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国际互认  
检测  
TESTING  
CNAS L3503

Report No.: 18270BC10244001

# Lithium Battery UN38.3 Test Report

Client Name :

Address :

Product Name : Lithium Battery

Date : Sept. 14, 2021

## Shenzhen Anbotek Compliance Laboratory Limited



**Shenzhen Anbotek Compliance Laboratory Limited**

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Code: AB-BAT-104-a



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## 1. SAMPLE DESCRIPTION:

Sample Name:		Lithium Battery		Sample Model:		12.8V80Ah	
Manufacturer:							
Address of manufacturer:							
Factory:							
Address of factory:							
Nominal Voltage:	12.8V	Rated Capacity:	80Ah 1024Wh	Trademark:			
Charge Current:	16A	Maximum Continuous Charge Current:	40A	End Charge Current:	0.2A		
Cut-off Voltage:	9V	Maximum Continuous Discharge Current:	100A	Limited Charge Voltage:	14.6V		
Cells Number:	12	Cell Model:	3.2v27Ah	Cell Rated Capacity:	27Ah		
Date of Sample Received:		Aug. 24, 2021					
Date of Test:		Aug. 24, 2021 to Sept. 03, 2021					
Tested by:		Checked by:		Approved by:			
							

## 2. REFERENCE METHOD

United Nations Recommendations On The Transport Of Dangerous Goods, Manual Of Tests And Criteria (ST/SG/AC.10/11/Rev.7)

## 3. EQUIPMENT LIST

Name of equipment /Model	Serial No.	Due Date
Altitude Simulation Testing Machine BE-DY-125	SE-132	2022-03-11
High Fast Temperature&Humidity Chamber ZJ-KSWB1506	SE-1488	2022-07-11
Electromagnetic Vibration Testing Machine EV103V	SE-439	2021-09-27
Shock Testing Machine HSKT-10	SE-440	2022-03-11
High Temperature Short Circuit Test Chamber KY-CS50	SE-4071	2022-05-18
Battery squeeze acupuncture test machine GX-5067-B	SE-4360	2022-07-25
Power Battery Detection System CE-7002-100V200A	SE-4087	2022-07-26
DC Stabilized Power Supply QJ3020E	SE-1532	2021-11-01
Electronic loading JT6111	SE-1535	2021-09-27
TRUE RMS multimeter MS8040	SE-2010	2022-05-18
Electronic Scale TCS-300	SE-1452	2021-12-08
Temperature rise recorder 34970A	SE-004	2022-03-11

#### 4. ENVIRONMENTAL CONDITIONS OF THE TEST

Temperature: (20±5) °C

R.H.: (25~75) %RH

#### 5. TEST ITEM AND CONCLUSION

ITEM	SAMPLE NUMBER	STANDARD	CONCLUSION
Altitude simulation	B1~B4, B5~B8	ST/SG/AC.10/11/Rev. 7	PASS
Thermal test			PASS
Vibration			PASS
Shock			PASS
External short circuit			PASS
Crush			C1~C5, C6~C10
Overcharge	B9~B12, B13~B16	PASS	
Forced discharge	C11~C20, C21~C30	PASS	

##### Notes:

B1~B4: Batteries at first cycle in fully charged states;

B5~B8: Batteries after 25 cycles ending in fully charged states;

B9~B12: Batteries at first cycle in fully charged states;

B13~B16: Batteries after 25 cycles ending in fully charged states;

C1~C5: Cells at first cycle at 50% of the design rated capacity;

C6~C10: Cells at 25 cycle at 50% of the design rated capacity;

C11~C20: Cell batteries at first cycle in fully discharge states;

C21~C30: Cells after 25 cycles ending in fully discharged states.

