

SPECTRO-UV

Test Report

Sample Name: High drain rechargeable battery

Model: Spectro-UV P/N 149828 - 18650 3200mA

Applicant

Applicant Name:		Spectro-UV	
Applicant Address:		4 Dubon Court, Farmingdale NY 11735	
Manufacturer			
Manufacturer Name:		Spectro-UV	
Manufacturer Address:		4 Dubon Court, Farmingdale NY 11735	
Tel:	866-230-7305	Email:	Sales@Spectro-UV.com
Website:	www.spectro-uv.com		

Sample Description			
Sample Name	High drain rechargeable battery	Model Name	P/N 149828
Rated Capacity	3200mAh	Rated Voltage	3.7V
		Watt-hour	11.84Wh
Sample Shape	Cylinder	Product Description	Li-ion Cell
Sample Mass	49.0g	Sample Size	18.2*65.5 mm (D*H)

Test Standard
UNITED NATION "Recommendations on the TRANSPORT OF DANGEROUS GOODS, Manual of Test and Criteria" ST/SG/AC 10/11/Rev.7, Section 38.3

Test Item and Conclusion			
Test Item	Result	Test Item	Result
T.1: <input checked="" type="checkbox"/> Altitude Simulation	Pass	<input checked="" type="checkbox"/> T.5: External short circuit	Pass
T.2: <input checked="" type="checkbox"/> Thermal Test	Pass	<input type="checkbox"/> T.6: Crush or <input checked="" type="checkbox"/> Impact	Pass
T.3: <input checked="" type="checkbox"/> Vibration	Pass	<input type="checkbox"/> T.7: Overcharge	N/A
T.4: <input checked="" type="checkbox"/> Shock	Pass	<input checked="" type="checkbox"/> T.8: Forced discharge	Pass
38.3.3 (f)	N/A	38.3.3 (g)	N/A

Test Summary Lists

Test No.	Test Item	Test Results	Conclusion
T1	Altitude simulation	See Appendix 1	Passed
T2	Thermal test	See Appendix 2	Passed
T3	Vibration	See Appendix 3	Passed
T4	Shock	See Appendix 4	Passed
T5	External short circuit	See Appendix 5	Passed
T6	Impact	See Appendix 6	Passed
	Crush	N/A	N/A
T7	Overcharge	N/A	N/A
T8	Forced discharge	See Appendix 8	Passed
Remark	1) Impact test applicable to cylindrical cells not less than 18.0mm in diameter. 2) Crush test applicable to prismatic, pouch, coin/button cells and cylindrical cells less than 18.0mm in diameter. 3) Batteries or single cell batteries not equipped with battery overcharge protection that are designed for use only as a component in another battery or in equipment, which affords such protection, are not applicable to overcharge test.		

Test Item	Sample No.	Sample State
T1~T5	C01~C05	At first cycle, in fully charged states
	C06~C10	After 25 cycles ending in fully charged states
T6	C11~C15	At first cycle at 50% of the design rated capacity
	C16~C20	After 25 cycle at 50% of the design rated capacity
T7	N/A	N/A
	N/A	N/A
T8	C21~C30	At first cycle in fully discharged states
	C31~C40	After 25 cycles ending in fully discharged states
The above samples have been charged and discharged cycles by the factory as required before the test.		

Appendix 1

Test Items	Altitude simulation						
1.1	Test procedure						
	<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).</p> <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.</p>						
1.2	Result						
Sample No.	Before		After		Mass loss (%)	Residual OCV (%)	Test result
	Mass (g)	Voltage (V)	Mass (g)	Voltage (V)			
C01	48.723	4.183	48.720	4.182	0.01	99.98	O
C02	48.985	4.185	48.983	4.183	0.00	99.95	O
C03	48.943	4.186	48.940	4.185	0.01	99.98	O
C04	48.946	4.184	48.943	4.184	0.01	100.00	O
C05	48.707	4.183	48.705	4.181	0.00	99.95	O
C06	48.645	4.185	48.642	4.185	0.01	100.00	O
C07	48.998	4.183	48.996	4.181	0.00	99.95	O
C08	48.659	4.183	48.656	4.182	0.01	99.98	O
C09	48.845	4.186	48.842	4.184	0.01	99.95	O
C10	48.753	4.185	48.751	4.185	0.00	100.00	O
<p>Note: L- Leakage, V- Venting, D- Disassembly, R- Rupture, F- Fire, O- No leakage, no venting, no disassembly, no rupture, no fire, no mass loss, change ratio is not less than 90 %.</p>							

