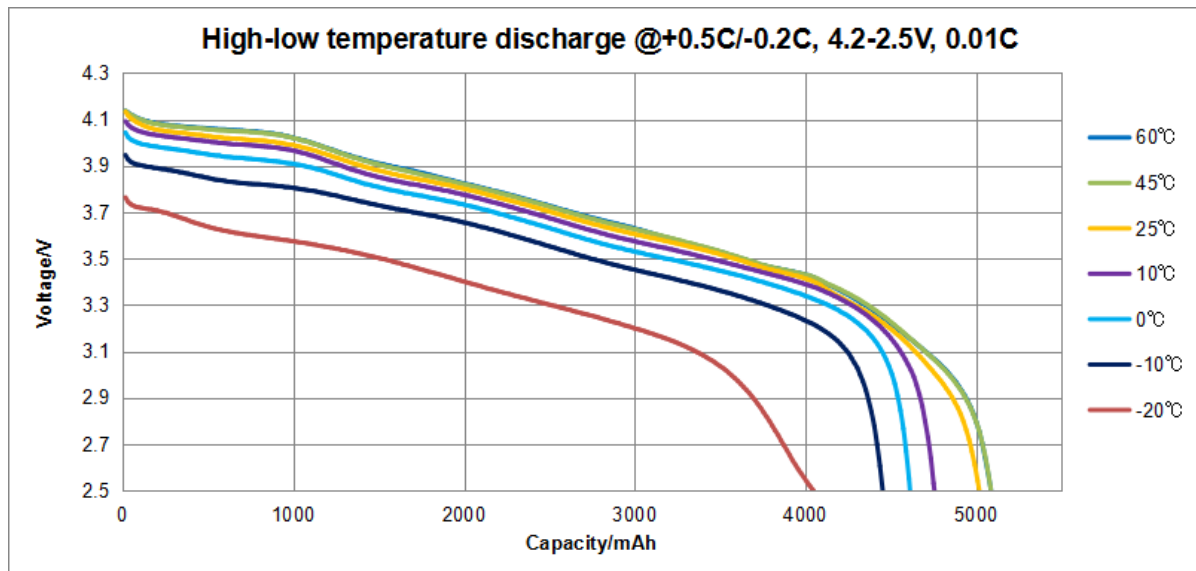
Confidential

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%

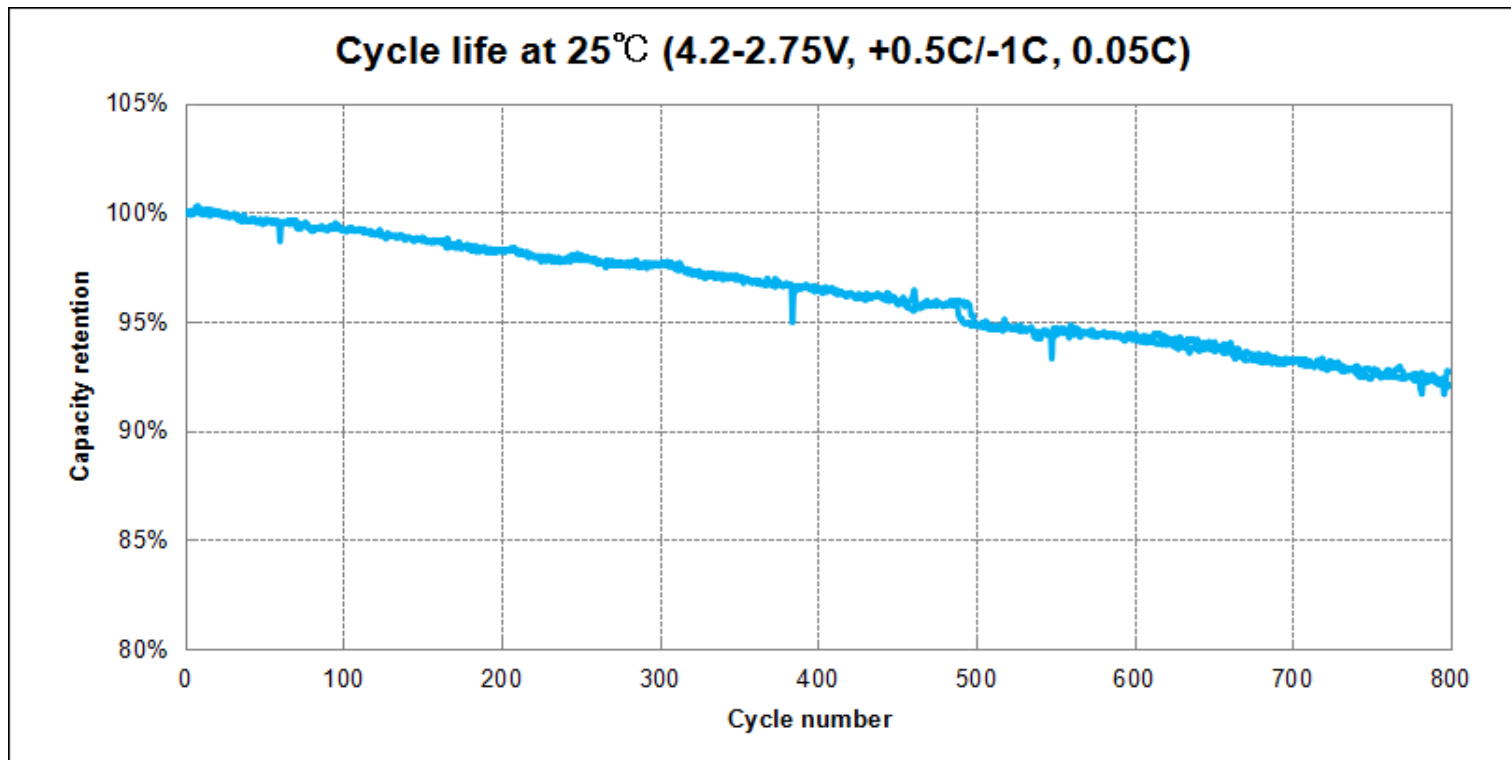
Confidential

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.



