

# ***Battery Pack Test Report*** ***UN38.3***

Customer: Lenovo

Pack Model: L15C3A01

Nominal voltage: 10.8V

Nominal capacity: 24Wh

Configuration: 3S1P

Customer P/N: 5B10L04161

Celxpert P/N: 921300079

Cell Type: LG INR18650S3 2200mAh

Jan. 24 . 2018

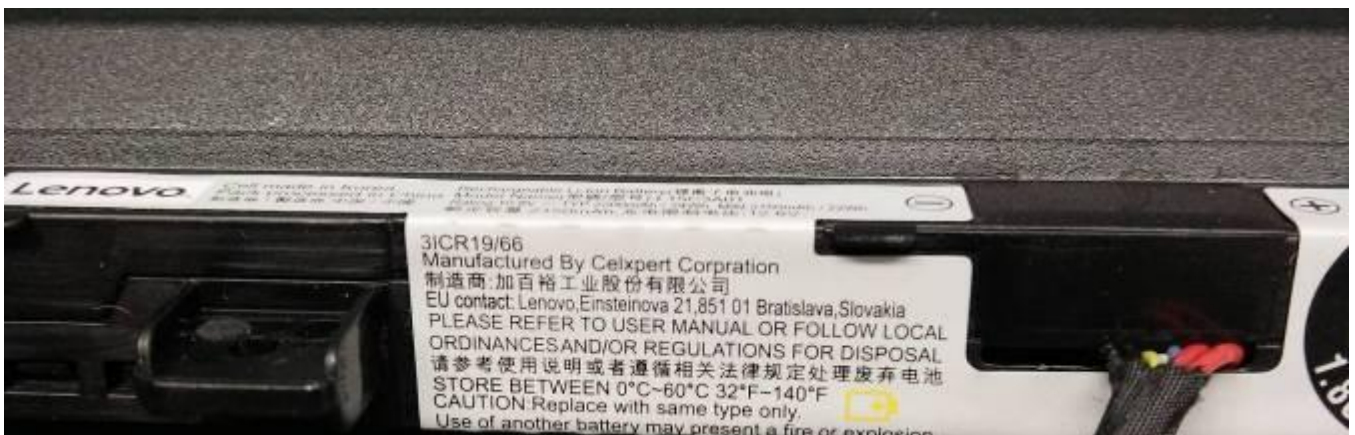
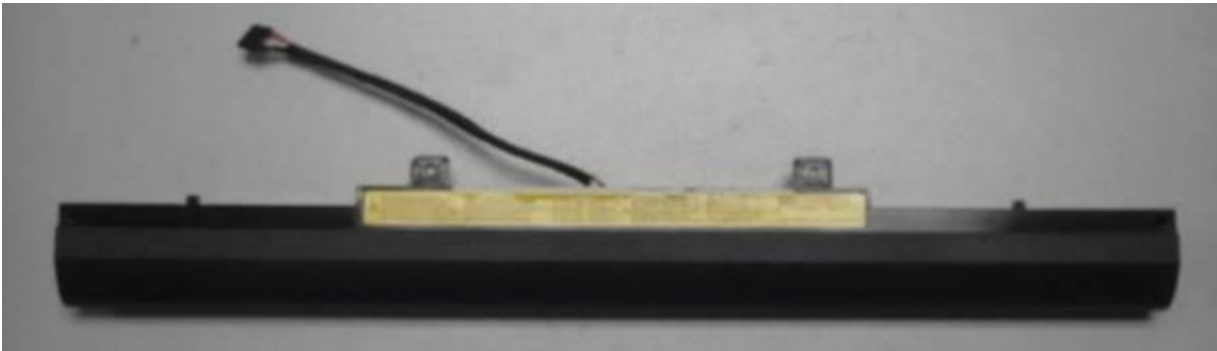
Approved by \_\_\_\_\_