## 6. TEST METHOD

Tests T.1 to T.5 shall be conducted in sequence on the same cell or battery. Tests T.6 and T.8 shall be conducted using not otherwise tested cells or batteries. Test T.7 may be conducted using undamaged batteries previously used in tests T.1 to T.5 for purposes of testing on cycled batteries. In order to quantify the mass loss, the following procedure is provided:

$$\text{Mass loss(\%)} = (M1-M2) / M1 \times 100$$

Where M1 is the mass before the test and M2 is the mass after the test. When mass loss does not exceed the values in Table blow, it shall be considered as “no mass loss”.

Mass M of cell or battery	Mass loss limit
M<1g	0.5%
1g≤M≤75g	0.2%
M>75g	0.1%

### T.1 Altitude simulation

Test cells and batteries shall be stored at a pressure of 11.6 kPa or less for at least six hours at ambient temperature (20 ± 5 °C).

Cells and batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.

### T.2 Thermal test

Test cells and batteries are to be stored for at least six hours at a test temperature equal to 72 ± 2°C, followed by storage for at least six hours at a test temperature equal to - 40 ± 2°C. The maximum time interval between test temperature extremes is 30 minutes. This procedure is to be repeated until 10 total cycles are complete, after which all test cells and batteries are to be stored for 24 hours at ambient temperature (20 ± 5°C). For large cells and batteries the duration of exposure to the test temperature extremes should be at least 12 hours.

Cells and batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.

### T.3 Vibration

Cells and batteries are firmly secured to the platform of the vibration machine without distorting the cells in such a manner as to faithfully transmit the vibration. The vibration shall be a sinusoidal waveform with a logarithmic sweep between 7 Hz and 200 Hz and back to 7 Hz traversed in 15 minutes. This cycle shall be repeated 12 times for a total of 3 hours for each of three mutually perpendicular mounting positions of the cell. One of the directions of vibration must be perpendicular to the terminal face.

The logarithmic frequency sweep shall differ for cells and batteries with a gross mass of not more than 12 kg (cells and small batteries), and for batteries with a gross mass of more than 12 kg (large batteries).

For cells and small batteries: from 7 Hz a peak acceleration of 1 g<sub>n</sub> is maintained until 18 Hz is reached. The amplitude is then maintained at 0.8 mm (1.6 mm total excursion) and the frequency increased until a peak acceleration of 8 g<sub>n</sub> occurs (approximately 50 Hz). A peak acceleration of 8 g<sub>n</sub> is then maintained until the frequency is increased to 200 Hz.

For large batteries: from 7 Hz to a peak acceleration of 1 g<sub>n</sub> is maintained until 18 Hz is reached. The amplitude is then maintained at 0.8 mm (1.6 mm total excursion) and the frequency increased until a

peak acceleration of 2 g<sub>n</sub> occurs (approximately 25 Hz). A peak acceleration of 2 g<sub>n</sub> is then maintained until the frequency is increased to 200 Hz.

Cells and batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire during the test and after the test and if the open circuit voltage of each test cell or battery directly after testing in its third perpendicular mounting position is not less than 90% of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.

#### T.4 Shock

Test cells and batteries shall be secured to the testing machine by means of a rigid mount which will support all mounting surfaces of each test battery.

Each cell shall be subjected to a half-sine shock of peak acceleration of 150 g<sub>n</sub> and pulse duration of 6 milliseconds. Alternatively, large cells may be subjected to a half-sine shock of peak acceleration of 50 g<sub>n</sub> and pulse duration of 11 milliseconds.

Each battery shall be subjected to a half-sine shock of peak acceleration depending on the mass of the battery. The pulse duration shall be 6 milliseconds for small batteries and 11 milliseconds for large batteries. The formulas below are provided to calculate the appropriate minimum peak accelerations.

Battery	Minimum peak acceleration	Pulse duration
Small batteries	150 g <sub>n</sub> or result of formula $\text{Acceleration}(g_n) = \sqrt{\left(\frac{100850}{\text{mass}^*}\right)}$ whichever is smaller	6 ms
Large batteries	50 g <sub>n</sub> or result of formula $\text{Acceleration}(g_n) = \sqrt{\left(\frac{30000}{\text{mass}^*}\right)}$ whichever is smaller	11 ms

\* Mass is expressed in kilograms.

