TEST REPORT

ST/SG/AC.10/11 Rev.5 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 . .	STR10118047S
Tested by (name+ signature)	Billy Tu
Approved by (+ signature)	: Ailis Ma
Date of issue	Nov. 15. 2010
Testing laboratory	SEM.Test Compliance Service Co., Ltd.
Address	3/F, Jinbao Commerce Building, Xin'an Fanshen Road, Bao'an District Shenzhen. P R C (518101)
Testing location	As above
Applicant	Zhuhai Lang Yi Communication Technology Co., Ltd.
Address	Zhuhai District Fuyong town of Xinhua District two three Lu Yidong 301 shop, China
Manufacturer	Zhuhai Lang Yi Communication Technology Co., Ltd.
Address	Zhuhai District Fuyong town of Xinhua District two three Lu Yidong 301 shop, China
Standard	: ST/SG/AC.10/11Rev.5 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	Li-ion Battery
Trademark	
Model/type reference	LA
Ratings	24V, (10000mAh)

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
Dimension	L : 50.3mm W: 34.7mm T : 7.0mm
Packing Material	ABS
Shape	Prismatic
Mass of apparatus	20g
Test Item:	
Test 1. Altitude simulation	P
Test 2: Thermal Test	P
Test 3: Vibration	P
Test 4: Shock	P
Test 5: External short circuit	P
Test 6. Impact	P
Test 7: Overcharge	P
Test 8: Forced Discharge	N (No need for batteries)
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	Nov. 04, 2010
Date(s) of performance of test	Nov. 04, 2010- Nov. 13, 2010

Test Conclusion:

The Li-ion Battery submitted by Better Power Electronic 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).

Test Result: Pass.

ST/SG/AC.10/11Rev.5 Section 38.3			
Clause	Requirement – Test	Result - Remark	Verdict
38.3	Lithium metal and lithium ion batteries		P
38.3.1	Purpose		P
	This section presents the procedures to be followed for the classification of Lithium metal and lithium ion cells and batteries.		-
38.3.2	Scope		P
38.3.2.1	Lithium metal and lithium ion cells and batteries which differ from a tested type by:		P
	a) For primary cells and batteries, a change of more than 0.1 g or 20% by mass, whichever is greater, to the cathode, to the anode, or to the electrolyte		N
	b) For rechargeable cells and batteries, a change in watt-hours of more than 20% or an increase in voltage of more than 20%.		P
	c) A change that would materially affect the test results. Shall be considered a new type and shall be subjected to the required test.		P
38.3.2.2	For the purposes of classification, the following definitions apply:		P
38.3.3	When a cell or battery type is to be tested under this sub-section, the number and condition of cells and batteries of each type to be tested are as follows:	Tests 1 to 5 must be conducted in sequence on the same battery.	P
	a) When testing primary cells and batteries under tests 1 to 5, the following shall be tested:		N
	Ten cells in undischarged states,		N
	Ten cells in fully discharged states,		N
	Four small batteries in undischarged states,		N
	Four small batteries in fully discharged states,		N
	Four large batteries in undischarged states		N
	Four large batteries in fully discharged states		N
	b) when testing rechargeable cells and batteries under tests 1 to 5 the following shall be tested:		P
	Ten cells at first cycle, in fully charged states,		N
	Four small batteries at first cycle, in fully charged states.		P
	Four small batteries 50 cycle ending in fully charged states.		P
	Two large batteries at first cycle, in fully charged states.		N
	Two large batteries 25 cycle ending in fully charged states.		N
	c) When testing primary and rechargeable cells under test 6(Impact), the following shall be tested in the quantity indicated:		P
	For primary cells, five cells in undischarged states and five cells in fully discharged states		N

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Clause	Requirement – Test	Result - Remark	Verdict
	For component cells of primary batteries, Five cells in undischarged states and five cells in fully discharged states.		N
	For rechargeable cells, five cells at first cycle at 50% of the design rated capacity,		N
	For components cells of rechargeable batteries, five cells at first cycle at 50% of the design rated capacity.		P
	For prismatic cells, ten test cells are required instead of the five described above, so that the procedure can be carried out on five cells along the longitudinal axes and, separately, five cells along the other axes. In every case, the test cell is only subjected to one impact.		P
	d) When testing rechargeable batteries under test 7(Overcharge), the following shall be tested in the quantity indicated:		P
	Four small batteries at first cycle, in fully charged states.		P
	Four small batteries after 50 cycles ending in fully charged states.		P
	Two large batteries at first cycle, in fully charged states.		N
	Two large batteries after 25 cycles ending in fully charged states.		N
	e) When testing primary and rechargeable cells under test 8(Forced Discharge), the following shall be tested in the quantity indicated:	The requirement is not applicable to test batteries.	N
	Ten primary cells in fully discharged states		N
	Ten rechargeable cells, at first cycle in fully discharged states		N
	Ten rechargeable cells after 50 cycles ending in fully discharged states		N
	f) when testing a battery assembly in which the aggregate lithium content of all anodes, when fully charged, is not more than 500g, or in the case of a lithium ion battery, with a watt-hour rating of not more than 6200 Watt-hours.		N

