

TEST REPORT

ST/SG/AC.10/11 Rev.5/Amend.2 Section 38.3

AMENDMENTS TO THE FIFTH REVISED EDITION OF THE RECOMMENDATIONS ON THE TRANSPORT OF DANGEROUS GOODS, MANUAL OF TEST AND CRITERIA

(Section 38.3: Lithium batteries)

Report reference No. : STR14018242S

Tested by (name+ signature) : Roy Wu

Approved by (+ signature) : Ailis Ma

Date of issue : Jan. 14, 2014



Testing laboratory : Shenzhen SEM.Test Technology Co., Ltd.

Address : 1/F, Building A, Hongwei Industrial Park, Liuxian 2nd Road, Bao'an District, Shenzhen, P.R.C (518101)

Testing location : As above

Applicant : Shenzhen Zhuoneng New Energy Technology Co., Ltd.

Address : Bldg. 1, 3rd Yingtai Hemei Industry Area, Nianfeng Village, Pingdi, Shenzhen, China

Manufacturer : Shenzhen Zhuoneng New Energy Technology Co., Ltd.

Address : Bldg. 1, 3rd Yingtai Hemei Industry Area, Nianfeng Village, Pingdi, Shenzhen, China

Standard..... : **ST/SG/AC.10/11Rev.5/Amend.2 Section 38.3**

Test procedure : Type approved

Procedure deviation : N.A.

Non-standard test method : N.A.

This test report is specially limited to the above client company and product model only, It may not be duplicated without prior written consent of SEM. Test.

Product Name : Cylindrical lithium-ion battery

Trademark : ----

Model/type reference : SZN18650_2000mAh

Ratings..... : 3.7V, 7.4Wh(2000mAh)

Max. charge voltage : 4.2V

Max. charge current : 2000mA

Standard charge current : 400mA

Max. discharge current : 2000mA

Standard discharge current : 400mA

- Cylindrical cell (greater than 20mm in diameter)
- Cylindrical cell (not more than 20mm in diameter)

Shape of cell : Prismatic cell

- Coin cell/Button cell
- Pouch cell

Particulars: test item vs. test requirements

Classification : Lithium metal batteries
 Lithium metal cells
 Lithium ion batteries
 Lithium ion cells

Samples Type : Large battery
 Large cell
 Small battery
 Small cell
 Single cell battery

Dimension : D : 18.3mm
H : 65.0mm

Mass of apparatus : 43g

Possible test case verdicts:

- test case does not apply to the test object : N(.A.)
- test object does meet the requirement : P(ass)
- test object does not meet the requirement : F(ail)

Testing:

Date of receipt of test item : Jan. 02, 2014

Date(s) of performance of test : Jan. 02, 2014- Jan. 14, 2014

Test Conclusion:

The Cylindrical lithium-ion battery submitted by Shenzhen Zhuoneng New Energy Technology Co., Ltd. is tested according to Section 38.3 of Amendments to the Fifth Revised Edition of the Recommendations on the Transport of Dangerous Goods, Manual of Test and Criteria (ST/SG/AC.10/11/Rev.5/Amend.2).

Test Result: Pass.