Each cell or battery shall be subjected to three shocks in the positive direction and to three shocks in the negative direction in each of three mutually perpendicular mounting positions of the cell or battery for a total of 18 shocks.

Cells and batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.

#### T.5 External short circuit

The cell or battery to be tested shall be heated for a period of time necessary to reach a homogeneous stabilized temperature of 57±4°C, measured on the external case. This period of time depends on the size and design of the cell or battery and should be assessed and documented. If this assessment is not feasible, the exposure time shall be at least 6 hours for small cells and small batteries, and 12 hours for large cells and large batteries. Then the cell or battery at 57±4°C shall be subjected to one short circuit condition with a total external resistance of less than 0.1 ohm.

This short circuit condition is continued for at least one hour after the cell or battery external case temperature has returned to 57±4°C, or in the case of the large batteries, has decreased by half of the maximum temperature increase observed during the test and remains below that value.

The short circuit and cooling down phases shall be conducted at least at ambient temperature.

Cells and batteries meet this requirement if their external temperature does not exceed 170°C and there is no disassembly, no rupture and no fire during the test and within six hours after the test.

#### T.6 Impact / Crush

Impact (applicable to cylindrical cells greater than 18 mm in diameter)

The sample cell or component cell is to be placed on a flat smooth surface. A  $15.8 \pm 0.1$  mm diameter, at least 6 cm long, or the longest dimension of the cell, whichever is greater, Type 316 stainless steel bar is to be placed across the centre of the sample. A  $9.1 \pm 0.1$  kg mass is to be dropped from a height of  $61 \pm 2.5$  cm at the intersection of the bar and sample in a controlled manner using a near frictionless, vertical sliding track or channel with minimal drag on the falling mass. The vertical track or channel used to guide the falling mass shall be oriented 90 degrees from the horizontal supporting surface.

The test sample is to be impacted with its longitudinal axis parallel to the flat surface and perpendicular to the longitudinal axis of the  $15.8 \pm 0.1$  mm diameter curved surface lying across the centre of the test sample. Each sample is to be subjected to only a single impact.

Crush (applicable to prismatic, pouch, coin/button cells and cylindrical cells not more than 18 mm in diameter)

A cell or component cell is to be crushed between two flat surfaces. The crushing is to be gradual with a speed of approximately 1.5 cm/s at the first point of contact. The crushing is to be continued until the first of the three options below is reached.

- (a) The applied force reaches  $13 \pm 0.78$  kN;
- (b) The voltage of the cell drops by at least 100 mV; or
- (c) The cell is deformed by 50% or more of its original thickness.

Once the maximum pressure has been obtained, the voltage drops by 100 mV or more, or the cell is deformed by at least 50% of its original thickness, the pressure shall be released.

A prismatic or pouch cell shall be crushed by applying the force to the widest side. A button/coin cell shall be crushed by applying the force on its flat surfaces. For cylindrical cells, the crush force shall be applied perpendicular to the longitudinal axis.

Each test cell or component cell is to be subjected to one crush only. The test sample shall be observed for a further 6 h. The test shall be conducted using test cells or component cells that have not previously been subjected to other tests.

Cells and component cells meet this requirement if their external temperature does not exceed  $170^{\circ}\text{C}$  and there is no disassembly and no fire during the test and within six hours after this test.

#### T.7 Overcharge

The charge current shall be twice the manufacturer's recommended maximum continuous charge current. The minimum voltage of the test shall be as follows:

- (a) When the manufacturer's recommended charge voltage is not more than 18V, the minimum voltage of the test shall be the lesser of two times the maximum charge voltage of the battery or 22V.
- (b) When the manufacturer's recommended charge voltage is more than 18V, the minimum voltage of the test shall be 1.2 times the maximum charge voltage.

