

Celxpert Energy(KunShan)Corporation

Battery Pack

UN38.3 Test Report

Customer:	Lenovo
Model:	L18C3P72
Rating:	11.52V
Capacity:	Rated:4250mAh/49Wh
	Typical:4380mAh/51Wh
Issue Date:	May.31.2019



1.UN38.3 Lithium Battery Test Summary

Edition of UN Manual of Tests and Criteria Used		ST/SG/AC.10/11/Rev.6/Amend.1	
Customer	Lenovo	Sample type	Pack 16pcs/Cell 30pcs
Model Name	L18C3P72	Pack Configuration	3S1P
Rating	11.52V	Battery weight	201g
Cell Factory/Model	BYD CSL467973 4380mAh	Physical Description	Prismatic
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) Energy.,Ltd	Laboratory Name	CPK LAB
Factory Tel	+86-512-57775999	Laboratory Tel	+86-512-57775999
Factory E-mail	Frank_Gao@cn.celxpert.com	Lab E-mail	Frank_Gao@cn.celxpert.com
Factory Web	www.celxpert.com.tw	Laboratory Web	www.celxpert.com.tw
Client Date	2019-05-14	Completing Data	2019-05-30
Item	Test Item		Test Result(Pass/Fail)
38.3.4.1 T1	Altitude simulation		Pass
38.3.4.1 T2	Thermal		Pass
38.3.4.1 T3	Vibration		Pass
38.3.4.1 T4	Shock		Pass
38.3.4.1 T5	External Short Circuit		Pass
38.3.4.1 T6	Crush		Pass
38.3.4.1 T7	Overcharge		Pass
38.3.4.1 T8	Forced Discharge		Pass