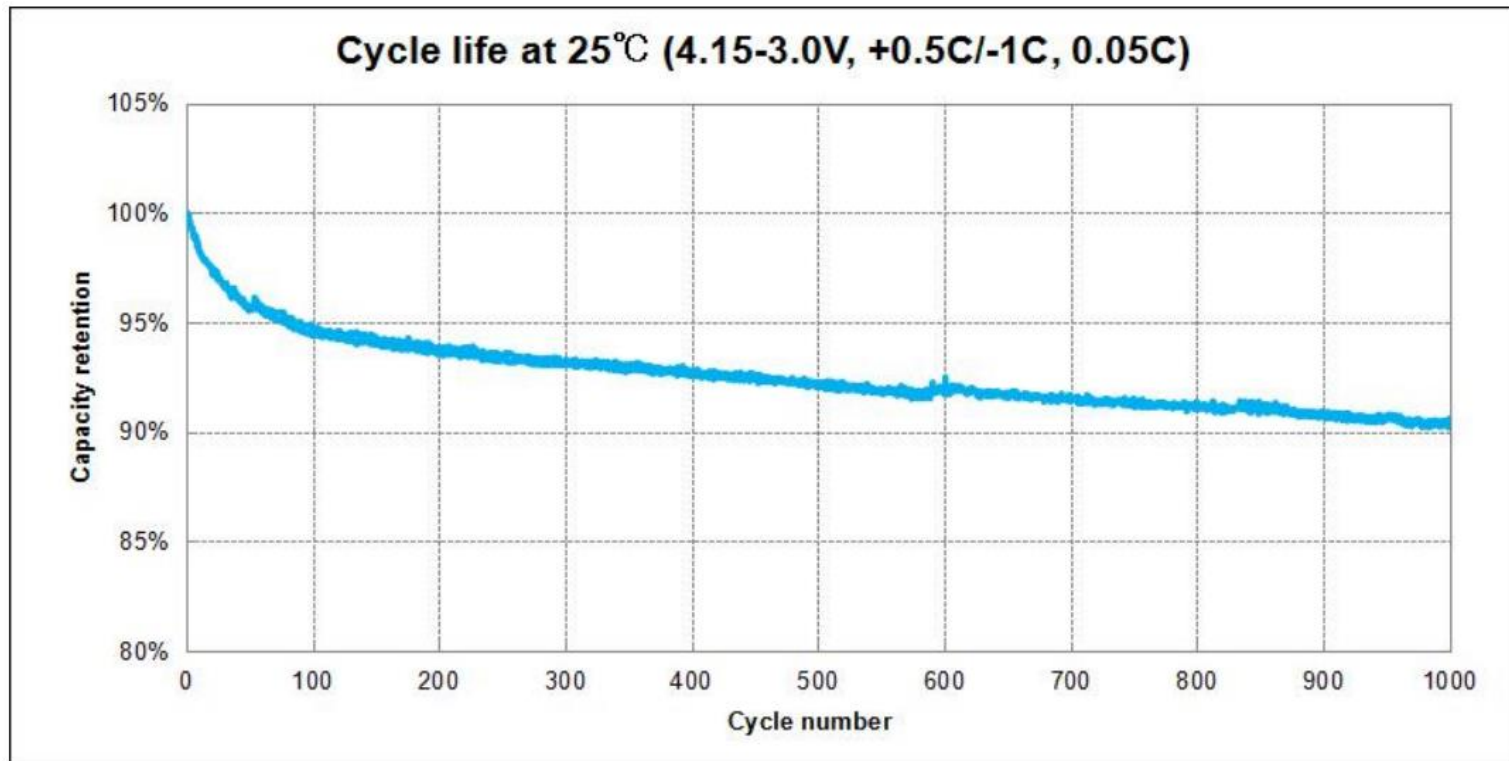
Confidential

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.