ST/SG/AC.10/11Rev.5/Amend.2 Section 38.3

Clause	Requirement – Test	Result - Remark	Verdict				
38.3.4	Procedure		P				
	Test 1 to 5 must be conducted in sequence on the same cell or battery.		P				
	Test 6 and 8 should be conducted using not otherwise tested cells or batteries.		P				
	Test 7 may be conducted using undamaged batteries previously used in tests 1 to 5 for purposes of testing on cycled batteries.		N				
38.3.4.1	Test 1: Altitude Simulation		P				
38.3.4.1.1	Purpose		P				
	This test simulates air transport under low-pressure conditions.		-				
38.3.4.1.2	Test procedure		P				
	stored at a pressure	11.6 kPa	-				
	ambient temperature (20 ± 5°C)	24°C	-				
	Stored times(≥ 6 hours)	8 hours	-				
38.3.4.1.3	Requirement		P				
	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.	No leakage, no venting, no disassembly, no rupture and no fire. Battery after testing is not less than 90% of its voltage immediately prior to this procedure.	P				
Group	No.	Mass M of Test Battery (g)			OCV (V)		
		M1 (before the test)	M2 (after the test)	Mass Loss limit (0.2%)	OCV1 (before the test)	OCV2 (after the test)	OCV (≥90%)
Group A (at first cycle, in fully charged states)	01	42.825	42.823	0.005%	4.186	4.185	99.976%
	02	42.815	42.814	0.002%	4.181	4.180	99.976%
	03	42.796	42.792	0.009%	4.188	4.185	99.928%
	04	42.853	42.852	0.002%	4.184	4.182	99.952%
	05	42.786	42.785	0.002%	4.187	4.184	99.928%
	06	42.831	42.830	0.002%	4.186	4.183	99.928%
	07	42.826	42.826	0.000%	4.187	4.184	99.928%
	08	42.784	42.783	0.002%	4.190	4.188	99.952%
	09	42.769	42.769	0.000%	4.180	4.178	99.952%
	10	42.805	42.804	0.002%	4.188	4.186	99.952%
Remark							
1. Mass loss (%)=(M1-M2)/M1*100% (Where M ₁ is the mass before the test and M ₂ is the mass after the test).							
2. Leakage means the visible escape of electrolyte or other material from a cell or battery or the loss of material (except battery casing, handling devices or labels) from a cell or battery such that the loss of mass exceeds the values in Table.							
3. The OCV of each test cell after testing is not less than 90% of its voltage immediately prior to this procedure.							

Conclusion:

Cylindrical lithium-ion battery had passed altitude simulation test.

ST/SG/AC.10/11Rev.5/Amend.2 Section 38.3

Clause	Requirement – Test	Result - Remark	Verdict				
38.3.4.2	Test 2: Thermal Test		P				
38.3.4.2.1	Purpose		-				
	This test assesses cell and battery seal integrity and internal electrical connections. The test is conducted using rapid and extreme temperature changes.		-				
38.3.4.2.2	Test procedure		P				
	Test temperature and stored hours	1) $72 \pm 2^\circ\text{C}$, $\geq 6\text{h}$ 2) $-40 \pm 2^\circ\text{C}$, $\geq 6\text{h}$	-				
	The maximum time interval	Between test temperature extremes is 30 minutes.	-				
	Test times	repeated 10 times	-				
	After which all test cells and batteries are to be stored for 24 hours at ambient temperature ($20 \pm 5^\circ\text{C}$).	24°C	-				
	For large cells and batteries the duration of exposure to the test temperature extremes should be at least 12 hours.	Small cell	N				
38.3.4.2.3	Requirement		P				
	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.	No leakage, no venting, no disassembly, no rupture and no fire. Battery after testing is not less than 90% of its voltage immediately prior to this procedure.	P				
Group	No.	Mass M of Test Battery (g)			OCV (V)		
		M1 (before the test)	M2 (after the test)	Mass Loss limit (0.2%)	OCV1 (before the test)	OCV2 (after the test)	OCV ($\geq 90\%$)
Group A (at first cycle, in fully charged states)	01	42.823	42.818	0.012%	4.185	4.145	99.044%
	02	42.814	42.810	0.009%	4.180	4.144	99.139%
	03	42.792	42.788	0.009%	4.185	4.145	99.044%
	04	42.852	42.845	0.016%	4.182	4.146	99.139%
	05	42.785	42.776	0.021%	4.184	4.144	99.044%
	06	42.830	42.817	0.030%	4.183	4.150	99.211%
	07	42.826	42.819	0.016%	4.184	4.142	98.996%
	08	42.783	42.779	0.009%	4.188	4.145	98.973%
	09	42.769	42.762	0.016%	4.178	4.144	99.186%
	10	42.804	42.798	0.014%	4.186	4.145	99.186%
Remark							
1. Mass loss (%) = $(M_1 - M_2) / M_1 * 100\%$ (Where M_1 is the mass before the test and M_2 is the mass after the test).							
2. Leakage means the visible escape of electrolyte or other material from a cell or battery or the loss of material (except battery casing, handling devices or labels) from a cell or battery such that the loss of mass exceeds the values in Table.							
3. The OCV of each test cell after testing is not less than 90% of its voltage immediately prior to this procedure.							
4. Ambient temperature: 24°C							

Conclusion:

Cylindrical lithium-ion battery had passed thermal test.



