

TEST REPORT

UN38.3

NAME OF SAMPLE: Rechargeable Li-ion Cell

CLIENT: Spectro-UV, LLC

CLASSIFICATION OF TEST: Commission Test

TEST REPORT

No.: RZUN2021-0676

Page 2 of 13 Pages

Name of samples: Rechargeable Li-ion Cell	Type/Model: ICR18650 2600mAh 3,7V 9,62Wh
Appearance: Green	Trade mark:
Commissioned by Spectro-UV, LLC	Manufacturer: Spectro-UV, LLC
Commissioner address: 4 Dubon Court Farmingdale NY 11735	Manufacturer address: 4 Dubon Court Farmingdale NY 11735
Classification of test: Commission Test	Quantity of sample: 35 cells
Tested according to: ST/SG/AC.10/11/Rev.6/Section 38.3	Sample identification: c1#~c35#
Receiving date: 2021-01-04	Means of receiving: Submitted by commissioner
Completing date: 2021-01-25	Test item: 7 items
Test conclusion: The Rechargeable Li-ion cells submitted by Spectro-UV, LLC are tested according to Section 38.3 of the sixth Revised Edition of the Recommendations on the Transport of Dangerous Goods, Manual of Test and Criteria (ST/SG/AC.10/11/Rev.6/Section 38.3). The test items are full items. The test results comply with the relevant requirements of the standard.	

Description and illustration of the sample:
The sample's status is good

Test item	Sample No.	State	Remark
T.1~T.5	c1#~c10#	at first cycle, in fully charged state	-
T.6	c11#~c15#	at first cycle at 50% of the design rated capacity	-
T.8	c16#~c25#	at first cycle, in fully discharged state	-
	c26#~c35#	after fifty cycles ending in fully discharged state	-

Description of the sampling procedure:

/

Description of the deviation from the standard, if any:

/

Remarks:

Throughout this report a comma is used as the decimal separator.

ST/SG/AC.10/11/Rev.6/Section 38.3			
Clause	Requirements	Result	Verdict
38.3.4	Procedure		—
38.3.4.1	Test 1: Altitude simulation:		P
	Test cells and batteries shall be stored at a pressure of 11,6kPa or less for at least six hour at ambient temperature (20±5°C)		
	Requirement/ 1 Cells and batteries Mass loss limit: ≤0,2% 2 Open circuit voltage not less than 90%, The requirement relating to voltage is not applicable to test cells and batteries at full discharged states. 3 No leakage, no venting, no disassembly, no rupture and no fire	The samples c1#~c10# : No leakage, no venting, no disassembly, no rupture and no fire/ c1#~c10# The data see table1/	
38.3.4.2	Test 2: Thermal test		P
	Test cells and batteries are to be stored for 1 one temperature cycle: 72±2°C(6h) —40±2°C(6h) 72±2°C(6h) —40±2°C(6h) 2 The maximum time interval between test temperature extremes is 30 minutes/温 30min 3 This procedure is to be repeated 10 times 4 after which all test cells and batteries are to be stored for 24 hours at ambient temperature (20±5°C)		
	Requirements 1 Cells and batteries Mass loss limit: ≤0,2% 2 Open circuit voltage not less than 90%, The requirement relating to voltage is not applicable to test cells and batteries at full discharged states. 3 No leakage, no venting, no disassembly, no rupture and no fire	The samples c1#~c10# : No leakage, no venting, no disassembly, no rupture and no fire The data see table1	

ST/SG/AC.10/11/Rev.6/Section 38.3			
Clause	Requirements	Result	Verdict
38.3.4.3	Test 3: Vibration		P
	<p>1 Cells and batteries are firmly secured to the platform of the vibration machine</p> <p>2 The vibration :a sinusoidal waveform with a logarithmic sweep between 7 Hz and 200 Hz and back to 7 Hz traversed in 15 minutes</p> <p>3 the logarithmic frequency sweep is as follows: 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 a peak acceleration of 8 gn occurs (approximately 50Hz), A peak acceleration of 8 gn is then maintained until the frequency is increased to 200 Hz</p> <p>4This cycle repeated 12 times for a total of 3 hours for each of three mutually perpendicular mounting position of the cell. One of the directions of vibration must be perpendicular to the terminal face.</p>		
	<p>Requirements</p> <p>1 Cells and batteries Mass loss limit: ≤0,2%</p> <p>2 Open circuit voltage not less than 90%, The requirement relating to voltage is not applicable to test cells and batteries at full discharged states.</p> <p>3 No leakage, no venting, no disassembly, no rupture and no fire</p>	<p>The samples c1#~c10# :</p> <p>No leakage, no venting, no disassembly, no rupture and no fire</p> <p>The data see table1</p>	

ST/SG/AC.10/11/Rev.6/Section 38.3			
Clause	Requirements	Result	Verdict
38.3.4.4	<p>Test 4: Shock</p> <p>1 Test cells and batteries shall be secured to the testing machine</p> <p>2 Each cell shall be subjected to a half-sine shock of peak acceleration of 150 g_n and pulse duration of 6 milliseconds. Large cells may be subjected to a half-sine shock of peak acceleration of 50 g_n and pulse duration of 11 milliseconds.</p> <p>Small batteries shall be subjected to a half-sine shock of peak acceleration of 150 g_n (or Acceleration(g_n)= $\sqrt{\left(\frac{100850}{mass}\right)}$, which is smaller) and pulse duration of 6 milliseconds, large batteries shall be subjected to a half-sine of peak acceleration of 50 g_n (or Acceleration(g_n)= $\sqrt{\left(\frac{30000}{mass}\right)}$, which is smaller) and pulse duration of 11 milliseconds</p> <p>3 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.</p>		P
	<p>Requirements:</p> <p>1 Cells and batteries Mass loss limit: ≤0,2%</p> <p>2 Open circuit voltage not less than 90%, The requirement relating to voltage is not applicable to test cells and batteries at full discharged states.</p> <p>3 No leakage, no venting, no disassembly, no rupture and no fire.</p>	<p>The samples c1#~c10# :</p> <p>Acceleration= 150g_n</p> <p>No leakage, no venting, no disassembly, no rupture and no fire/</p> <p>The data see table1</p>	