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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		P
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.		P
38.3.4.1.2	Test procedure		-
	stored at a pressure	11.6 kPa	-
	ambient temperature (20 ± 5℃).	24℃	-
	Stored times(≥ 6 hours)	8 hours.	-
38.3.4.1.3	Requirement		P
	Cells and batteries meet this requirement if there is no mass loss, 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 mass loss, 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 (0.1%)	OCV1 (before the test)	OCV2 (after the test)	OCV (≥90%)
Group A (at first cycle, in fully charged states)	01	20.526g	20.526g	0.00%	3.945	3.945	100.0%
	02	20.445g	20.445g	0.00%	3.938	3.938	100.0%
	03	20.357g	20.357g	0.00%	3.940	3.940	100.0%
	04	20.534g	20.534g	0.00%	3.955	3.955	100.0%
Group B (after fifty cycles ending in fully charged states)	05	20.317g	20.317g	0.00%	3.940	3.940	100.0%
	06	20.413g	20.413g	0.00%	3.948	3.948	100.0%
	07	20.454g	20.454g	0.00%	3.942	3.942	100.0%
	08	20.525g	20.526g	0.00%	3.950	3.950	100.0%

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. When mass loss does not exceed the value in Table: Mass loss limit, it shall be considered as "no mass loss".
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℃

Conclusion:

Li-ion Battery had passed altitude simulation test.

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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) 75℃, ≥6h 2) -40℃, ≥6h	-
	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±5℃)	24℃	-
	For large cells and batteries the duration of exposure to the test temperature extremes should be at least 12 hours.	Small battery	N
38.3.4.2.3	Requirement		P
	Cells and batteries meet this requirement if there is no mass loss, 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 mass loss, 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 (0.1%)	OCV1 (before the test)	OCV2 (after the test)	OCV (≥90%)
Group A (at first cycle, in fully charged states)	01	20.526g	20.526g	0.00%	3.945	3.940	99.87%
	02	20.445g	20.445g	0.00%	3.938	3.933	99.87%
	03	20.357g	20.357g	0.00%	3.940	3.935	99.87%
	04	20.534g	20.534g	0.00%	3.955	3.949	99.85%
Group B (after fifty cycles ending in fully charged states)	05	20.317g	20.317g	0.00%	3.940	3.935	99.87%
	06	20.413g	20.413g	0.00%	3.948	3.943	99.87%
	07	20.454g	20.454g	0.00%	3.942	3.937	99.87%
	08	20.526g	20.526g	0.00%	3.950	3.944	99.85%

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. When mass loss does not exceed the value in Table: Mass loss limit, it shall be considered as "no mass loss".
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℃

Conclusion:

Li-ion Battery had passed thermal test.

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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 mass loss, 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 mass loss, 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 (0.1%)	OCV1 (before the test)	OCV2 (after the test)	OCV (≥90%)
Group A (at first cycle, in fully charged states)	01	20.526g	20.526g	0.00%	3.940	3.940	100.0%
	02	20.445g	20.445g	0.00%	3.933	3.933	100.0%
	03	20.357g	20.357g	0.00%	3.935	3.935	100.0%
	04	20.534g	20.534g	0.00%	3.949	3.949	100.0%
Group B (after fifty cycles ending in fully charged states)	05	20.317g	20.317g	0.00%	3.935	3.935	100.0%
	06	20.413g	20.413g	0.00%	3.943	3.943	100.0%
	07	20.454g	20.454g	0.00%	3.937	3.937	100.0%
	08	20.526g	20.526g	0.00%	3.944	3.944	100.0%

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. When mass loss does not exceed the value in Table. Mass loss limit, it shall be considered as "no mass loss".
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℃

Conclusion:

LI-ion Battery had passed vibration test.

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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 batteries	
	a half-sine shock of peak acceleration	150 g.	
	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 mass loss, 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 mass loss, 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 (0.1%)	OCV1 (before the test)	OCV2 (after the test)	OCV (≥90%)
Group A (at first cycle, in fully charged states)	01	20.626g	20.626g	0.00%	3.940	3.940	100.0%
	02	20.445g	20.445g	0.00%	3.933	3.933	100.0%
	03	20.357g	20.357g	0.00%	3.935	3.935	100.0%
	04	20.534g	20.534g	0.00%	3.949	3.949	100.0%
Group B (after fifty cycles ending in fully charged states)	05	20.317g	20.317g	0.00%	3.935	3.935	100.0%
	06	20.413g	20.413g	0.00%	3.943	3.943	100.0%
	07	20.454g	20.454g	0.00%	3.937	3.937	100.0%
	08	20.526g	20.526g	0.00%	3.944	3.944	100.0%

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. When mass loss does not exceed the value in Table: Mass loss limit, it shall be considered as "no mass loss".
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℃

Conclusion:

Li-ion Battery had passed shock test.