ST/SG/AC.10/11Rev.5/Amend.2 Section 38.3

Clause	Requirement – Test	Result - Remark	Verdict
38.3.4.3	Test 3: Vibration		P
38.3.4.3.1	Purpose		P
	This test simulates vibration during transport.		-
38.3.4.3.2	Test procedure		P
	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.		P
	Duration	15min	-
	Frequency range	7Hz.....200Hz.....7Hz	-
	Amplitude	0.8mm	-
	This cycle shall be repeated 12 times for a total of 3 hours for each of three mutually perpendicular mounting positions of the cell.		-
38.3.4.3.3	Requirement		P
	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.	There is no leakage, no venting, no disassembly, no rupture and no fire.	P

Group	No.	Mass M of Test Battery (g)			OCV (V)		
		M1 (before the test)	M2 (after the test)	Mass Loss limit (0.2%)	OCV1 (before the test)	OCV2 (after the test)	OCV (≥90%)
Group A (at first cycle, in fully charged states)	01	42.818	42.816	0.005%	4.145	4.144	99.976%
	02	42.810	42.805	0.012%	4.144	4.142	99.952%
	03	42.788	42.787	0.002%	4.145	4.142	99.928%
	04	42.845	42.844	0.002%	4.146	4.143	99.928%
	05	42.776	42.776	0.000%	4.144	4.141	99.928%
	06	42.817	42.816	0.002%	4.150	4.145	99.880%
	07	42.819	42.815	0.009%	4.142	4.140	99.952%
	08	42.779	42.778	0.002%	4.145	4.144	99.976%
	09	42.762	42.761	0.002%	4.144	4.142	99.952%
	10	42.798	42.797	0.002%	4.145	4.143	99.952%

Remark

- Mass loss (%)=(M1-M2)/M1*100% (Where M₁ is the mass before the test and M₂ is the mass after the test).
- Leakage means the visible escape of electrolyte or other material from a cell or battery or the loss of material (except battery casing, handling devices or labels) from a cell or battery such that the loss of mass exceeds the values in Table.
- The OCV of each test cell after testing is not less than 90% of its voltage immediately prior to this procedure.
- Ambient temperature: 24°C

Conclusion:

Cylindrical lithium-ion battery had passed vibration test.

ST/SG/AC.10/11Rev.5/Amend.2 Section 38.3

Clause	Requirement – Test	Result - Remark	Verdict				
38.3.4.4	Test 4: Shock		P				
38.3.4.4.1	Purpose		P				
	This test simulates possible impacts during transport.		-				
38.3.4.4.2	Test procedure		P				
	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.	This is small cells.	-				
	a half-sine shock of peak acceleration	150 g _n	-				
	Pulse duration	6ms	-				
	the positive direction followed	three times shocks	-				
	Each cell or battery shall be subjected to three shocks in the positive direction followed by three shocks in the negative direction of three mutually perpendicular mounting positions of the cell or battery for a total of 18 shocks.		-				
38.3.4.4.3	Requirement		P				
	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.	There is no leakage, no venting, no disassembly, no rupture and no fire.	P				
Group	No.	Mass M of Test Battery (g)			OCV (V)		
		M1 (before the test)	M2 (after the test)	Mass Loss limit (0.2%)	OCV1 (before the test)	OCV2 (after the test)	OCV (≥90%)
Group A (at first cycle, in fully charged states)	01	42.816	42.815	0.002%	4.144	4.142	99.952%
	02	42.805	42.805	0.000%	4.142	4.140	99.952%
	03	42.787	42.786	0.002%	4.142	4.140	99.952%
	04	42.844	42.843	0.002%	4.143	4.141	99.952%
	05	42.776	42.772	0.009%	4.141	4.138	99.928%
	06	42.816	42.815	0.002%	4.145	4.143	99.952%
	07	42.815	42.814	0.002%	4.140	4.138	99.952%
	08	42.778	42.776	0.005%	4.144	4.142	99.952%
	09	42.761	42.760	0.002%	4.142	4.140	99.952%
	10	42.797	42.796	0.002%	4.143	4.142	99.952%
Remark							
1. Mass loss (%)=(M1-M2)/M1*100% (Where M ₁ is the mass before the test and M ₂ is the mass after the test).							
2. Leakage means the visible escape of electrolyte or other material from a cell or battery or the loss of material (except battery casing, handling devices or labels) from a cell or battery such that the loss of mass exceeds the values in Table.							
3. The OCV of each test cell after testing is not less than 90% of its voltage immediately prior to this procedure.							
4. Ambient temperature: 24°C							

