



TEST REPORT

1. **Report Number** KR20-YBM0007
2. **Applicant**
 - Name SEMISOLUTION Inc.
 - Address Suite 2005 Heungdeok U-Tower, 120, Heungdeokjungang-ro, Giheung-gu, Yongin-si, Gyeonggi-do, Korea
 - Date of Receipt 2019. 11. 22
3. **Manufacturer**
 - Name Shenzhen Aerospace Electronic Co., Ltd.
 - Address 2/F, 4/F & 5/F, No.42, Langkou Industrial Zone, Langkou Community, Dalang Sub-district, Longhua District, Shenzhen City, Guangdong Province, China
4. **Use of Report** For Quality Control
5. **Test item description**
 - Product Name Rechargeable Li-ion Battery Cell
 - Model Name PLV553837
6. **Test method used** UN 38.3 (ST/SG/AC.10/11/Rev.6/Amend.1)
7. **Date of Test** 2019. 11. 22 – 2020. 03. 27
8. **Environment**
 - Temperature (20 ± 5)°C
 - Relative Humidity -
9. **Test Results** Pass Fail

※ This test results apply only to the test sample supplied by applicant and do not guarantee the whole product quality. This test report shall not be reproduced except in full, without the written approval by the KCTL Inc.

Affirmation	Tested by	Technical Manager
	Name : Yong Lee 	Name : Hyung Keun Lim 

2020. 03. 27

KCTL INC.



Test item particulars		
Battery Type.....	<input type="checkbox"/> rechargeable battery <input checked="" type="checkbox"/> rechargeable cell <input type="checkbox"/> single cell battery <input type="checkbox"/> large battery <input type="checkbox"/> small battery <input type="checkbox"/> large cell <input checked="" type="checkbox"/> small cell	
Test Items performed	<input checked="" type="checkbox"/> T1: ALTITUDE SIMULATION TEST: <input checked="" type="checkbox"/> T2 THERMAL TEST <input checked="" type="checkbox"/> T3: VIBRATION TEST <input checked="" type="checkbox"/> T4: SHOCK TEST <input checked="" type="checkbox"/> T5: SHORT CIRCUIT TEST <input checked="" type="checkbox"/> T6: IMPACT/CRUSH TEST <input type="checkbox"/> T7: OVERCHARGE TEST <input checked="" type="checkbox"/> T8: FORCED-DISCHARGE TEST	
Ratings.....	3.8 V, 1 000 mAh	
Cell Connections.....	N/A	
Possible test case verdicts:		
- test case does not apply to the test object	N/A	
- test object does meet the requirement.....	P (Pass)	
- test object does not meet the requirement.....	F (Fail)	
Testing		
Date of receipt of test item	2019. 11. 22	
Date(s) of performance of tests	2019. 11. 22 – 2020. 03. 27	
Summary of testing:		
General product information:		
1. Otherwise specified, all tests have been carried out under temperature of 20 ± 5°C.		
2. The test samples are pre-production without serial numbers.		
Number and condition of samples:		
Tests	Number of samples	Condition of samples
T1-T5	5	First Cycle, in fully charged states
	5	25 Cycles, in fully charged states
T6	5	First Cycle, in half charged states
	5	25 Cycles, in half charged states
T7	-	First Cycle, in fully charged states
	-	25 Cycles, in fully charged states
T8	10	First Cycle, in fully discharged states
	10	25 Cycles, in fully discharged states
Appended Contents:		
ATTACHMENT : Photographs		

T1	ALTITUDE SIMULATION TEST:	Results: <input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail
Procedure	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).	<input checked="" type="checkbox"/> no leakage, no venting, no disassembly, no rupture and no fire <input checked="" type="checkbox"/> mass loss, voltage drop see below table
Requirements	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.	