Tests are to be conducted at ambient temperature; the duration of the test shall be 24 hours.

Rechargeable batteries meet this requirement if there is no disassembly and no fire during the test and within seven days after the test.

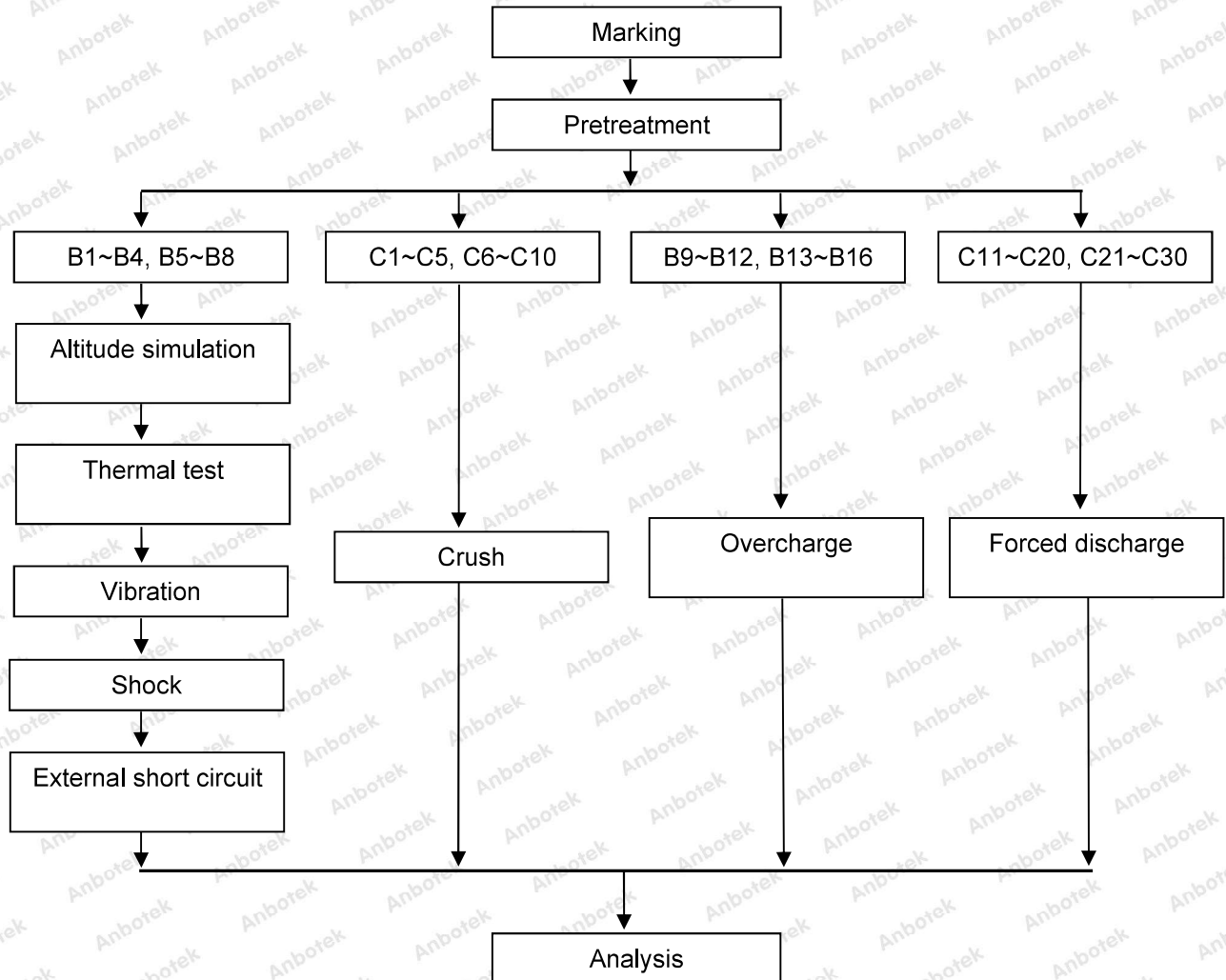
#### T.8 Forced discharge

Each cell shall be forced discharged at ambient temperature by connecting it in series with a 12V D.C. power supply at an initial current equal to the maximum discharge current specified by the manufacturer.