Reviewed by \_\_\_\_\_

Prepared by \_\_\_\_\_



Figure photo of the pack



# 1. UN38.3 Test Report

Test Period	2015/12/15~2016/01/12		Test Spec.	ST/SG/AC.10/11/Rev.5 Amend.2	
Parts Name	Battery Pack	Application	NB	Quantity	Pack 16PCS/Cell 25pcs

## 1.1 Test Summary

Item	Test Item	Test Result	Details
T1	Altitude simulation test (UN38.3-1)	Pass	Page 9
T2	Thermal test (UN38.3-2)	Pass	Page 10
T3	Vibration test (UN38.3-3)	Pass	Page 11
T4	Shock test (UN38.3-4)	Pass	Page 12
T5	Short Circuit test (UN38.3-5)	Pass	Page 13
T6	Crush Test (UN38.3-6)	Pass	Page 13
T7	Overcharge test (UN38.3-7)	Pass	Page 14
T8	Forced discharge test (UN38.3-8)	Pass	Page 15

**The battery pack passes UN38.3 test.**

**1.2 Test sample list**

No.	Pack S/N	Test item	No.	Cell Num.	Test item
1	Sample No:1/16	38.3.1~5	1	LG INR18650 S3 2200mAh	38.3.6
2	Sample No:2/16	38.3.1~5	2	LG INR18650 S3 2200mAh	38.3.6
3	Sample No:3/16	38.3.1~5	3	LG INR18650 S3 2200mAh	38.3.6
4	Sample No:4/16	38.3.1~5	4	LG INR18650 S3 2200mAh	38.3.6
5	Sample No:5/16	38.3.1~5	5	LG INR18650 S3 2200mAh	38.3.6
6	Sample No:6/16	38.3.1~5	6	LG INR18650 S3 2200mAh	38.3.8
7	Sample No:7/16	38.3.1~5	7	LG INR18650 S3 2200mAh	38.3.8
8	Sample No:8/16	38.3.1~5	8	LG INR18650 S3 2200mAh	38.3.8
9	Sample No:9/16	38.3.7	9	LG INR18650 S3 2200mAh	38.3.8
10	Sample No:10/16	38.3.7	10	LG INR18650 S3 2200mAh	38.3.8
11	Sample No:11/16	38.3.7	11	LG INR18650 S3 2200mAh	38.3.8
12	Sample No:12/16	38.3.7	12	LG INR18650 S3 2200mAh	38.3.8
13	Sample No:13/16	38.3.7	13	LG INR18650 S3 2200mAh	38.3.8
14	Sample No:14/16	38.3.7	14	LG INR18650 S3 2200mAh	38.3.8
15	Sample No:15/16	38.3.7	15	LG INR18650 S3 2200mAh	38.3.8
16	Sample No:16/16	38.3.7	16	LG INR18650 S3 2200mAh	38.3.8
			17	LG INR18650 S3 2200mAh	38.3.8
			18	LG INR18650 S3 2200mAh	38.3.8
			19	LG INR18650 S3 2200mAh	38.3.8
			20	LG INR18650 S3 2200mAh	38.3.8
			21	LG INR18650 S3 2200mAh	38.3.8
			22	LG INR18650 S3 2200mAh	38.3.8
			23	LG INR18650 S3 2200mAh	38.3.8
			24	LG INR18650 S3 2200mAh	38.3.8
			25	LG INR18650 S3 2200mAh	38.3.8

