Battery Pack Test Report

UN38.3

Customer: Lenovo

Pack Model: L15C4E01

Nominal voltage: 14.6V

Nominal capacity: 41Wh

Configuration: 4S1P

Customer P/N: 5B10L04160

Celxpert P/N: 921300081

Cell Type: LG INR18650C4 2850mAh

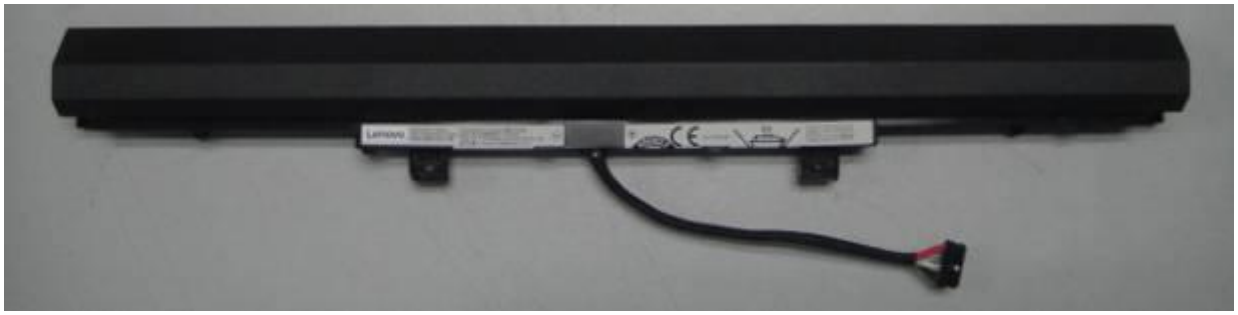
Jan. 25 . 2018

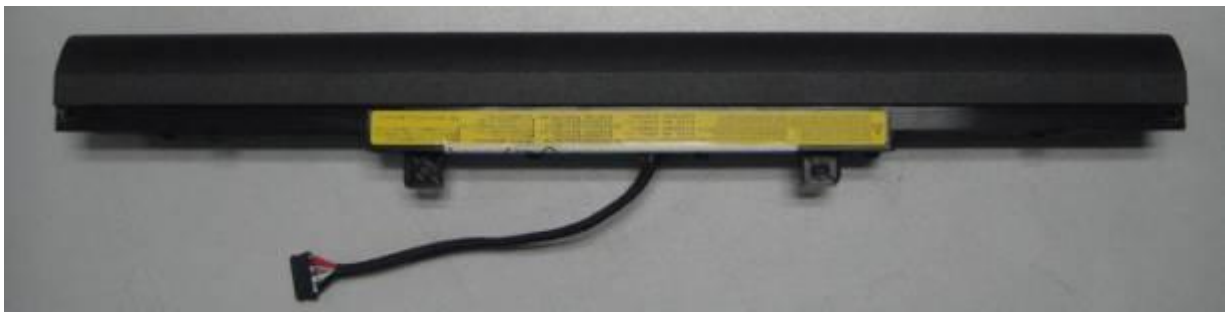
Approved by_____

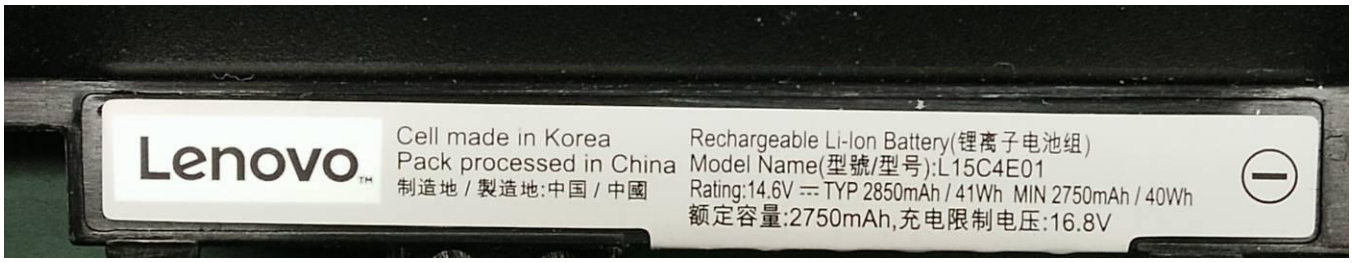
Reviewed by_____

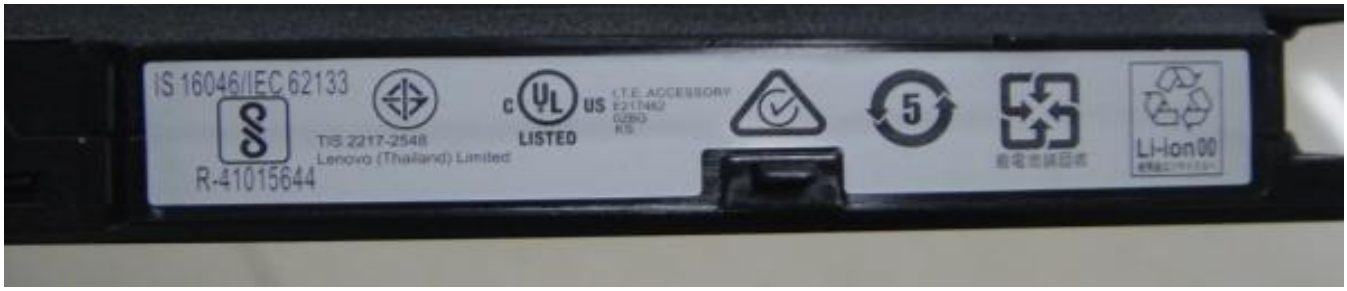
Prepared by 王献霞

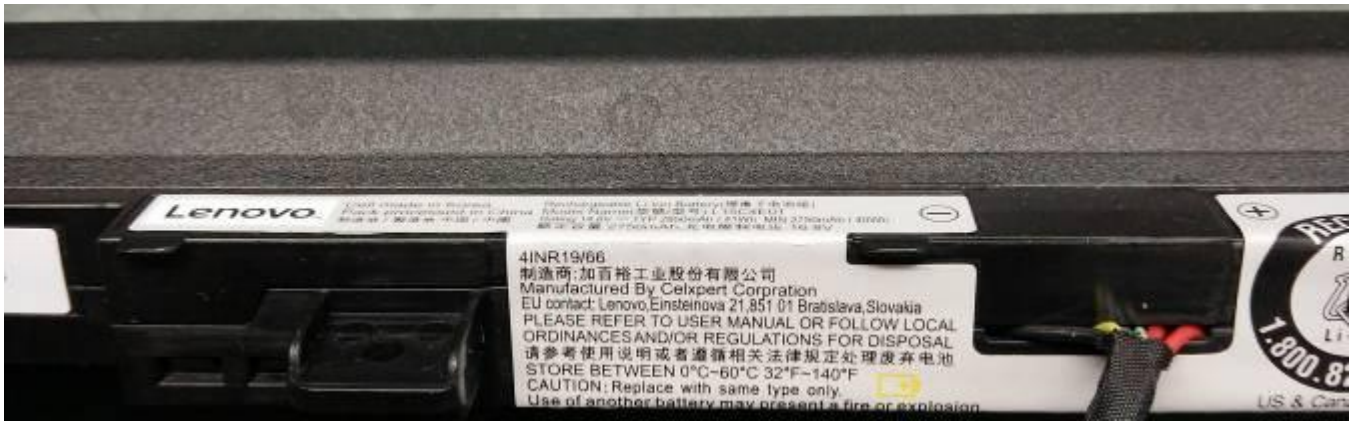
Figure photo of the pack











1. UN38.3 Test Report

Test Period	2015/12/02~2015/12/28		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 INR18650C4 2850mAh	38.3.6
2	Sample No:2/16	38.3.1~5	2	LG INR18650C4 2850mAh	38.3.6
3	Sample No:3/16	38.3.1~5	3	LG INR18650C4 2850mAh	38.3.6
4	Sample No:4/16	38.3.1~5	4	LG INR18650C4 2850mAh	38.3.6
5	Sample No:5/16	38.3.1~5	5	LG INR18650C4 2850mAh	38.3.6
6	Sample No:6/16	38.3.1~5	6	LG INR18650C4 2850mAh	38.3.8
7	Sample No:7/16	38.3.1~5	7	LG INR18650C4 2850mAh	38.3.8
