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Lithium Battery UN38.3 Test Report

Client	: SWISSINNO SOLUTIONS AG
Manufacturer	: GREAT POWER BATTERY (ZHUHAI) CO., LTD.
Product	: Rechargeable Li-ion Battery
Model	: ICR18650 3.7V 8000mAh 29.6Wh
Date of Test	: Jun. 01, 2017 to Jun. 20, 2017
Date of Report	: Jun. 20, 2017
Approved : Signatory	Mark Zhu
Checked by :	LUCY Zeng Stamp Anbolek
Tested by :	Eris Tang



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1. 样品描述(SAMPLE DESCRIPTION):					
Sample Name:	Rechargeable Li-ion Battery E		Battery Model:	ICR18650 3.7V 8000)mAh 29.6Wh
Client:	SWISSINNO	SOLUTIONS AG			
Add. Of Client:	Rosenbergst	rasse 22 9000 St. (Gallen, SWITZEF	RLAND	
Manufacturer:	GREAT POWER BATTERY (ZHUHAI) CO., LTD				
Nominal Voltage:	3.7V	Rated Capacity:	8000mAh 29.6Wh	Trademark:	1
Charge Current:	1600mA	Maximum Continuous Charge Current:	8000mA	End Charge Current:	160mA
Cut-off Voltage	3.0V	Maximum Discharge Current	12000mA	Limited Charge Voltage	4.2V
Cells Number	4	Cell Model	18650	Cell Rated Capacity	2000mAh
Client date	Jun. 01, 201	7	Finished date	Jun. 20, 2017	

2. REFERENCE METHOD

«United Nations Recommendations On The Transport Of Dangerous Goods, Manual Of Tests And Criteria» (ST/SG/AC.10/11/Rev.6).



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3. TEST ITEM		
1. Altitude simulation		5. External short circuit
2. Thermal test		6. Crush
3. Vibration		7. Overcharge
4. Shock		8. Forced discharge
4. Major instruments of measure	ement used in the	e test:
Name of equipment /Model	Serial No.	Due Date
Low Pressure Test Machine BE-DY-125	SE-132	2018-04-18
High and Low Temperature Chamber BE-THK-150M8	SE-137	2017-08-23
Vibration Machine EV103VT650VC Susb-2	SE-439	2018-04-19
Shock Machine HSKT-10	SE-440	2018-04-19
Thermostat Short-circuit Testing Machine BE-1000W	SE-133	2018-04-26
Impact Machine BE-5060	SE-135	2017-09-01
Battery Charge and Discharge Machine CT-3008-25V10A-NA	SE-157	2018-04-18



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5. Place and Environmental Conditions of the test

Place: Shenzhen Anbotek Compliance Temperature (20 ± 5) °C R.H. (40~70) %RH Laboratory Limited

6. CONCLUSION

ITEM	SAMPLE NUMBER	STANDARD	CONCLUSION
Altitude simulation	B1~B4, B5~B8		PASS
Thermal test			PASS
Vibration			PASS
Shock			PASS
External short circuit		01038.3	PASS
Impact	C21~C25		PASS
Overcharge	B1~B4, B5~B8		PASS
Forced discharge	C1~C10, C11~C20		PASS

Notes:

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

C21~C25: Cells at first cycle at 50% of the design rated capacity;

C1~C10:Cells at first cycle in fully discharged states;

B5~B8: Batteries after 50 cycles ending in fully charged states;

C11~C20: Cells after 50 cycles ending in fully discharged states.



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7. 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:

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<1(g)	0.5%
1g≤M≤75(g)	0.2%
M>75(g)	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 75 ± 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 gn 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



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a peak acceleration of 8 gn occurs (approximately 50 Hz). A peak acceleration of 8 gn is then maintained until the frequency is increased to 200 Hz.

For large batteries: from 7 Hz to a peak acceleration of 1 gn 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 gn occurs (approximately 25 Hz). A peak acceleration of 2 gn 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 gn and pulse duration of 6 milliseconds. Alternatively, large cells may be subjected to a half-sine shock of peak acceleration of 50 gn 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
	150 gn or result of formula	
Small batteries	Acceleration(gn)= $\sqrt{\left(\frac{100850}{\text{mass}^*}\right)}$	6 ms
	whichever is smaller	
	50 g _n or result of formula	
Large batteries	Acceleration(gn)= $\sqrt{\left(\frac{30000}{\text{mass}^*}\right)}$	11 ms
	whichever is smaller	

* Mass is expressed in kilograms.

Each cell or ba tery 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 shall be heated for a period of time necessary to reach a homogeneous stabilized temperature of 57 \pm 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



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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 \pm 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 \pm 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 mm \pm 0.1mm 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 kg \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 mm \pm 0.1mm 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 kN ± 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 °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.



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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.