Approved By	Checked By	Prepared By
高海洋	高海洋	单秋梅

2.Test items and quantity

T.1. ☒ Altitude simulation

T.5. ☒ External short circuit

T.2. ☒ Thermal

T.6. ☒Crush / ☐Impact

T.3. ☒ Vibration

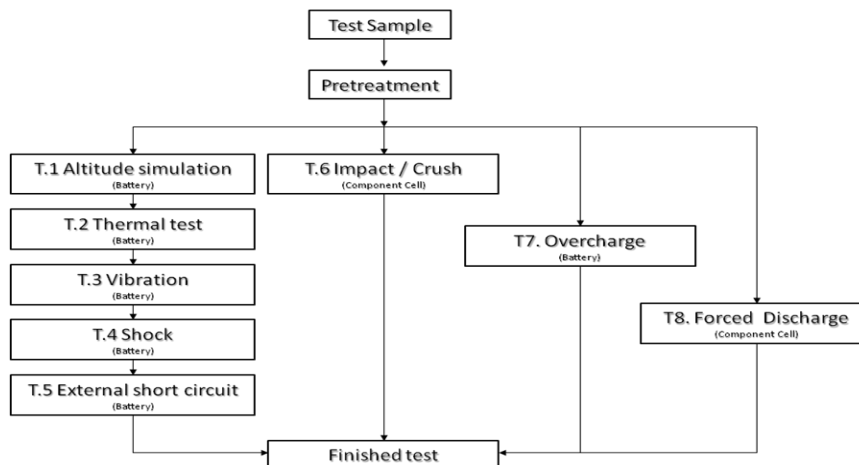
T.7. ☒ Overcharge

T.4. ☒ Shock

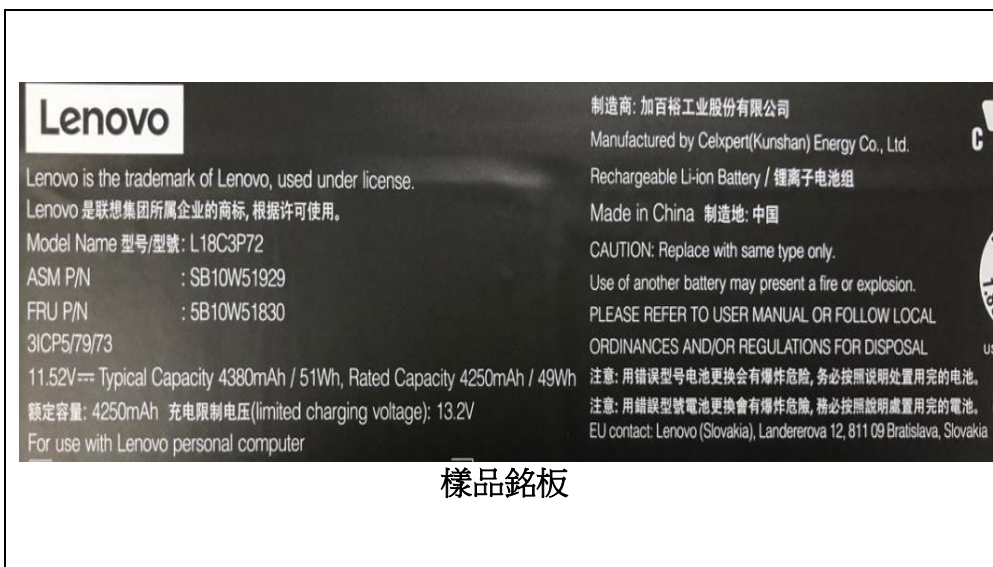
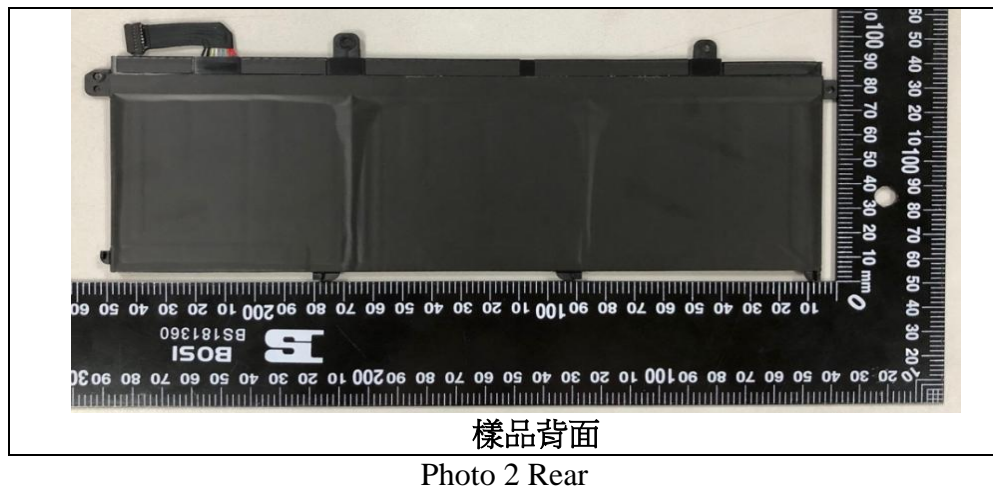
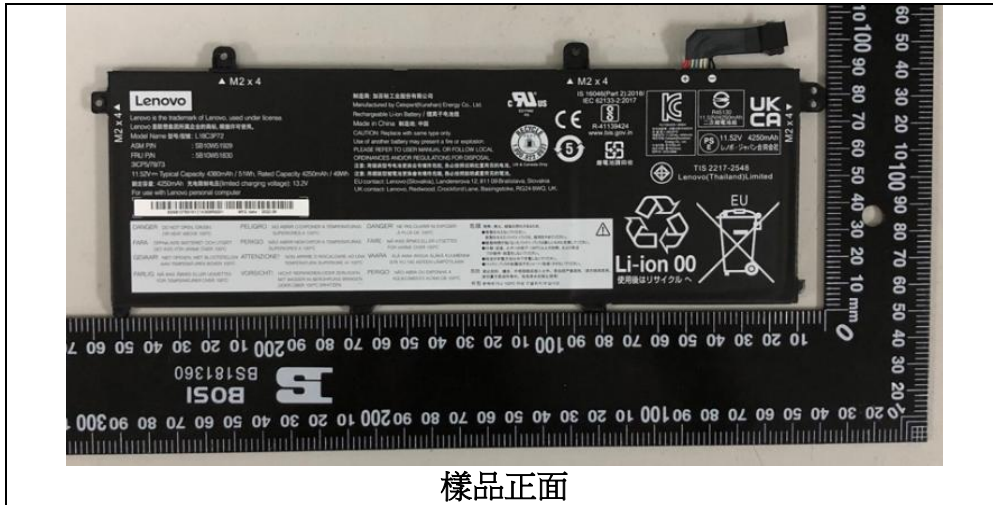
T.8. ☒ Forced Discharge

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		

3.Test Procedure



4.Photo of The Sample



5.Test method and verdict

Clause	Requirements	Verdict							
Table 38.3.1	Mass loss means a loss of mass that exceeds the values in table 38.3.1 below								
	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>		Mass M of cell or battery	Mass loss limit	M<1g	0.5%	1g ≤ M ≤ 75g	0.2%	M>75g
Mass M of cell or battery	Mass loss limit								
M<1g	0.5%								
1g ≤ M ≤ 75g	0.2%								
M>75g	0.1%								
38.3.4.1	T1 :Altitude simulation								
	This test simulates air transport under low-pressure conditions	No leakage no venting no disassemble no rupture no fire. voltage not less than 90% Mass loss limit (see table 38.3.1)							
	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℃)								
	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								
38.3.4.2	T2:Thermal test								
	This test assesses cell and battery seal integrity and internal electrical connections. The test is conducted using rapid and extreme temperature changes.	No leakage no venting no disassemble no rupture no fire voltage not less than 90% Mass loss limit (see table 38.3.1).							
	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.								
	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.								
38.3.4.3	T3:Vibration								
	This test simulates vibration during transport	No leakage no venting no disassemble no rupture no fire. voltage not less than 90% Mass loss limit (see table 38.3.1)							
	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.								
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.									