8	Sample No:8/16	38.3.1~5	8	LG INR18650C4 2850mAh	38.3.8
9	Sample No:9/16	38.3.7	9	LG INR18650C4 2850mAh	38.3.8
10	Sample No:10/16	38.3.7	10	LG INR18650C4 2850mAh	38.3.8
11	Sample No:11/16	38.3.7	11	LG INR18650C4 2850mAh	38.3.8
12	Sample No:12/16	38.3.7	12	LG INR18650C4 2850mAh	38.3.8
13	Sample No:13/16	38.3.7	13	LG INR18650C4 2850mAh	38.3.8
14	Sample No:14/16	38.3.7	14	LG INR18650C4 2850mAh	38.3.8
15	Sample No:15/16	38.3.7	15	LG INR18650C4 2850mAh	38.3.8
16	Sample No:16/16	38.3.7	16	LG INR18650C4 2850mAh	38.3.8
			17	LG INR18650C4 2850mAh	38.3.8
			18	LG INR18650C4 2850mAh	38.3.8
			19	LG INR18650C4 2850mAh	38.3.8
			20	LG INR18650C4 2850mAh	38.3.8
			21	LG INR18650C4 2850mAh	38.3.8
			22	LG INR18650C4 2850mAh	38.3.8
			23	LG INR18650C4 2850mAh	38.3.8
			24	LG INR18650C4 2850mAh	38.3.8
			25	LG INR18650C4 2850mAh	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 ℃. 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: 2015/12/02 End:2015/12/02		
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