Appendix 2

Test Items	Thermal test						
2.1	Test procedure						
	<p>Test cells and batteries are to be stored for at least six hours at a test temperature equal to $72 \pm 2^\circ\text{C}$, followed by storage for at least six hours at a test temperature equal to $-40 \pm 2^\circ\text{C}$. The maximum time interval between test temperature extremes in 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 ($20 \pm 5^\circ\text{C}$). For large cells and batteries, the duration of exposure to the test temperature extremes should be at least 12 hours.</p> <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.</p>						
2.2	Result						
Sample No.	Before		After		Mass loss (%)	Residual OCV (%)	Test result
	Mass (g)	Voltage (V)	Mass (g)	Voltage (V)			
C01	48.720	4.182	48.708	4.153	0.02	99.31	O
C02	48.983	4.183	48.970	4.156	0.03	99.35	O
C03	48.940	4.185	48.929	4.153	0.02	99.24	O
C04	48.943	4.184	48.930	4.157	0.03	99.35	O
C05	48.705	4.181	48.694	4.152	0.02	99.31	O
C06	48.642	4.185	48.629	4.153	0.03	99.24	O
C07	48.996	4.181	48.984	4.153	0.02	99.33	O
C08	48.656	4.182	48.645	4.157	0.02	99.40	O
C09	48.842	4.184	48.830	4.158	0.02	99.38	O
C10	48.751	4.185	48.738	4.156	0.03	99.31	O
<p>Note: L- Leakage, V- Venting, D- Disassembly, R- Rupture, F- Fire, O- No leakage, no venting, no disassembly, no rupture, no fire, no mass loss, change ratio is not less than 90 %.</p>							

Appendix 3

Test Items	Vibration
3.1	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 wave form with a logarithmic sweep between 7Hz and 200Hz and back to 7Hz traversed in 15minutes, this cycle shall be 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>The logarithmic frequency sweep shall differ for cells and batteries with a gross mass of not more than 12kg (cells and small batteries), and for batteries with a gross mass of more than 12kg (large batteries).</p> <p>For cells and small batteries: from 7Hz a peak acceleration of 1gn is maintained until 18Hz is reached. The amplitude is then maintained at 0.8mm (1.6mm total excursion) and the frequency increased until a peak acceleration of 8gn occurs (approximately 50Hz). A peak acceleration of 8gn is then maintained until the frequency is increased to 200Hz.</p> <p>For large batteries: from 7Hz to a peak acceleration of 1gn is maintained until 18Hz is reached. The amplitude is then maintained at 0.8mm (1.6mm total excursion) and the frequency increased until a peak acceleration of 2gn occurs (approximately 25Hz). A peak acceleration of 2gn is then maintained until the frequency is increased to 200Hz.</p> <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.</p>

3.2	Result						
Sample No.	Before		After		Mass loss (%)	Residual OCV (%)	Test result
	Mass (g)	Voltage (V)	Mass (g)	Voltage (V)			
C01	48.708	4.153	48.706	4.152	0.00	99.98	O
C02	48.970	4.156	48.967	4.154	0.01	99.95	O
C03	48.929	4.153	48.926	4.153	0.01	100.00	O
C04	48.930	4.157	48.928	4.155	0.00	99.95	O
C05	48.694	4.152	48.691	4.152	0.01	100.00	O
C06	48.629	4.153	48.626	4.152	0.01	99.98	O
C07	48.984	4.153	48.982	4.151	0.00	99.95	O
C08	48.645	4.157	48.642	4.156	0.01	99.98	O
C09	48.830	4.158	48.828	4.157	0.00	99.98	O
C10	48.738	4.156	48.735	4.154	0.01	99.95	O

Note: **L**- Leakage, **V**- Venting, **D**- Disassembly, **R**- Rupture, **F**- Fire,
O- No leakage, no venting, no disassembly, no rupture, no fire, no mass loss, change ratio is not less than 90 %.