**1.3 Test result**

Item	Test Item	Test specification	Judge criteria	Sample(s)				
T1	Altitude Simulation (UN38.3-1)	1-1. 4 batteries are standard charged. 4 batteries are 1C cycled 50 times, ending in fully charged state. All batteries weight is measured. The charged batteries voltage are measured and recorded. 1-2. Batteries shall be stored at a pressure of 11.6Kpa or less for at least six hours at ambient temperature 20+/-5 °C. 1-3. Vacuum is released. All cells weight is measured. The charged cell voltage are measured and recorded.	No mass loss (<0.1%), no leakage, no venting, no disassembly, no rupture and no fire. Battery voltage drop < 10%.	4 packs are standard charged (Pack#1~4) 4 packs 50 cycled ending in fully charged states (Pack#5~8)				
Test Period	Start: 2015/12/15                      End:2015/12/15							
Test Equipment	數位電表 Q153, 電子天平 Q090, 真空烘箱 Q146							
Major Problem	-							
Warning Point	-							
Recommendation	The battery packs pass the test.							
Raw Data	<b>Altitude Simulation Test on Charged Packs</b>							
	No.	Before		After		voltage residue	mass loss	other event
		OCV (V)	Weight (g)	OCV (V)	Weight (g)	Volt (%)	Weight (%)	
	1	12.523	171.26	12.493	171.25	99.76%	0.00%	O
	2	12.520	171.13	12.519	171.12	99.99%	0.00%	O
	3	12.521	171.09	12.520	171.08	99.99%	0.00%	O
	4	12.522	171.22	12.519	171.21	99.98%	0.00%	O
	5	12.532	170.73	12.530	170.72	99.98%	0.01%	O
	6	12.531	170.46	12.528	170.45	99.98%	0.01%	O
	7	12.535	170.84	12.534	170.83	99.99%	0.01%	O
8	12.528	170.92	12.524	170.91	99.97%	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								

Item	Test Item	Test specification	Judge criteria	Sample(s)					
T2	Thermal test (UN38.3-2)	2-1. Packs are stored for 6 hours at 72±2°C, followed by storage for 6 hours at -40±2°C. The maximum time interval between test temperature extremes is 30 minutes. 2-2.Repeat 2-1 for 10 times. Then store the packs at ambient for 24 hours. All packs weight are measured. The charged battery voltage are measured and recorded.	No mass loss (<0.1%), no leakage, no venting, no disassembly, no rupture and no fire. Battery voltage drop < 10%.	4 packs are standard charged (Pack#1~4) 4 packs 50 cycled ending in fully charged states (Pack#5~8)					
Test Period		Start: 2015/12/16                      End:2015/12/22							
Test Equipment		數位電表 Q153, 電子天平 Q090, 冷熱衝擊機 Q336							
Major Problem		-							
Warning Point		-							
Recommendation		The packs pass the test.							
Raw Data		<b>Thermal Test on Charged Packs</b>							
		No.	Before		After		voltage residue	mass loss	other event
			OCV (V)	Weight (g)	OCV (V)	Weight (g)	Volt (%)	Weight (%)	
		1	12.493	171.25	12.424	171.20	99.45%	0.03%	O
		2	12.519	171.12	12.443	171.05	99.39%	0.04%	O
		3	12.520	171.08	12.445	171.01	99.40%	0.04%	O
		4	12.519	171.21	12.445	171.16	99.41%	0.03%	O
		5	12.530	170.72	12.459	170.68	99.43%	0.02%	O
		6	12.528	170.45	12.453	170.38	99.40%	0.04%	O
		7	12.534	170.83	12.466	170.79	99.46%	0.03%	O
8	12.524	170.91	12.449	170.85	99.40%	0.04%	O		
Note: L-Leakage ; V-Venting ; D-Disassembly ; R-Rupture ; F-Fire									
O-No Leakage , No Venting , No Disassembly , No Rupture , No Fire									