Sample No.	Sample Condition	Weight Before Test (g)	Weight After Test (g)	Percentage of Weight Loss (%)	Voltage Before Test (V)	Voltage After Test (V)	Percent of Voltage Drop (%)
1	A	16.25	16.25	0	4.33	4.32	0.23
2	A	16.45	16.45	0	4.33	4.32	0.23
3	A	16.55	16.55	0	4.33	4.32	0.23
4	A	16.47	16.47	0	4.33	4.32	0.23
5	A	16.54	16.54	0	4.33	4.32	0.23
6	B	16.39	16.39	0	4.33	4.32	0.23
7	B	16.58	16.58	0	4.33	4.32	0.23
8	B	16.69	16.69	0	4.33	4.32	0.23
9	B	16.73	16.73	0	4.33	4.32	0.23
10	B	16.57	16.57	0	4.33	4.32	0.23

Supplementary Information:
 A: First cycle, in fully charged states
 B: 25 Cycles, in fully charged states
 C: First Cycle, in half charged states
 D: 25 Cycles, in half charged states
 E: First Cycle, in fully discharged states
 F: 25 Cycles, in fully discharged states

T2	THERMAL TEST (TEMPERATURE CYCLING TEST):	Results: [X] Pass [] Fail
Procedure	Test cells and batteries are to be stored for at least six hours at a test temperature equal to 72 ± 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.	[X]no leakage, no venting, no disassembly, no rupture and no fire [X]mass loss, voltage drop see below table
Requirements	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.	

Sample No.	Sample Condition	Weight Before Test (g)	Weight After Test (g)	Percentage of Weight Loss (%)	Voltage Before Test (V)	Voltage After Test (V)	Percent of Voltage Drop (%)
1	A	16.25	16.25	0	4.32	4.31	0.23
2	A	16.45	16.45	0	4.32	4.31	0.23
3	A	16.55	16.55	0	4.32	4.31	0.23
4	A	16.47	16.47	0	4.32	4.31	0.23
5	A	16.54	16.54	0	4.32	4.31	0.23
6	B	16.39	16.39	0	4.32	4.31	0.23
7	B	16.58	16.58	0	4.32	4.31	0.23
8	B	16.69	16.69	0	4.32	4.31	0.23
9	B	16.73	16.73	0	4.32	4.31	0.23
10	B	16.57	16.57	0	4.32	4.31	0.23

Supplementary Information: A: First cycle, in fully charged states B: 25 Cycles, in fully charged states C: First Cycle, in half charged states D: 25 Cycles, in half charged states E: First Cycle, in fully discharged states F: 25 Cycles, in fully discharged states
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T3	VIBRATION TEST:	Results: <input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail
Procedure	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 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.	<p><input checked="" type="checkbox"/>no leakage, no venting, no disassembly, no rupture and no fire</p> <p><input checked="" type="checkbox"/>mass loss, voltage drop see below table</p>
Requirements	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.	

Sample No.	Sample Condition	Weight Before Test (g)	Weight After Test (g)	Percentage of Weight Loss (%)	Voltage Before Test (V)	Voltage After Test (V)	Percent of Voltage Drop (%)
1	A	16.25	16.25	0	4.31	4.30	0.23
2	A	16.45	16.45	0	4.31	4.30	0.23
3	A	16.55	16.55	0	4.31	4.30	0.23
4	A	16.47	16.47	0	4.31	4.30	0.23
5	A	16.54	16.54	0	4.31	4.30	0.23
6	B	16.39	16.39	0	4.31	4.30	0.23
7	B	16.58	16.58	0	4.31	4.30	0.23
8	B	16.69	16.69	0	4.31	4.30	0.23
9	B	16.73	16.73	0	4.31	4.30	0.23
10	B	16.57	16.57	0	4.31	4.30	0.23

Supplementary Information:

- A: First cycle, in fully charged states
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- E: First Cycle, in fully discharged states
- F: 25 Cycles, in fully discharged states

T4	Shock:	Results: <input checked="" type="checkbox"/> Pass [] Fail
Procedure	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 150 gn and pulse duration of 6 milliseconds. 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. However, large cells and large batteries shall be subjected to a half-sine shock of peak acceleration of 50 gn and pulse duration of 11 milliseconds.	<input checked="" type="checkbox"/> no leakage, no venting, no disassembly, no rupture and no fire <input checked="" type="checkbox"/> mass loss, voltage drop see below table
Requirements	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.	