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9. DATA

T.1Altitude simulation

No.	Pre-	-test	Afte	r test	Mass loss	Voltage	Whether leakage,
	Mass	Voltage	Mass	Voltage	(%)	loss (%)	venting, disassembly,
	(g)	(V)	(g)	(V)			rupture, fire (Y/N)
B1	179.992	4.167	179.992	4.166	0.00	0.02	N
B2	180.703	4.162	180.703	4.162	0.00	0.00	N
B3	180.187	4.166	180.187	4.166	0.00	0.00	N
B4	180.054	4.164	180.041	4.164	0.01	0.00	Ν
B5	179.884	4.163	179.884	4.163	0.00	0.00	N
B6	181.441	4.161	181.441	4.161	0.00	0.00	N
B7	180.862	4.165	180.862	4.164	0.00	0.01	N
B8	180.358	4.162	180.358	4.162	0.00	0.00	N

T.2 Thermal test

No.	Pre-	-test	Afte	r test	Mass loss	Voltage	Whether leakage,
	Mass	Voltage	Mass	Voltage	(%)	loss (%)	venting, disassembly,
	(g)	(V)	(g)	(V)			rupture, fire (Y/N)
B1	179.992	4.166	179.937	4.148	0.03	0.43	N
B2	180.703	4.162	180.684	4.149	0.01	0.31	N
B3	180.187	4.166	180.141	4.148	0.03	0.43	N
B4	180.041	4.164	179.985	4.149	0.03	0.36	N
B5	179.884	4.163	179.845	4.145	0.02	0.43	N
B6	181.441	4.161	181.424	4.145	0.01	0.38	N
B7	180.862	4.164	180.812	4.151	0.03	0.32	N
B8	180.358	4.162	180.325	4.149	0.02	0.31	N



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T.3 Vibration

No.	Pre-	-test	Afte	r test	Mass loss	Voltage	Whether leakage,
	Mass	Voltage	Mass	Voltage	(%)	loss (%)	venting, disassembly,
	(g)	(V)	(g)	(V)			rupture, fire (Y/N)
B1	179.937	4.148	179.921	4.147	0.01	0.01	Ν
B2	180.684	4.149	180.684	4.149	0.00	0.00	N
B3	180.141	4.148	180.141	4.148	0.00	0.00	Ν
B4	179.985	4.149	179.985	4.148	0.00	0.01	N
B5	179.845	4.145	179.845	4.145	0.00	0.00	N
B6	181.424	4.145	181.414	4.144	0.01	0.01	N
B7	180.812	4.151	180.812	4.151	0.00	0.00	N
B8	180.325	4.149	180.325	4.149	0.00	0.00	N

T.4 Shock

Peak acceleration: 150 gn, Pulse duration: 6 ms

No.	Pre-	-test	Afte	r test	Mass loss	Voltage	Whether leakage,
	Mass	Voltage	Mass	Voltage	(%)	loss (%)	venting, disassembly,
	(g)	(V)	(g)	(V)			rupture, fire (Y/N)
B1	179.921	4.147	179.921	4.147	0.00	0.00	N
B2	180.684	4.149	180.684	4.148	0.00	0.01	N
B3	180.141	4.148	180.141	4.148	0.00	0.00	N
B4	179.985	4.148	179.985	4.148	0.00	0.00	N
B5	179.845	4.145	179.824	4.144	0.01	0.01	N
B6	181.414	4.144	181.414	4.144	0.00	0.00	N
B7	180.812	4.151	180.812	4.151	0.00	0.00	N
B8	180.325	4.149	180.325	4.148	0.00	0.01	N



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T.5 External short circuit

Peak temperature ($^{\circ}C$)	Whether disassembly, rupture, fire (Y/N)
57.8	Ν
58.1	Ν
57.4	N
58.3	N
58.6	Ν
57.5	Ν
57.7	N
57.2	N
	Peak temperature (°C) 57.8 58.1 57.4 58.3 58.6 57.5 57.7 57.2

T.6 Impact

No.	Peak temperature (℃)	Whether disassembly, fire (Y/N)
C21	85.6	N
C22	81.8	Ν
C23	83.2	N
C24	84.1	N
C25	86.5	N

T.7 Overcharge

No.	Whether disassembly, fire (Y/N)
B1	Ν
B2	Ν
B3	Ν
B4	Ν
B5	Ν
B6	Ν
B7	N
B8	Ν



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T.8 Forced discharge

No.	Whether disassembly, fire (Y/N)
C1	N
C2	Ν
C3	N
C4	Ν
C5	N
C6	N
C7	N
C8	Ν
C9	Ν
C10	Ν
C11	Ν
C12	Ν
C13	Ν
C14	Ν
C15	N
C16	N
C17	N
C18	Ν
C19	Ν
C20	Ν



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10. Photos of the Sample

Battery





Cell







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DECLARATION

1. 《United Nations Recommendations On The Transport Of Dangerous Goods, Manual Of Tests And Criteria》(ST/SG/AC.10/11/Rev.6).

2. Test place Lab: Shenzhen Anbotek Compliance Laboratory Limited

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 results only related to the items tested.
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