The specified discharge current is to be obtained by connecting a resistive load of the appropriate size and rating in series with the test cell. Each cell shall be forced discharged for a time interval (in hours) equal to its rated capacity divided by the initial test current (in ampere).

Primary or rechargeable cells meet this requirement if there is no disassembly and no fire during the test and within seven days after the test.

## 7. TEST PROCEDURE





## 8. DATA

### T.1 Altitude simulation

No.	Pre-test		After test		Mass loss (%)	Voltage loss (%)	Whether leakage, venting, disassembly, rupture, fire (Y/N)
	Mass (kg)	Voltage (V)	Mass (kg)	Voltage (V)			
B1	10.973	13.656	10.973	13.656	0.00	0.00	N
B2	10.958	13.716	10.958	13.715	0.00	0.01	N
B3	10.945	13.696	10.945	13.696	0.00	0.00	N
B4	10.987	13.656	10.987	13.655	0.00	0.01	N
B5	10.976	13.704	10.976	13.704	0.00	0.00	N
B6	10.982	13.740	10.982	13.740	0.00	0.00	N
B7	10.940	13.684	10.940	13.684	0.00	0.00	N
B8	10.981	13.692	10.981	13.692	0.00	0.00	N

### T.2 Thermal test

No.	Pre-test		After test		Mass loss (%)	Voltage Loss (%)	Whether leakage, venting, disassembly, rupture, fire (Y/N)
	Mass (kg)	Voltage (V)	Mass (kg)	Voltage (V)			
B1	10.973	13.656	10.972	13.619	0.01	0.27	N
B2	10.958	13.715	10.957	13.672	0.01	0.31	N
B3	10.945	13.696	10.944	13.657	0.01	0.28	N
B4	10.987	13.655	10.986	13.614	0.01	0.30	N
B5	10.976	13.704	10.975	13.666	0.01	0.28	N
B6	10.982	13.740	10.981	13.698	0.01	0.31	N
B7	10.940	13.684	10.939	13.644	0.01	0.29	N
B8	10.981	13.692	10.980	13.655	0.01	0.27	N

### T.3 Vibration

No.	Pre-test		After test		Mass loss (%)	Voltage Loss (%)	Whether leakage, venting, disassembly, rupture, fire (Y/N)
	Mass (kg)	Voltage (V)	Mass (kg)	Voltage (V)			
B1	10.972	13.619	10.972	13.618	0.00	0.01	N
B2	10.957	13.672	10.957	13.672	0.00	0.00	N
B3	10.944	13.657	10.944	13.657	0.00	0.00	N
B4	10.986	13.614	10.985	13.614	0.01	0.00	N
B5	10.975	13.666	10.975	13.666	0.00	0.00	N
B6	10.981	13.698	10.981	13.698	0.00	0.00	N
B7	10.939	13.644	10.939	13.643	0.00	0.01	N
B8	10.980	13.655	10.980	13.655	0.00	0.00	N

### T.4 Shock

Peak acceleration: 95.8 g<sub>n</sub>, Pulse duration: 6 ms

No.	Pre-test		After test		Mass loss (%)	Voltage Loss (%)	Whether leakage, venting, disassembly, rupture, fire (Y/N)
	Mass (kg)	Voltage (V)	Mass (kg)	Voltage (V)			
B1	10.972	13.618	10.972	13.618	0.00	0.00	N
B2	10.957	13.672	10.957	13.671	0.00	0.01	N
B3	10.944	13.657	10.944	13.657	0.00	0.00	N
B4	10.985	13.614	10.985	13.613	0.00	0.01	N
B5	10.975	13.666	10.975	13.666	0.00	0.00	N
B6	10.981	13.698	10.981	13.698	0.00	0.00	N
B7	10.939	13.643	10.938	13.643	0.01	0.00	N
B8	10.980	13.655	10.980	13.654	0.00	0.01	N