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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℃		-
	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℃		-
38.3.4.5.3	Requirement		P
	Cells and batteries meet this requirement if their external temperature does not exceed 170℃ and there is no disassembly, no rupture and no fire within six hours of this test.	Battery external temperature does not exceed 170℃, and there is no disassembly, no fire and no rupture within six hours of this test	P

Group	No.	External Highest Temperature (℃)	Criteria	Result
Group A (at first cycle, in fully charged states)	01	55.8℃	Battery external temperature does not exceed 170℃, and there is no disassembly, no fire and no rupture within six hours of this test	P
	02	55.7℃		P
	03	55.5℃		P
	04	55.3℃		P
Group B (after fifty cycles ending in fully charged states)	05	55.8℃		P
	06	55.4℃		P
	07	55.7℃		P
	08	55.5℃		P

Ambient temperature: 23℃

Conclusion:

Li-ion Battery had passed external short circuit test.

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Clause	Requirement – Test	Result - Remark	Verdict
38.3.4.6	Test 6: Impact	The test sample Component cell of rechargeable batteries	P
38.3.4.6.1	Purpose		P
	This test simulates an impact.		P
38.3.4.6.2	Test procedure		P
	- Dropped height	61±2.5cm;	
	- mass	9.1Kg	
	- diameter bar	15.8mm	
	- Impact position: Prismatic cell is to be impacted with its longitudinal axis parallel to the flat surface and perpendicular to the longitudinal axis of the 15.8 mm diameter curved surface lying across the centre of the test sample. Prismatic cell is also to be rotated 90 degrees around its longitudinal axis so that both the wide and narrow sides will be subjected to the impact.		P
	A coin or button cell is to be impacted with the flat surface of the sample parallel to the flat surface and the 15.8 mm diameter curved surface lying across its centre.		N
38.3.4.6.3	Requirement		P
	Cells and component cells meet this requirement if their external temperature does not exceed 170℃ and there is no disassembly and no fire within six hours of this test.	After the test, The component Cells external temperature does not exceed 170℃ and there is no disassembly and no fire within six hours of this test.	P

Group	No.	Component cells external temperature (℃)	Criteria	Result
Group A. at first cycle at 50% of the design rated capacity (Horizontal)	01	78.6℃	The component Cells external temperature does not exceed 170℃ and there is no disassembly and no fire within six hours of this test.	P
	02	76.7℃		P
	03	75.5℃		P
	04	81.4℃		P
	05	78.6℃		P
Group B, at first cycle at 50% of the design rated capacity (Vertical)	06	43.5℃		P
	07	47.8℃		P
	08	47.2℃		P
	09	46.1℃		P
	10	45.7℃		P
Ambient temperature: 24.0℃				

Conclusion:

Li-ion Battery had passed Impact test.

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Clause	Requirement – Test	Result - Remark	Verdict
38.3.4.7	Test 7: Overcharge		P
38.3.4.7.1	Purpose		P
	This test evaluates the ability of a rechargeable battery to withstand an overcharge condition.		
38.3.4.7.2	Test procedure		P
	The charge current	2×900=1800mA. Twice the manufacturer's recommended maximum continuous charge current	P
	The minimum voltage of the test.		P
	a) The minimum voltage of the test (The manufacturer's recommended charge voltage is not more than 18V)	2×4.2=8.4V, the lesser of two times the maximum charge voltage of the battery or 22V.	P
	b) The minimum voltage of the test (The manufacturer's recommended charge voltage is more than 18V)		N
	Ambient temperature	24°C	-
	The duration of the test	24 hours	-
38.3.4.7.3	Requirement		P
	Rechargeable batteries meet this requirement if there is no disassembly and no fire within seven days of the test	There is no disassembly and no fire within seven days of the test	P

Group	No.	Criteria	Result
Group A (at first cycle, in fully charged states)	01	There is no disassembly and no fire within seven days of the test	P
	02		P
	03		P
	04		P
Group B (after fifty cycles ending in fully charged states)	05		P
	06		P
	07		P
	08		P
Ambient temperature: 24°C			

Conclusion:

LI-ion Battery had passed overcharge test.

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Clause	Requirement – Test	Result - Remark	Verdict
38.3.4.8	Test 8: Forced discharge		N
38.3.4.8.1	Purpose		N
	This test evaluates the ability of a primary or a rechargeable cell to withstand a forced discharge condition		
38.3.4.8.2	Test procedure		N
	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.		N
	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)		N
38.3.4.8.3	Requirement		N
	Primary or rechargeable cells meet this requirement if there is no disassembly and no fire within seven days of the test		N