Conclusion:

Cylindrical lithium-ion battery had passed shock test.



ST/SG/AC.10/11Rev.5/Amend.2 Section 38.3

Clause	Requirement – Test	Result - Remark	Verdict	
38.3.4.5	Test 5: External Short Circuit		P	
38.3.4.5.1	Purpose		P	
	This test simulates an external short circuit.		P	
38.3.4.5.2	Test procedure		P	
	The cell or battery to be tested shall be temperature stabilized so that its external case temperature reaches $55 \pm 2^\circ\text{C}$.		-	
	Short circuit condition with a total External resistance of less than 0.1ohm.		-	
	The cell or battery must be observed for a further six hours for the test to be concluded.		-	
	This short circuit condition is continued for at least one hour after the cell or battery external case temperature has returned to $55 \pm 2^\circ\text{C}$.		-	
38.3.4.5.3	Requirement		P	
	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 this test.	Cells external temperature does not exceed 170°C , and there is no disassembly, no fire during the test and within six hours after this test.	P	
Group	No.	External Highest Temperature ($^\circ\text{C}$)	Criteria	Result
Group A (at first cycle, in fully charged states)	01	68.7	Cells 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 this test.	P
	02	62.5		P
	03	64.3		P
	04	65.6		P
	05	63.8		P
	06	67.2		P
	07	72.6		P
	08	68.4		P
	09	65.6		P
	10	66.8		P
Ambient temperature: 23°C				

Conclusion:

Cylindrical lithium-ion battery had passed external short circuit test.

ST/SG/AC.10/11 Rev.5/Amend.2 Section 38.3

Clause	Requirement – Test	Result - Remark	Verdict	
38.3.4.6	Test 6: Impact / Crush	This is rechargeable cells.	P	
38.3.4.6.1	Purpose		P	
	These tests simulate mechanical abuse from an impact or crush that may result in an internal short circuit.		P	
38.3.4.6.2	Test procedure – Impact (applicable to cylindrical cells not less than 18.0 mm in diameter)		N	
	The sample cell or component cell is to be placed on a flat smooth surface. A 15.8 mm ± 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 ± 0.1 kg mass is to be dropped from a height of 61 ± 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.		N	
	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 ± 0.1mm diameter curved surface lying across the centre of the test sample. Each sample is to be subjected to only a single impact.		N	
38.3.4.6.3	Test Procedure – Crush (applicable to prismatic, pouch, coin/button cells and cylindrical cells less than 18.0 mm in diameter)		P	
	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.		P	
	The applied force reaches 13 kN ± 0.78 kN;	<input checked="" type="checkbox"/> Reach this condition	P	
	The voltage of the cell drops by at least 100 mV;	<input type="checkbox"/> Reach this condition	P	
	The cell is deformed by 50% or more of its original thickness.	<input type="checkbox"/> Reach this condition	P	
38.3.4.6.4	Requirement		P	
	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.	After the test, The, component Cells 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.	P	
Group	No.	Component cells external temperature (°C)	Criteria	Result
Group B (at first cycle at 50% of the design rated capacity)	11	48.4	The Cells 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.	P
	12	32.1		P
	13	33.5		P
	14	36.1		P



Report No.: STR14018242S

	15	30.8		P
Ambient temperature: 24.0°C				

Conclusion:

Cylindrical lithium-ion battery had passed Crush test.