Sample No.	Sample Condition	Weight Before Test (g)	Weight After Test (g)	Percentage of Weight Loss (%)	Voltage Before Test (V)	Voltage After Test (V)	Percent of Voltage Drop (%)
1	A	16.25	16.25	0	4.30	4.30	0
2	A	16.45	16.45	0	4.30	4.30	0
3	A	16.55	16.55	0	4.30	4.30	0
4	A	16.47	16.47	0	4.30	4.30	0
5	A	16.54	16.54	0	4.30	4.30	0
6	B	16.39	16.39	0	4.30	4.30	0
7	B	16.58	16.58	0	4.30	4.30	0
8	B	16.69	16.69	0	4.30	4.30	0
9	B	16.73	16.73	0	4.30	4.30	0
10	B	16.57	16.57	0	4.30	4.30	0

Supplementary Information:

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- E: First Cycle, in fully discharged states
- F: 25 Cycles, in fully discharged states

T5	External Short Circuit:	Results: <input checked="" type="checkbox"/> Pass [] Fail
Procedure	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 ± 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. 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. The short circuit and cooling down phases shall be conducted at least at ambient temperature.	<input checked="" type="checkbox"/> no disassembly, no rupture and no fire <input checked="" type="checkbox"/> external temperature see below table
Requirements	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.	

Sample No.	Condition	Voltage Before Test (V)	Maximum Temperature (°C)	External Resistance (Ω)
1	A	4.30	113.6	99.63
2	A	4.30	107.1	99.63
3	A	4.30	113.0	99.10
4	A	4.30	120.8	98.82
5	A	4.30	117.0	99.33
6	B	4.30	109.8	99.51
7	B	4.30	113.6	98.71
8	B	4.30	117.9	98.65
9	B	4.30	118.9	99.43
10	B	4.30	113.2	98.74

<p>Supplementary Information:</p> <p>Measured Test Ambient: 58.0 °C</p> <p>A: First cycle, in fully charged states</p> <p>B: 25 Cycles, in fully charged states</p> <p>C: First Cycle, in half charged states</p> <p>D: 25 Cycles, in half charged states</p> <p>E: First Cycle, in fully discharged states</p> <p>F: 25 Cycles, in fully discharged states</p>

T6	Impact:	Results: [] Pass [] Fail
Procedure	<p>NOTE: Diameter here refers to the design parameter (for example the diameter of 18 650 cells is 18.0 mm). The test sample cell or component cell is to be placed on a flat smooth surface. A 15.8 mm ± 0.1 mm 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 ± 0.1kg 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. 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 ± 0.1 mm diameter curved surface lying across the centre of the test sample. Each sample is to be subjected to only a single impact.</p>	<p>[] no disassembly, no fire [] external temperature see below table</p>
Requirements	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.	

Sample No.	Condition	Voltage Before Test (V)	Maximum Temperature (°C)
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

Supplementary Information:
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 F: 25 Cycles, in fully discharged states

T6	Crush:	Results: <input checked="" type="checkbox"/> Pass [] Fail
Procedure	<p>NOTE: Diameter here refers to the design parameter (for example the diameter of 18 650 cells is 18.0 mm). 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> <p>(a) The applied force reaches 13 kN ± 0.78 kN; Example: The force shall be applied by a hydraulic ram with a 32 mm diameter piston until a pressure of 17 MPa is reached on the hydraulic ram.</p> <p>(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.</p> <p>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.</p>	<p><input checked="" type="checkbox"/> no disassembly, no fire <input checked="" type="checkbox"/> external temperature see below table</p>
Requirements	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.	

