Celxpert(kunshan)Energy Co.,Ltd

Battery Pack UN38.3 Test Report

Customer:Lenovo

Model: L18C4P71

Rating:15.36V/49Wh/3230mAh

51Wh/3325mAh

IssueDate:Oct .05.2018

Approved By	Checked By	Prepared By
Section manager	Section manager	Engineer

1.Standard

UN38.3S-T/SG/AC.10/11/Rev.6/Amend.1

2.Sample Description

Model Name	L18C4P71	Pack Configuration	4S1P
Sample type	Pack 16pcs/Cell 30pcs	Use	NB
Cell Factory/Model	Coslight CA4341B0G 3325mAh	Battery weight	205g
Factory Address	**NO.1111, Hanpu Road, Yushan Town, Kunshan City, Jiangsu Province, P.R. China**	**Laboratory Address:**	**NO.1111, Hanpu Road, Yushan Town, Kunshan City, Jiangsu Province, P.R. China**
Factory Name:	**Celxpert（kunshan）Enengy Co.,Ltd**	**Laboratory Name:**	**CPK LAB**
Factory TEL	**+86-512-57775999**	**Laboratory Tel:**	**+86-512-57775999**
Factory E-mail:	**Frank_Gao@cn.celxpert.com**	**Laboratory E-mail:**	**Frank_Gao@cn.celxpert.com**
Factory Web:	**www. celxpert.com.tw**	**Laboratory Web:**	**www. celxpert.com.tw**
Client Date	2018/09/18	**Completing Data**	2018/10/04

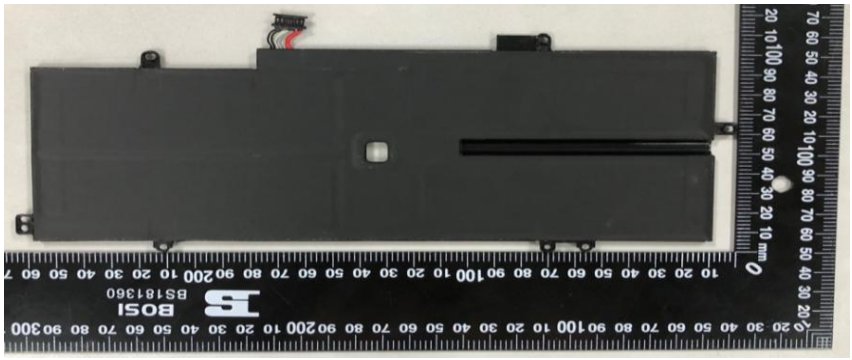
3. Test items and quantity

T.1. ☒ **Altitude simulation**
T.2. ☒ **Thermal test**
T.3. ☒ **Vibration**
T.4. ☒ **Shock**
T.5. ☒ **External short circuit**
T.6. ☒ **Crush /□ Impact**
T.7. ☒ **Overcharge**
T.8. ☒ **Forced discharge**

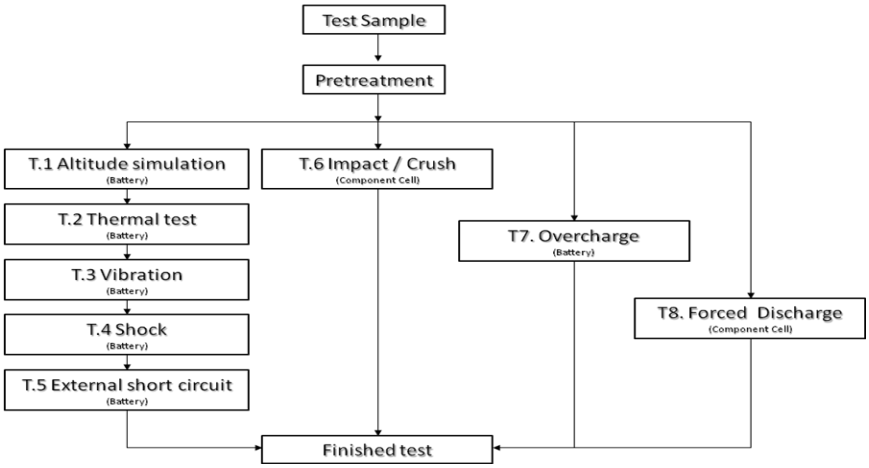
summary table of required test for rechargeable cells and batteries

			T.1	T.2	T.3	T.4	T.5	T.6	T.7	T.8	SUM
Cell		First cycle,50% charged state						5			30
		25th cycle,50% charged state						5			
		First cycle, fully discharged state								10	
		25th cycle, fully discharged state								10	
<12kg	Small batteries	First cycle, fully charged state	4						4		16
		25th cycle, fully charged state	4						4		
>12kg	Large batteries	First cycle, fully charged state	2						2		8
		25th cycle, fully charged state	2						2		