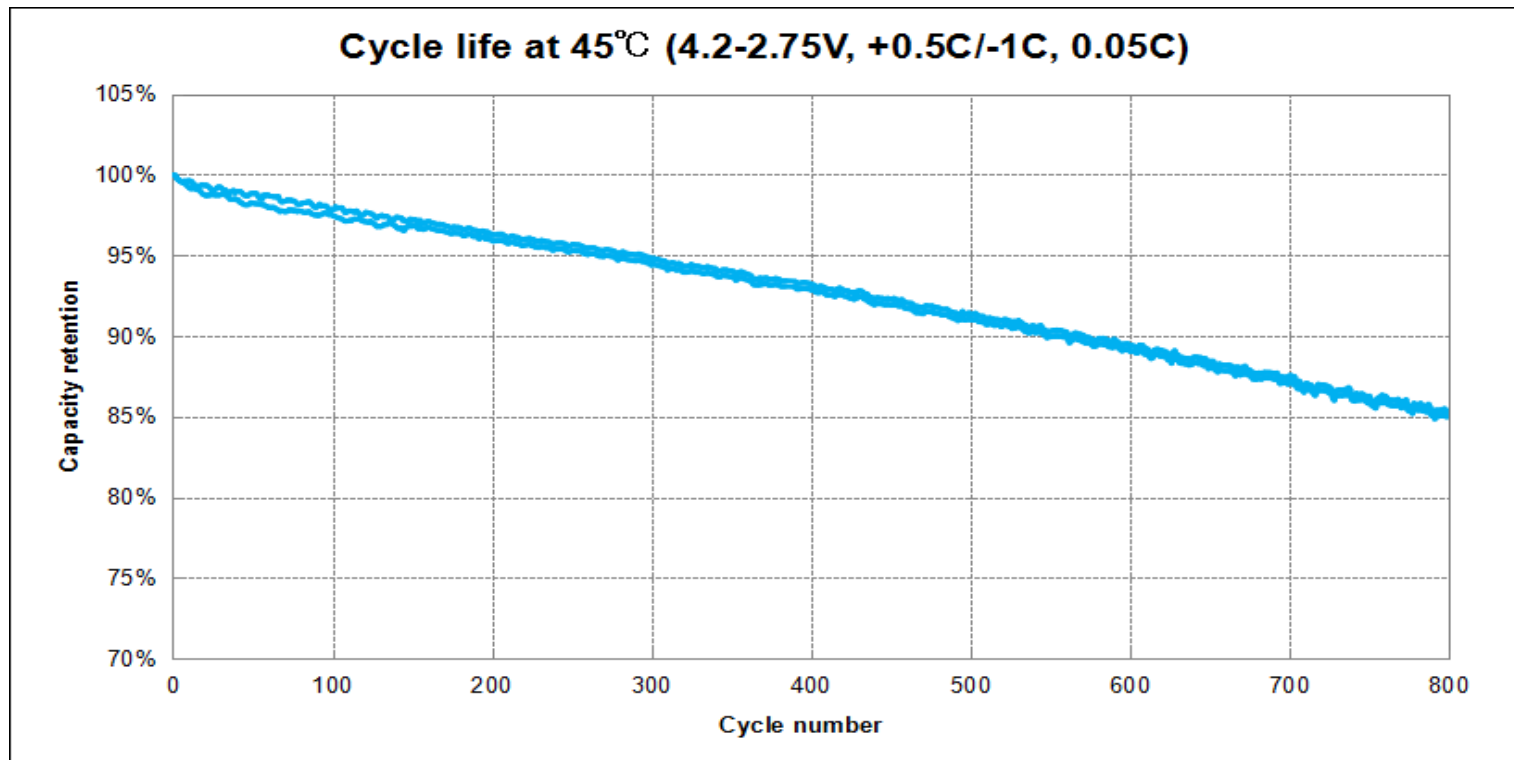
Confidential

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.



Confidential

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#	4.185	12.9	5020	4.146	13.1	4951	98.63%	5017	99.94%
2#	4.184	13.1	5018	4.146	13.3	4946	98.57%	5013	99.90%
3#	4.185	13.0	5023	4.145	13.2	4958	98.71%	5019	99.92%

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	13.8	4700	93.53%	4945	98.41%
2#	4.187	13.1	5028	4.105	14.2	4708	93.64%	4950	98.45%
3#	4.185	13.2	5030	4.106	14.0	4713	93.70%	4963	98.67%

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

Confidential

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	4.186	--	12.9	--	123.3	Passed
2#	C0	4.185	--	13.2	--	124.4	Passed
3#	C0	4.185	--	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	4.185	--	13.2	--	121.6	Passed
2#	C0	4.184	--	13.3	--	120.8	Passed
3#	C0	4.186	--	13.3	--	120.9	Passed

Confidential

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	2.956	--	13.8	--	84.6	Passed
2#	C0	2.958	--	13.4	--	87.4	Passed
3#	C0	2.958	--	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	72.2	Passed
3#	C0	2.961	--	13.5	13.9	70.3	Passed

Confidential