## T.5 External short circuit

No.	Peak temperature (°C)	Whether disassembly, rupture, fire (Y/N)
B1	57.9	N
B2	57.7	N
B3	57.7	N
B4	57.6	N
B5	57.9	N
B6	57.8	N
B7	57.7	N
B8	57.8	N

## T.6 Crush

No.	Peak temperature (°C)	Whether disassembly, fire (Y/N)
C1	23.5	N
C2	23.4	N
C3	23.7	N
C4	23.5	N
C5	23.6	N
C6	23.7	N
C7	23.5	N
C8	23.4	N
C9	23.5	N
C10	23.6	N

## T.7 Overcharge

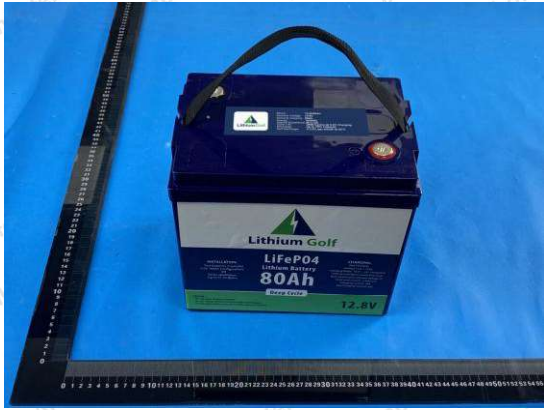
No.	Whether disassembly, fire (Y/N)
B9	N
B10	N
B11	N
B12	N
B13	N
B14	N
B15	N
B16	N

T.8 Forced discharge

No.	Whether disassembly, fire (Y/N)
C11	N
C12	N
C13	N
C14	N
C15	N
C16	N
C17	N
C18	N
C19	N
C20	N
C21	N
C22	N
C23	N
C24	N
C25	N
C26	N
C27	N
C28	N
C29	N
C30	N

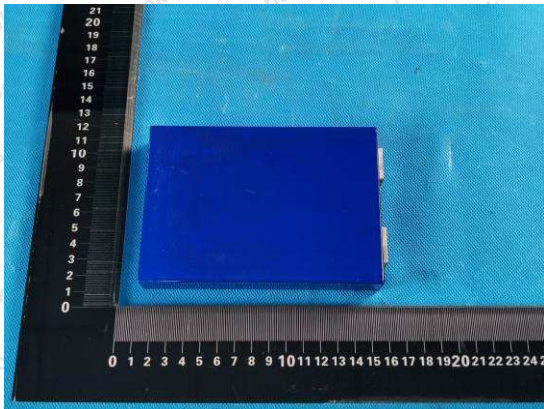
## 9. PHOTOS OF THE SAMPLE

### Battery



Model : 12.8V80Ah  
Nominal Voltage: 12.8V  
Nominal Capacity: 80Ah  
Energy: 1024Wh  
Internal Resistance:  $45 \leq m\Omega$   
Cycle Life: 2000 Cycles @ 0.2C Charging  
Discharge: Up to 70% Capacity  
Self Discharge:  $\leq 3.5\%$  per month at 25°C

### Cell



## DECLARATION

1. United Nations Recommendations On The Transport Of Dangerous Goods, Manual Of Tests And Criteria(ST/SG/AC.10/11/Rev.7).
2. Test place Lab: Shenzhen Anbotek Compliance Laboratory Limited  
Address: East of 4/F., Building A, Hourui No.3 Industrial Zone, Xixiang Street, Bao'an District, Shenzhen, Guangdong, China
3. This report shall not be revised and deleted.
4. The test results presented in this report are only relevant to the test sample.
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