ST/SG/AC.10/11/Rev.6/Section 38.3			
Clause	Requirements	Result	Verdict
38.3.4.5	<p>Test 5: External Short Circuit</p> <p>1 The cell or battery to be tested shall be temperature stabilized so that its external case temperature reaches $57\pm 4^{\circ}\text{C}$</p> <p>2 the cell or battery shall be subjected to a short circuit condition with a total external resistance of less than 0,1 ohm at $57\pm 4^{\circ}\text{C}$, This short circuit condition is continued for at least one hour after the cell or battery external case temperature has returned to 57 ± 4</p> <p>3 the cell or battery must be observed for a further six hour for the test to be concluded,</p>		P
	<p>Requirements</p> <p>During the test and within six hours after test, the cells or batteries</p> <p>1. External temperature not exceed 170°C</p> <p>2. No disassembly, no rupture and no fire.</p>	<p>The samples c1#~c10# :</p> <p>no disassembly, no rupture and no fire/</p> <p>The data see table1</p>	

ST/SG/AC.10/11/Rev.6/Section 38.3			
Clause	Requirements	Result	Verdict
38.3.4.6	Test 6: Impact / Crush		P
	Impact (applicable to cylindrical cells not less than 18mm in diameter) /		P
	1. This test sample cell or component cell is to be placed on a flat smooth surface 2. A 15,8 mm diameter bar is to be placed across the center of the sample, A 9,1kg mass is to be dropped from a height of 61±2,5cm onto the sample. 3. 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.		
	Requirements 1. Cells external temperature not exceed 170°C 2. No disassembly, no fire within six hours of this test	The samples c11#~c15#: no disassembly and no fire/The data see table2/	
Crush (applicable to prismatic, pouch, coin/button cells and cylindrical cells less than 18mm in diameter)		N/A	
1 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 (c) The cell is deformed by 50% or more of its original thickness 2. 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.			
Requirements 1 Cells external temperature not exceed 170°C. 2 No disassembly, no fire within six hours of this test	-		

ST/SG/AC.10/11/Rev.6/Section 38.3				
Clause	Requirements	Result	Verdict	
38.3.4.7	Test 7: Overcharge		N/A	
	1 The charge current shall be twice the manufacturer’s recommended maximum continuous charge current 2 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 3 Tests are to be conducted at ambient temperature 20±5°C, The duration of the test shall be 24 hours/20±5°C			-
	Requirements No disassembly and no fire within seven days of this test			-
38.3.4.8	Test 8: Forced discharge		P	
	Each cell shall be forced discharged at ambient temperature by connecting it in series with a 12 V 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)			
Requirements No disassembly and no fire within seven days of this test		c16#~c35# For voltage data before test, see table 3.		

Table1: T1~T5											
Sample No.	Mass prior to test (g)	OCV prior to test (V)	Test 1: Altitude simulation/		Test 2: Thermal test/		Test 3: Vibration/		Test 4: Shock/		Test 5: External Short Circuit
			Mass loss(%)	Change ratio (%)	Mass loss(%)	Change ratio (%)	Mass loss(%)	Change ratio (%)	Mass loss(%)	Change ratio (%)	Temp. (°C)
c1#	44,136	4,189	0,000	100,00	0,002	98,59	0,000	100,00	0,000	100,00	75,9
c2#	43,670	4,187	0,000	99,95	0,009	98,66	0,000	100,00	0,000	99,98	78,6
c3#	44,506	4,187	0,000	99,93	0,004	98,66	0,000	99,98	0,002	100,00	74,3
c4#	43,841	4,189	0,000	99,98	0,002	98,59	0,000	100,00	0,000	100,00	75,2
c5#	43,819	4,188	0,000	100,00	0,004	98,62	0,002	100,00	0,000	100,00	76,8
c6#	43,545	4,187	0,000	100,00	0,004	98,61	0,000	100,00	0,000	100,00	76,1
c7#	44,278	4,187	0,002	99,98	0,006	98,69	0,000	99,98	0,002	100,00	93,2
c8#	44,083	4,189	0,000	99,95	0,004	98,64	0,002	100,00	0,000	100,00	70,4
c9#	43,579	4,186	0,004	99,98	0,009	98,71	0,000	100,00	0,000	100,00	72,5
c10#	43,865	4,187	0,000	99,98	0,002	98,64	0,000	100,00	0,000	99,98	73,8

Table2: Impact						
Test 6: Impact	Sample No.	c11#	c12#	c13#	c14#	c15#
	OCV prior to test (V)	3,826	3,833	3,809	3,812	3,826
	Temp. (°C)	47,1	56,2	49,8	36,1	56,7

Table 3: Forced discharge											
Test 8: Forced discharge	Sample No.	c16#	c17#	c18#	c19#	c20#	c21#	c22#	c23#	c24#	c25#
	OCV prior to test (V)	3,320	3,304	3,247	3,309	3,250	3,311	3,319	3,257	3,308	3,255
	Sample No.	c26#	c27#	c28#	c29#	c30#	c31#	c32#	c33#	c34#	c35#
	OCV prior to test / (V)	3,304	3,296	3,271	3,309	3,286	3,270	3,305	3,288	3,325	3,314