Appendix 4

Test Items	Shock									
4.1	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. Each cell or battery shall be subjected to a half sine shock of peak acceleration of 150gn and pulse duration of 6milliseconds. Alternatively, large cells may be subjected to a half-sine shock of peak acceleration of 50gn 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.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Battery</th> <th>Minimum peak acceleration</th> <th>Pulse duration</th> </tr> </thead> <tbody> <tr> <td>Small batteries</td> <td> 150 gn or result of formula $\text{Acceleration(gn)} = \sqrt{\frac{100850}{\text{mass}^*}}$ whichever is smaller </td> <td>6 ms</td> </tr> <tr> <td>Large batteries</td> <td> 50 gn or result of formula $\text{Acceleration(gn)} = \sqrt{\frac{30000}{\text{mass}^*}}$ whichever is smaller </td> <td>11 ms</td> </tr> </tbody> </table> <p style="text-align: center;">Note: "*" Mass is expressed in kilograms</p> <p>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.</p> <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. (NOTE: Mass is express in kilograms)</p>	Battery	Minimum peak acceleration	Pulse duration	Small batteries	150 gn or result of formula $\text{Acceleration(gn)} = \sqrt{\frac{100850}{\text{mass}^*}}$ whichever is smaller	6 ms	Large batteries	50 gn or result of formula $\text{Acceleration(gn)} = \sqrt{\frac{30000}{\text{mass}^*}}$ whichever is smaller	11 ms
Battery	Minimum peak acceleration	Pulse duration								
Small batteries	150 gn or result of formula $\text{Acceleration(gn)} = \sqrt{\frac{100850}{\text{mass}^*}}$ whichever is smaller	6 ms								
Large batteries	50 gn or result of formula $\text{Acceleration(gn)} = \sqrt{\frac{30000}{\text{mass}^*}}$ whichever is smaller	11 ms								

4.2	Result						
Sample No.	Before		After		Mass loss (%)	Residual OCV (%)	Test result
	Mass (g)	Voltage (V)	Mass (g)	Voltage (V)			
C01	48.706	4.152	48.703	4.152	0.01	100.00	O
C02	48.967	4.154	48.966	4.152	0.00	99.95	O
C03	48.926	4.153	48.923	4.152	0.01	99.98	O
C04	48.928	4.155	48.925	4.155	0.01	100.00	O
C05	48.691	4.152	48.687	4.151	0.01	99.98	O
C06	48.626	4.152	48.624	4.150	0.00	99.95	O
C07	48.982	4.151	48.979	4.151	0.01	100.00	O
C08	48.642	4.156	48.640	4.154	0.00	99.95	O
C09	48.828	4.157	48.825	4.156	0.01	99.98	O
C10	48.735	4.154	48.733	4.152	0.00	99.95	O

Note: **L**- Leakage, **V**- Venting, **D**- Disassembly, **R**- Rupture, **F**- Fire,
O- No leakage, no venting, no disassembly, no rupture, no fire, no mass loss, change ratio is not less than 90 %.

Appendix 5

Test Items	External short circuit	
5.1	Test procedure	
	<p>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.</p> <p>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.</p> <p>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 within six hours of this test.</p>	
5.2	Result	
Sample No.	Max. External Temperature (°C)	Test result
C01	109.6	O
C02	108.7	O
C03	109.4	O
C04	109.3	O
C05	110.2	O
C06	109.3	O
C07	109.5	O
C08	110.1	O
C09	108.9	O
C10	109.8	O
<p>Note: D- Disassembly, R- Rupture, F- Fire, O- No disassembly, no rupture, no fire, test sample external temperature does not exceed 170 °C.</p>		

Appendix 6

Test Items	<input checked="" type="checkbox"/> Impact <input type="checkbox"/> Crus	
6.1	Test procedure	
	<p>The sample cell or component cell is to be placed on a flat smooth surface. A 15.8mm ± 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 center of the sample. A 9.1kg ± 0.1kg mass is to be dropped from a height of 61 ± 2.5cm 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.</p> <p>The test sample is to be impacted with its longitudinal axis parallel to the flat surface and perpendicular to the longitudinal axis of the 15.8mm ± 0.1mm diameter curved surface lying across the center of the test sample. Each sample is to be subjected to only a single impact. 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.</p>	
6.2	Result	
Sample No.	Max. External Temperature (°C)	Test result
C11	28.6	O
C12	29.1	O
C13	29.0	O
C14	28.4	O
C15	28.5	O
C16	29.0	O
C17	28.9	O
C18	28.1	O
C19	28.7	O
C20	28.3	O
Note: D - Disassembly, F - Fire, O - No disassembly, no fire, test sample external temperature does not exceed 170 °C.		