Clause	Requirements	Verdict
38.3.4.4	T4:Shock	No leakage no venting no disassemble no rupture no fire. voltage not less than 90% Mass loss limit (see table 38.3.1)
	This test assesses the robustness of cells and batteries against cumulative shocks	
	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.	
38.3.4.5	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.	no disassemble no rupture no fire. Packs exterior peak temperature <170°C Mass loss limit (see table 38.3.1)
	T5:External short circuit	
	This test simulates an external short circuit	
	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.	
	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.	
38.3.4.5	Cells and batteries meet this requirement if their external temperature does not exceed 170°C and there is no disassemble, no rupture and no fire within six hours of this test.	

Clause	Requirements	Verdict
38.3.4.6	T6: Crush/ Impact	no disassemble no rupture no fire. not exceed 170°C Mass loss limit (see table 38.3.1)
	These tests simulate mechanical abuse from an impact or crush that may result in an internal short circuit.	
	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°C and there is no disassemble and no fire during the test and within six hours after this test.	

Clause	Requirements	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)
	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)
	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.	

6.Test Data

38.3.4.1	T1.Altitude simulation						
Test Equipment	Digital Meter :Q-153		, Vacuum Oven :Q-0443		Scales :Q-090		
Test Period	Start: 2019/05/14		End:2019/05/14				
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	12.689	201.56	12.677	201.56	99.91%	0.00%	O
2	12.718	201.46	12.707	201.46	99.91%	0.00%	O
3	12.724	201.86	12.711	201.86	99.90%	0.00%	O
4	12.723	201.47	12.709	201.47	99.89%	0.00%	O
5	12.694	201.37	12.682	201.37	99.91%	0.00%	O
6	12.709	201.49	12.694	201.49	99.88%	0.00%	O
7	12.697	201.53	12.685	201.52	99.91%	0.00%	O
8	12.726	201.73	12.715	201.73	99.91%	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 :Q-153		, Programmable Thermal Tester:Q-0446		Scales:Q-090		
Test Period	Start:2019/05/15		End:2019/05/21				
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	12.677	201.56	12.613	201.51	99.50%	0.02%	O
2	12.707	201.46	12.656	201.41	99.60%	0.02%	O
3	12.711	201.86	12.642	201.83	99.46%	0.01%	O
4	12.709	201.47	12.648	201.42	99.52%	0.02%	O
5	12.682	201.37	12.615	201.33	99.47%	0.02%	O
6	12.694	201.49	12.623	201.44	99.44%	0.02%	O
7	12.685	201.52	12.616	201.50	99.46%	0.01%	O
8	12.715	201.73	12.664	201.70	99.60%	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 :Q-153		Vibration Tester :Q-300		Scales:Q-090		
Test Period	Start: 2019/05/23		End:2019/05/24				
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	12.613	201.51	12.599	201.50	99.89%	0.01%	O
2	12.656	201.41	12.641	201.38	99.88%	0.01%	O
3	12.642	201.83	12.625	201.80	99.87%	0.01%	O
4	12.648	201.42	12.632	201.40	99.87%	0.01%	O
5	12.615	201.33	12.601	201.32	99.89%	0.01%	O
6	12.623	201.44	12.610	201.42	99.90%	0.01%	O
7	12.616	201.50	12.605	201.47	99.91%	0.01%	O
8	12.664	201.70	12.649	201.67	99.88%	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							
38.3.4.4	T.4 Shock						
Test Equipment	Digital Meter: Q-153		Shock Tester:Q-154		Scales:Q-090		
Test Period	Start: 2019/05/27		End:2019/05/27				
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	12.599	201.50	12.585	201.48	99.89%	0.01%	O
2	12.641	201.38	12.629	201.35	99.91%	0.01%	O
3	12.625	201.80	12.611	201.79	99.89%	0.01%	O
4	12.632	201.40	12.619	201.37	99.90%	0.02%	O
5	12.601	201.32	12.589	201.28	99.90%	0.02%	O
6	12.610	201.42	12.596	201.38	99.89%	0.02%	O
7	12.605	201.47	12.593	201.46	99.90%	0.01%	O
8	12.649	201.67	12.636	201.65	99.90%	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							

38.3.4.5	T.5 External Short circuit		
Test Equipment	Digital Meter:Q-153 Data Logger:Q-075 Oven:Q-171		
Test Period	Start: 2019/05/29		

38.3.4.7	T 7 Ovecharge				
Test Equipment	Digital Meter:Q-153 Data Logger:Q-078 Power Supply unit:Q-148/Q-150/Q-0236				
Test Period	Start: 2019/05/16				