Item	Test Item	Test specification	Judge criteria	Sample(s)				
T3	Vibration test (UN38.3-3)	3-1. Packs are firmly secured to the platform of the vibration machine without distorting the packs in such a manner as to faithfully transmit the vibration. The vibration shall be a sinusoidal waveform with a logarithmic sweep between 7 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 3 mutually perpendicular to the terminal face. 3-2. The logarithmic frequency sweep is as follows: 7-18 Hz → 1gn 18-50 Hz → 0.8mm amplitude 50-200 Hz → 8gn 3-3. All packs weight are measured. The charged packs voltage are measured and recorded.	No mass loss (<0.1%), no leakage, no venting, no disassembly, no rupture and no fire. Battery voltage drop < 10%.	4 packs are standard charged (Pack#1~4) 4 packs 50 cycled ending in fully charged states (Pack#5~8)				
Test Period	Start: 2015/12/24      End:2015/12/25							
Test Equipment	數位電表 Q153, 電子天平 Q090, 振動測試機 Q300							
Major Problem	-							
Warning Point	-							
Recommendation	The packs pass the test.							
Raw Data	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	12.424	171.20	12.417	171.17	99.94%	0.02%	O
	2	12.443	171.05	12.436	171.03	99.94%	0.01%	O
	3	12.445	171.01	12.437	170.99	99.94%	0.02%	O
	4	12.445	171.16	12.437	171.14	99.94%	0.01%	O
	5	12.459	170.68	12.451	170.66	99.94%	0.01%	O
	6	12.453	170.38	12.447	170.35	99.95%	0.02%	O
	7	12.466	170.79	12.457	170.76	99.93%	0.02%	O
8	12.449	170.85	12.442	170.82	99.94%	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								

Item	Test Item	Test specification	Judge criteria	Sample(s)				
T4	Shock test (UN38.3-4)	4-1. Packs shall be secured to the testing machine by means of a rigid mount, which will support all mounting surfaces. 4-2. Packs shall be subjected to a half-sine shock of peak acceleration 150gn and pulse duration of 6 milliseconds. Each pack shall be subjected to 3 shocks in the positive direction followed by three shocks in the negative direction of three mutually perpendicularly mounting positions of the pack for a total of 18 shocks. 4-3. All batteries weight are measured. The charged cell voltage are measured and recorded.	No mass loss (<0.1%), no leakage, no venting, no disassembly, no rupture and no fire. Battery voltage drop < 10%.	4 packs are standard charged (Pack#1~4) 4 packs 50 cycled ending in fully charged states (Pack#5~8)				
Test Period	Start: 2015/12/30                      End:2015/12/30							
Test Equipment	數位電表 Q153, 電子天平 Q090, 衝擊測試機 Q154							
Major Problem	-							
Warning Point	-							
Recommendation	The packs pass the test.							
Raw Data	<b>Shock Test on Charged Packs</b>							
	No.	Before		After		voltage residue	mass loss	other event
		OCV (V)	Weight (g)	OCV (V)	Weight (g)	Volt (%)	Weight (%)	
	1	12.417	171.17	12.411	171.16	99.95%	0.00%	O
	2	12.436	171.03	12.431	171.02	99.96%	0.00%	O
	3	12.437	170.99	12.432	170.98	99.96%	0.00%	O
	4	12.437	171.14	12.431	171.13	99.95%	0.00%	O
	5	12.451	170.66	12.447	170.65	99.97%	0.00%	O
	6	12.447	170.35	12.440	170.35	99.94%	0.00%	O
	7	12.457	170.76	12.451	170.75	99.95%	0.00%	O
8	12.442	170.82	12.437	170.82	99.96%	0.00%	O	