Appendix 7

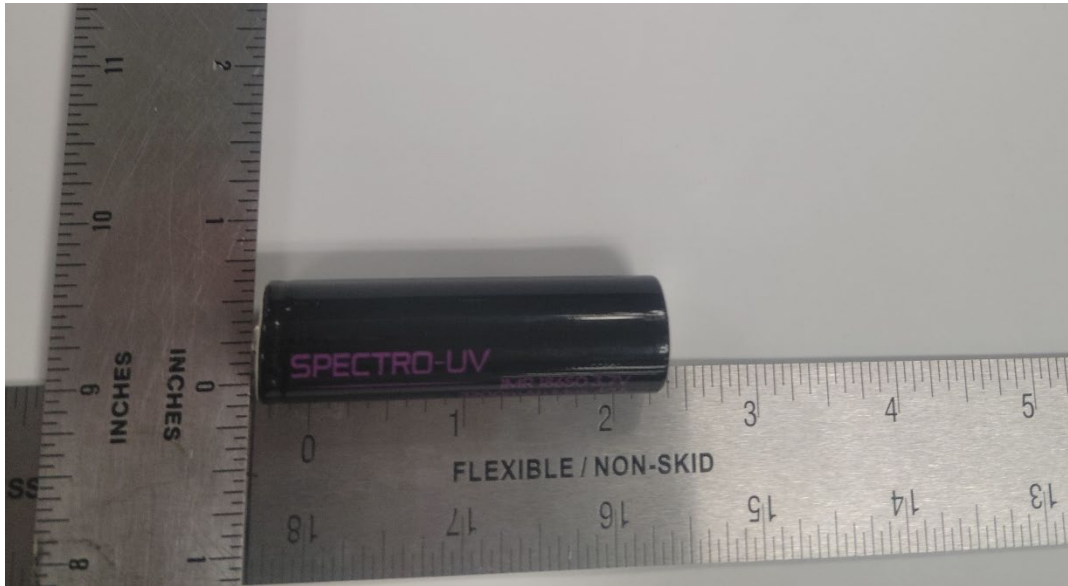
Test Items	Overcharge	
7.1	Test procedure	
	The charge current shall be twice the manufacturer's recommended maximum continuous charge current. The duration of the test shall be 24 hours. The minimum voltage of the test shall be as follows:	
	When the manufacturer's recommended charge voltage is not more than 18V, the minimum voltage of the test shall be the lesser of two times the maximum charge voltage of the or 22V. Rechargeable batteries meet this requirement if there is no disassembly and no fire within seven days of the test.	N/A
	When the manufacturer's recommended charge voltage is more than 18V, the minimum voltage of the test shall be 1.2 times maximum charge voltage. Rechargeable batteries meet this requirement if there is no disassembly and no fire within seven days of the test.	N/A
7.2	Result	
Sample No.	Voltage Before test(V) (V)	Test result
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Note: D - Disassembly, F - Fire, O - No disassembly, no fire.		

Appendix 8

Test Items	Forced discharge				
8.1	Test procedure				
	<p>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 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 within seven days of the test.</p>				
8.2	Result				
Sample No.	Voltage Before test (V)	Test result	Sample No.	Voltage Before test (V)	Test result
C21	3.316	O	C31	3.308	O
C22	3.312	O	C32	3.312	O
C23	3.315	O	C33	3.309	O
C24	3.314	O	C34	3.306	O
C25	3.310	O	C35	3.302	O
C26	3.311	O	C36	3.305	O
C27	3.308	O	C37	3.304	O
C28	3.312	O	C38	3.307	O
C29	3.310	O	C39	3.303	O
C30	3.309	O	C40	3.298	O

Note: **D**- Disassembly, **F**- Fire, **O**- No disassembly, no fire.

Photo of sample



--- End of Report ---