Sample No.	Condition	Voltage Before Test (V)	Maximum Temperature (°C)
11	C	3.8	20.6
12	C	3.8	21.0
13	C	3.8	20.1
14	C	3.8	20.8
15	C	3.8	20.3
16	D	3.6	20.5
17	D	3.7	20.7
18	D	3.6	20.7
19	D	3.6	20.4
20	D	3.7	20.7

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F: 25 Cycles, in fully discharged states

T7	Overcharge:	Results: <input type="checkbox"/> Pass <input type="checkbox"/> Fail
Procedure	<p>The charge current shall be twice the manufacturer's recommended maximum continuous charge current. The minimum voltage of the test shall be as follows:</p> <p>(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.</p> <p>(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. Tests are to be conducted at ambient temperature. The duration of the test shall be 24 hours.</p>	<input type="checkbox"/> no disassembly, <input type="checkbox"/> no fire
Requirements	No disassembly and no fire within seven days of the test.	

Sample No.	Condition	Voltage Before Test (V)	Test Voltage (V)	Max. Measured Overcharge Current (mA)	Test time (h)
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-

Supplementary Information:

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 F: 25 Cycles, in fully discharged states

T8	Forced discharge:	Results: <input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail
Procedure	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).	<input checked="" type="checkbox"/> no disassembly, <input checked="" type="checkbox"/> no fire
Requirements	No disassembly and no fire within seven days of the test.	

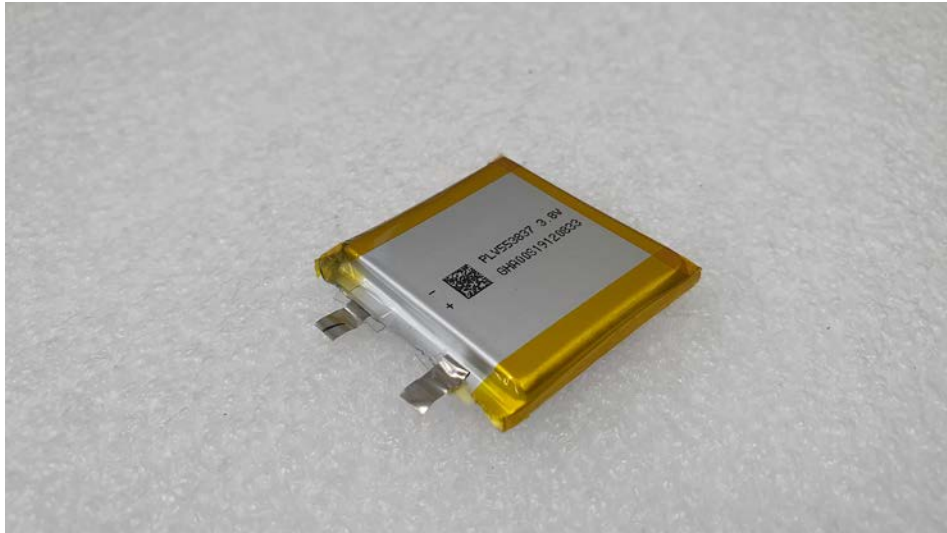
Sample No.	Condition	Voltage Before Test (V)	Test Current (A)	Test time (h)
21	E	3.35	0.5	2.0
22	E	3.34	0.5	2.0
23	E	3.36	0.5	2.0
24	E	3.34	0.5	2.0
25	E	3.36	0.5	2.0
26	E	3.35	0.5	2.0
27	E	3.38	0.5	2.0
28	E	3.34	0.5	2.0
29	E	3.35	0.5	2.0
30	E	3.35	0.5	2.0
31	F	3.33	0.5	2.0
32	F	3.33	0.5	2.0
33	F	3.37	0.5	2.0
34	F	3.31	0.5	2.0
35	F	3.32	0.5	2.0
36	F	3.35	0.5	2.0
37	F	3.32	0.5	2.0
38	F	3.32	0.5	2.0
39	F	3.33	0.5	2.0
40	F	3.35	0.5	2.0

Supplementary Information:

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- D: 25 Cycles, in half charged states
- E: First Cycle, in fully discharged states
- F: 25 Cycles, in fully discharged states

ATTACHMENT : Photographs

<Fig. 1>



<Fig. 2>