Item	Test Item	Test specification	Judge criteria	Sample(s)
T5	Short Circuit Test (UN38.3-5)	5-1.Packs are placed in to a 55±2°C oven, and exterior packs temperature are monitored 5-2.When packs exterior reach 55±2°C, they are shorted by connecting terminals with a copper wire of resistance less than 100m Ohm. 5-4. The short was continued for more than 1hour or the cell temperature return to 55°C. The packs are observed for a further 6 hours.	No rupture, no disassembly, no explosion, no fire, no smoke. Packs exterior peak temperature <170°C.	4 packs are standard charged (Pack#1~4) 4 packs 50 cycled ending in fully charged states (Pack#5~8)
Test Period		Start: 2016/01/08 End:2016/01/12		
Test Equipment		數位電表 Q153, 資料收集器 Q075, 烘箱 Q171		
Recommendation		The packs pass the test.		
Raw Data		<b>Short Circuit Test on Charged Packs</b>		
		No.	Max. Temp.(°C)	Other event
		1	55.45	O
		2	55.38	O
		3	55.49	O
		4	55.61	O
		5	55.95	O
		6	55.68	O
		7	55.77	O
		8	55.86	O
		Note: D-Disassembly ; R-Rupture ; F-Fire		
		O- No Disassembly , No Rupture , No Fire		
Item	Test Item	Test specification	Judge criteria	Sample(s)
T6	Crush test/ Impact test (UN38.3-6)	6-1.Cell's diameter > 20mm, Execution impact test. (A 9.1 Kg mass is to be dropped from a height of 61±2.5cm onto the sample.)  6-2.Cell's diameter < 20mm, Execution crush test (The cells are crushed with a 13 KN with the crush tester. Once the force is obtained it is to be released.)	External temperature of cell does not exceed 170°C and there is no disassembly and no fire within 6 hours of the test.	5 cells are 50% charged (Cell #1~5)
Test Period		Start: 2015/12/23 End: 2015/12/23		
Test Equipment		數位電表 Q153, 資料收集器 Q152, 擠壓試驗機 Q437/撞擊測試機 Q231		
Recommendation		The Cells pass the test.		
Raw Data		<b>Impact/Cursh Test on 50% Charged Cells</b>		
		No.	Max. Temp.(°C)	Other event
		1	25.5	O
		2	25.1	O
		3	25.4	O
		4	24.7	O
		5	25.0	O
		Note: D-Disassembly ; F-Fire / O-No Disassembly , No Fire		

Item	Test Item	Test specification	Judge criteria	Sample(s)
T7	Overcharge test (UN38.3-7)	7-1. The charge current shall be twice the Spec's recommended maximum continuous charge current. 7-2. The minimum voltage of the test shall be as follows: (a) When the Spec'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 Spec's recommended charge voltage is more than 18V, the minimum voltage of the test shall be 1.2 times the maximum charge voltage. 7-3. Tests are to be conducted at ambient temperature. The duration of the test shall be 24 hours.	No disassembly, no fire within seven days after the test.	4 packs are fully charged (Pack#9~12) 4 packs are 50 times cycled ending in fully charged state (Pack #13~16)
Test Period		Start: 2016/01/07      End:2016/01/11		
Test Equipment		數位電表 Q153, 資料收集器 Q078, 電源供應器 Q148/Q149/Q150		
Major Problem		-		
Warning Point		-		
Recommendation		The packs pass the test.		
Raw Data	<b>Overcharge Test on Charged Packs</b>			
	No.	Charge Voltage(V)	Charge Current(A)	Max. Temp.(°C)
	9	22.0 V	2.15A	26.22
	10			25.63
	11			26.03
	12			25.37
	13			25.73
	14			25.87
	15			27.01
	16			25.96
Note: D-Disassembly ; F-Fire / O-No Disassembly ,No Fire				

Item	Test Item	Test specification	Judge criteria	Sample(s)		
T8	Forced discharge test (UN38.3-8)	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.	No disassembly, no fire within seven days after the test.	10 cells are first cycle in fully discharged states (Pack#6~15) 10 cells are after 50 cycles ending in fully discharged states (Pack #16~25)		
Test Period	Start: 2015/12/24                      End:2015/12/25					
Test Equipment	數位電表 Q153, 資料收集器 Q160, 電源供應器 Q147/Q236/Q237					
Major Problem	-					
Warning Point	-					
Recommendation	The packs pass the test.					
Raw Data	Forced discharge are first cycle in fully discharged		Forced discharge are after 50 cycles ending in fully discharged			
	No.	Max. Temp.(°C)	Other event	No.	Max. Temp.(°C)	Other event
	6	74.71	0	16	70.87	0
	7	76.00	0	17	71.29	0
	8	70.51	0	18	50.67	0
	9	69.30	0	19	60.98	0
	10	69.72	0	20	55.12	0
	11	49.10	0	21	50.36	0
	12	59.41	0	22	47.60	0
	13	56.35	0	23	46.01	0
	14	72.58	0	24	46.92	0
	15	61.11	0	25	58.41	0
	Note:D-Disassembly ; F-Fire / O-No Disassembly , No Fire					