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	--	12.9	--	132.2	Passed
2#	C0	4.184	--	13.2	--	132.2	Passed
3#	C0	4.185	--	13.3	--	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	4.182	13.4	13.6	29.4	Passed
2#	C0	4.187	4.185	13.2	13.8	30.1	Passed
3#	C0	4.184	4.182	13.2	13.6	30.1	Passed

Confidential

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	13.1	13.3	66.733	66.733	passed
2#	C0	4.185	4.183	12.9	13.1	66.862	66.862	passed
3#	C0	4.185	4.183	13.2	13.3	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	13.3	13.5	66.675	66.675	Passed
2#	C0	4.184	4.183	13.2	13.3	66.584	66.584	Passed
3#	C0	4.184	4.183	13.5	13.6	66.790	66.790	Passed

Confidential

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	4.186	4.182	12.9	13.0	66.762	66.762	Passed
2#	C0	4.185	4.183	13.0	13.1	66.431	66.431	Passed
3#	C0	4.185	4.183	12.8	12.8	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	4.185	4.128	13.5	13.8	66.652	66.652	Passed
2#	C0	4.184	4.127	13.6	13.8	66.565	66.565	Passed
3#	C0	4.186	4.129	13.2	13.4	66.688	66.688	Passed

Confidential

Thank you !



深圳市南山区粤海街道科研路9号比克科技大厦
深圳市大鹏新区葵涌街道比克工业园
www.bak.com.cn

T 0755-89770015 (比克大厦)
0755-61886818 (比克工业园)
F 0755-89770062