4.Photo of The Sample



5.Test Procedure



6.Test method and verdict

<table>
<tr><th>Clause</th><th>Requirements</th><th>Result</th><th>Verdict</th></tr>
<tr><td rowspan="2">Table 38.3.1</td><td colspan="3">Mass loss means a loss of mass that exceeds the values in table 38.3.1 below</td></tr>
<tr><td colspan="3">Table 38.3.1:Mass loss limit
<table>
<tr><th>Mass M of cell or battery</th><th>Mass loss limit</th></tr>
<tr><td>M<1g</td><td>0.5%</td></tr>
<tr><td>1g≦M≦75g</td><td>0.2%</td></tr>
<tr><td>M>75g</td><td>0.1%</td></tr>
</table></td></tr>
<tr><td rowspan="4">38.3.4.1</td><td colspan="3">T1 :Altitude simulation</td></tr>
<tr><td>This test simulates air transport under low-pressure conditions</td><td rowspan="3">No leakage
no venting
no disassemble
no rupture
no fire.
voltage not less than 90%
Mass loss limit (see table 38.3.1)</td><td rowspan="3">P/F</td></tr>
<tr><td>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℃)</td></tr>
<tr><td>Cells and batteries meet this requirement if there is no leakage, no venting, no disassemble, 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</td></tr>
<tr><td rowspan="4">38.3.4.2</td><td colspan="3">T2:Thermal test</td></tr>
<tr><td>This test assesses cell and battery seal integrity and internal electrical connections. The test is conducted using rapid and extreme temperature changes.</td><td rowspan="3">No leakage
no venting
no disassemble
no rupture
no fire
voltage not less than 90%
Mass loss limit (see table 38.3.1).</td><td rowspan="3">P/F</td></tr>
<tr><td>Test cells and batteries are to be stored for at least six hours at a test temperature equal to 72±2℃, followed by storage for at least six hours at a test temperature equal to －40±2℃. 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℃). For large cells and batteries the duration of exposure to the test temperature extremes should be at least 12 hours.</td></tr>
<tr><td>Cells and batteries meet this requirement if there is no leakage, no venting, no disassemble, 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.</td></tr>
<tr><td rowspan="5">38.3.4.3</td><td colspan="3">T3:Vibration</td></tr>
<tr><td>This test simulates vibration during transport</td><td rowspan="4">No leakage
no venting
no disassemble
no rupture
no fire.
voltage not less than 90%
Mass loss limit (see table 38.3.1)</td><td rowspan="4">P/F</td></tr>
<tr><td>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.
For cells and small batteries: from 7 Hz a peak acceleration of 1gn 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 8gn occurs (approximately 50 Hz). A peak acceleration of 8gn is then maintained until the frequency is increased to 200 Hz.
For large batteries: from 7 Hz to a peak acceleration of 1gn 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 2gn occurs (approximately 25 Hz). A peak acceleration of 2gn is then maintained until the frequency is increased to 200 Hz.</td></tr>
<tr><td>Cells and batteries meet this requirement if there is no leakage, no venting, no disassemble, 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.</td></tr>
</table>

Clause	Requirements	Result	Verdict
38.3.4.4	**T4:Shock**		
	This test assesses the robustness of cells and batteries against cumulative shocks	No leakage no venting no disassemble no rupture no fire. voltage not less than 90% Mass loss limit (see table 38.3.1)	**P/F**
	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 shall be subjected to a half-sine shock of peak acceleration of 150gn and pulse duration of 6 milliseconds. 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. Each cell or battery is subjected to three shocks in the positive direction followed by three shocks in the negative direction of each of three mutually perpendicular mounting positions of the cell for a total of 18 shocks.		
	Cells and batteries meet this requirement if there is no leakage, no venting, no disassemble, 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.		
38.3.4.5	**T5:External short circuit**		
	This test simulates an external short circuit	no disassemble no rupture no fire. Packs exterior peak temperature <170℃ Mass loss limit (see table 38.3.1)	**P/F**
	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℃, 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℃ 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.		
	Cells and batteries meet this requirement if their external temperature does not exceed 170℃ and there is no disassemble, no rupture and no fire within six hours of this test.		