ST/SG/AC.10/11Rev.5/Amend.2 Section 38.3

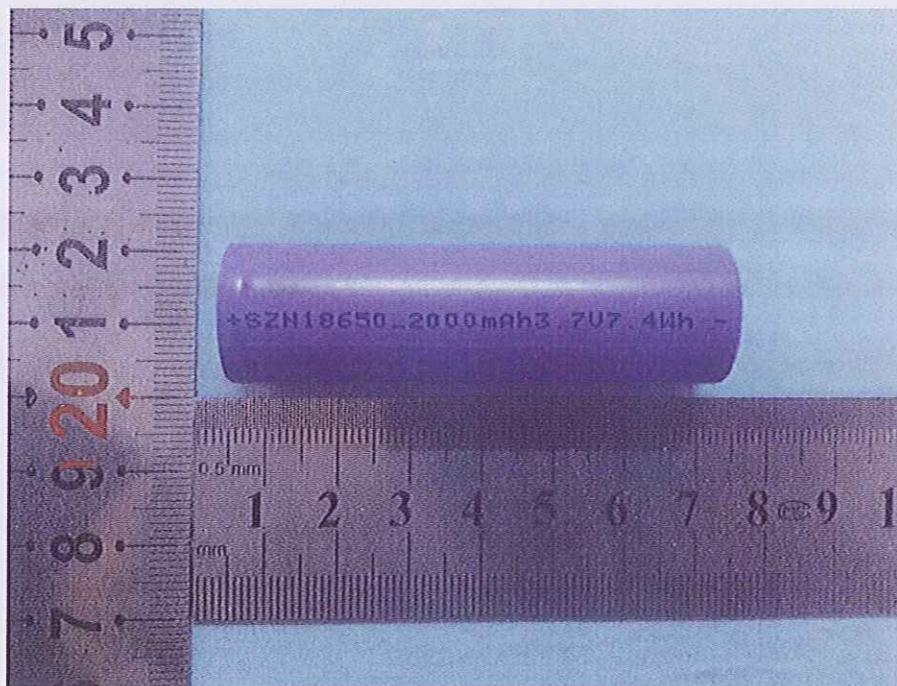
Clause	Requirement – Test	Result - Remark	Verdict
38.3.4.8	Test 8: Forced discharge		P
38.3.4.8.1	Purpose		P
	This test evaluates the ability of a primary or a rechargeable cell to withstand a forced discharge condition.		P
38.3.4.8.2	Test procedure		P
	Each cell shall be forced discharged at ambient temperature by connecting it in series with a 12 V DC, power supply at an initial current equal to the maximum discharge current specified by the manufacturer.		P
	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).		P
38.3.4.8.3	Requirement		P
	Primary or rechargeable cells meet this requirement if there is no disassembly and no fire during the test within seven days after the test.	There is no disassembly and no fire during the test within seven days after the test.	P
Group	No.	Status	Criteria
Group C (at first cycle in fully discharged states)	16	OK	There is no disassembly and no fire during the test within seven days after the test.
	17	OK	
	18	OK	
	19	OK	
	20	OK	
	21	OK	
	22	OK	
	23	OK	
	24	OK	
25	OK		
Group D (after 50 cycles ending in fully discharged states)	26	OK	
	27	OK	
	28	OK	
	29	OK	
	30	OK	
	31	OK	
	32	OK	
	33	OK	
	34	OK	
35	OK		
Ambient temperature: 24.0°C			

Conclusion:

Cylindrical lithium-ion battery had passed Forced discharge test.

Photos

Model: SZN18650_2000mAh



*** End of Report ***

Shenzhen SEM.Test Technology Co., Ltd.
1/F, Building A, Hongwei Industrial Park, Liuxian 2nd Road, Bao'an District, Shenzhen, P.R.C (518101)

Search System: www.semtest.com.cn/cn/search.asp
Search Number: SEM14017142