Clause	Requirements	Result	Verdict
38.3.4.6	**T6: Crush/ Impact**		
	These tests simulate mechanical abuse from an impact or crush that may result in an internal short circuit.	no disassemble no rupture no fire. not exceed 170℃ Mass loss limit (see table 38.3.1)	P/F
	Impact applicable to cylindrical cells not less than 18.00 in diameter.		
	The test sample cell or component cell is to be placed on a flat smooth surface. A 15.8mm±0.1mm diameter, at least 6cm 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 samples 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 centre of the test samples. Each sample is to be subjected to only a single impact.		
	Crush applicable to prismatic, pouch, coin/button cells and cylindrical cells less than 18mm in diameter.		
	A cell or component cell is to be crushed between two flat surfaces. The crushing is to be gradual with a speed of approximately 1.5cm/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 13kN±0.78kN; 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 (b) The voltage of the cell drops by at least 100mV; or (c) The cell is deformed by 50% or more of its original thickness. Once the maximum pressure has been obtained, the voltage drops by 100mV 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 Samples 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.		
	Cells and component cells meet this requirement if their external temperature does not exceed 170℃ and there is no disassemble and no fire during the test and within six hours after this test.		

Clause	Requirements	Result	Verdict
38.3.4.7	**T7:Ovecharge**		
	This test evaluates the ability of a rechargeable battery or a single cell rechargeable battery to withstand an overcharge condition	No disassemble no fire. Mass loss limit (see table 38.3.1)	P/F
	The charge current shall be twice the manufacturer's recommended maximum continuous charge current. 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. Tests are to be conducted at ambient temperature; the duration of the test shall be 24 hours		
	Rechargeable batteries meet this requirement if there is no disassemble and no fire during the test and within seven days after the test.		
38.3.4.8	**T8:Forced discharge**		
	This test evaluates the ability of a primary or a rechargeable cell to withstand a forced discharge condition	no disassembly no fire Mass loss limit (see table 38.3.1)	P/F
	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).		
	Primary or rechargeable cells meet this requirement if there is no disassembly and no fire during the test and within seven days after the test.		

7.Test Data

38.3.4.1	T1.Altitude simulation
Test Equipment	Digital Meter : Q153 , Vacuum Oven : Q0443 , Scales : Q090
Test Period	Start: 2018/09/18 End:2018/09/18

Altitude Simulation Test on Charged Packs

No.	Before		After		voltage residue	mass loss	other event
	OCV (V)	Weight (g)	OCV (V)	Weight (g)	Volt (%)	Weight (%)	
1	17.003	205.36	17.001	205.36	99.99%	0.00%	O
2	17.043	205.46	17.042	205.46	99.99%	0.00%	O
3	17.021	205.18	17.019	205.18	99.99%	0.00%	O
4	17.053	205.68	17.050	205.68	99.98%	0.00%	O
5	17.016	205.76	17.012	205.76	99.98%	0.00%	O
6	17.035	205.49	17.033	205.49	99.99%	0.00%	O
7	17.045	205.31	17.043	205.30	99.99%	0.00%	O
8	17.056	205.82	17.055	205.82	99.99%	0.00%	O

Note: L-Leakage ; V-Venting ; D-Disassembly ; R-Rupture ; F-Fire
O-No Leakage , No Venting , No Disassembly , No Rupture , No Fire

38.3.4.2	T2.Thermal test
Test Equipment	Digital Meter : Q153 , Programmable Thermal Tester : Q0446 , Scales : Q090
Test Period	Start:2018/09/19 End:2018/09/26

Thermal Test on Charged Packs

No.	Before		After		voltage residue	mass loss	other event
	OCV (V)	Weight (g)	OCV (V)	Weight (g)	Volt (%)	Weight (%)	
1	17.001	205.36	16.937	205.34	99.62%	0.01%	O
2	17.042	205.46	16.991	205.44	99.70%	0.01%	O
3	17.019	205.18	16.950	205.17	99.59%	0.00%	O
4	17.050	205.68	16.989	205.67	99.64%	0.00%	O
5	17.012	205.76	16.945	205.75	99.61%	0.00%	O
6	17.033	205.49	16.962	205.48	99.58%	0.00%	O
7	17.043	205.30	16.974	205.29	99.60%	0.01%	O
8	17.055	205.82	17.004	205.80	99.70%	0.01%	O

Note: L-Leakage ; V-Venting ; D-Disassembly ; R-Rupture ; F-Fire
O-No Leakage , No Venting , No Disassembly , No Rupture , No Fire

38.3.4.3	T3.Vibrationt
Test Equipment	Digital Meter : Q153 , Vibration Tester : Q300 , Scales : Q153
Test Period	Start: 2018/09/27 End:2018/09/28

Vibration Test on Charged Packs

No.	Before		After		voltage residue	mass loss	other event
	OCV (V)	Weight (g)	OCV (V)	Weight (g)	Volt (%)	Weight (%)	
1	16.937	205.34	16.933	205.34	99.98%	0.00%	O
2	16.991	205.44	16.987	205.44	99.98%	0.00%	O
3	16.950	205.17	16.947	205.16	99.98%	0.00%	O
4	16.989	205.67	16.985	205.66	99.98%	0.00%	O
5	16.945	205.75	16.941	205.74	99.98%	0.00%	O
6	16.962	205.48	16.959	205.47	99.98%	0.00%	O
7	16.974	205.29	16.973	205.29	99.99%	0.00%	O
8	17.004	205.80	17.002	205.80	99.99%	0.00%	O

Note: L-Leakage ; V-Venting ; D-Disassembly ; R-Rupture ; F-Fire
O-No Leakage , No Venting , No Disassembly , No Rupture , No Fire

38.3.4.4	T.4 Shock
Test Equipment	Digital Meter : Q153 , Shock Tester : Q154 , Scales : Q090
Test Period	Start: 2018/10/02 End:2018/10/02

Shock Test on Charged Packs

No.	Before		After		voltage residue	mass loss	other event
	OCV (V)	Weight (g)	OCV (V)	Weight (g)	Volt (%)	Weight (%)	
1	16.933	205.34	16.929	205.33	99.98%	0.00%	O
2	16.987	205.44	16.985	205.43	99.99%	0.00%	O
3	16.947	205.16	16.943	205.15	99.98%	0.00%	O
4	16.985	205.66	16.982	205.65	99.98%	0.00%	O
5	16.941	205.74	16.939	205.73	99.99%	0.00%	O
6	16.959	205.47	16.955	205.46	99.98%	0.00%	O
7	16.973	205.29	16.971	205.28	99.99%	0.00%	O
8	17.002	205.80	16.999	205.79	99.98%	0.00%	O

Note: L-Leakage ; V-Venting ; D-Disassembly ; R-Rupture ; F-Fire
O-No Leakage , No Venting , No Disassembly , No Rupture , No Fire

38.3.4.5	T.5 Short circuit
Test Equipment	Digital Meter: Q153 , Data Logger : Q075 , Oven: Q171
Test Period	Start:2018/10/03 End:2018/10/04

Short Circuit Test on Charged Packs

No.	Max. Temp.(℃)	Other event
1	55.13	O
2	55.24	O
3	55.86	O
4	55.37	O
5	55.49	O
6	55.82	O
7	55.19	O
8	55.34	O

Note: D-Disassembly ; R-Rupture ; F-Fire

O- No Disassembly , No Rupture , No Fire

38.3.4.6	T.6 Crush /Impact
Test Equipment	Digital Meter: Q153 Data Logger: Q152 Impact tester/Crush tester: Q437/ Q231
Test Period	Start: 2018/09/19 End:2018/09/19

Crush Test on 50% Charged Cells

No.	Max. Temp.(℃)	Other event	No.	Max. Temp.(℃)	Other event
1	20.36	O	6	20.45	O
2	20.45	O	7	21.36	O
3	21.54	O	8	21.48	O
4	21.56	O	9	20.59	O
5	20.85	O	10	21.74	O

Note: D-Disassembly ; R-Rupture ; F-Fire

O- No Disassembly , No Rupture , No Fire

38.3.4.7	T 7 Ovecharge
Test Equipment	Digital Meter: Q153 Data Logger: Q078 Power Supply unit : Q148/Q150/Q0236
Test Period	Start:2018/09/18 End:2018/09/27

Overcharge Test on Charged Packs

No.	Charge Voltage(V)	Charge Current(A)	Max. Temp.(°C)	Other event
11	22.0 V	6.65	20.36	O
12			20.35	O
13			21.45	O
14			21.85	O
15			20.69	O
16			20.58	O
17			21.47	O
18			21.52	O

Note: D-Disassembly ; F-Fire / O-No Disassembly ,No Fire

38.3.4.8	T8 Forced discharge
Test Equipment	Digital Meter: Q153 Data logger: Q160 Power Supply unit : Q0474/Q0475/Q0476
Test Period	Start:2018/10/02 End:2018/10/03

Forced discharge are first cycle in fully discharged			Forced discharge are after 25 cycles ending in fully discharged		
No.	Max. Temp.(°C)	Other event	No.	Max. Temp.(°C)	Other event
11	52.36	O	21	51.36	O
12	48.58	O	22	49.36	O
13	42.36	O	23	52.35	O
14	53.47	O	24	54.28	O
15	56.15	O	25	56.48	O
16	46.34	O	26	48.36	O
17	47.22	O	27	49.26	O
18	41.86	O	28	47.23	O
19	52.34	O	29	53.16	O
20	55.16	O	30	54.89	O

Note:D-Disassembly ; F-Fire / O-No Disassembly , No Fire