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	16.676	219.28	16.674	219.27	99.99%	0.00%	O
2	16.669	220.14	16.668	220.13	99.99%	0.00%	O
3	16.672	219.74	16.671	219.73	99.99%	0.00%	O
4	16.664	219.52	16.661	219.51	99.98%	0.00%	O
5	16.644	220.23	16.642	220.22	99.99%	0.00%	O
6	16.659	219.47	16.656	219.46	99.98%	0.00%	O
7	16.651	219.83	16.650	219.82	99.99%	0.00%	O
8	16.648	219.65	16.644	219.64	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

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℃, followed by storage for 6 hours at -40±2℃. 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: 2015/12/03 End:2015/12/09
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

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	16.674	219.27	16.605	219.19	99.59%	0.04%	O
2	16.668	220.13	16.592	220.05	99.54%	0.04%	O
3	16.671	219.73	16.596	219.66	99.55%	0.04%	O
4	16.661	219.51	16.587	219.44	99.56%	0.03%	O
5	16.642	220.22	16.571	220.15	99.57%	0.03%	O
6	16.656	219.46	16.581	219.38	99.55%	0.04%	O
7	16.650	219.82	16.582	219.73	99.59%	0.04%	O
8	16.644	219.64	16.569	219.56	99.55%	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: 2015/12/16 End:2015/12/17
Test Equipment	數位電表 Q153, 電子天平 Q090, 振動測試機 Q156
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	16.605	219.19	16.598	219.14	99.96%	0.02%	O
2	16.592	220.05	16.585	219.98	99.96%	0.03%	O
3	16.596	219.66	16.588	219.60	99.95%	0.03%	O
4	16.587	219.44	16.579	219.38	99.95%	0.03%	O
5	16.571	220.15	16.563	220.09	99.95%	0.02%	O
6	16.581	219.38	16.575	219.32	99.96%	0.03%	O
7	16.582	219.73	16.573	219.68	99.95%	0.02%	O
8	16.569	219.56	16.562	219.50	99.96%	0.03%	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: 2015/12/18 End:2015/12/18
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

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	16.598	219.14	16.592	219.13	99.96%	0.00%	O
2	16.585	219.98	16.580	219.97	99.97%	0.00%	O
3	16.588	219.60	16.583	219.59	99.97%	0.00%	O
4	16.579	219.38	16.573	219.37	99.96%	0.00%	O
5	16.563	220.09	16.559	220.08	99.98%	0.00%	O
6	16.575	219.32	16.568	219.31	99.96%	0.00%	O
7	16.573	219.68	16.567	219.67	99.96%	0.00%	O
8	16.562	219.50	16.557	219.49	99.97%	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

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℃ oven, and exterior packs temperature are monitored 5-2.When packs exterior reach 55±2℃, 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℃. The packs are observed for a further 6 hours.	No rupture, no disassembly, no explosion, no fire, no smoke. Packs exterior peak temperature <170℃.	4 packs are standard charged (Pack#1~4) 4 packs 50 cycled ending in fully charged states (Pack#5~8)
Test Period	Start: 2015/12/25 End:2015/12/28			
Test Equipment	數位電表 Q153, 資料收集器 Q075, 烘箱 Q171			
Recommendation	The packs pass the test.			

Raw Data

Short Circuit Test on Charged Packs

No.	Max. Temp.(℃)	Other event
1	54.56	O
2	54.33	O
3	54.91	O
4	54.72	O
5	55.12	O
6	55.08	O
7	55.25	O
8	54.63	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℃ and there is no disassemb ly and no fire within 6 hours of the test.	5 cells are 50% charged (Cell #1~5)
Test Period	Start: 2015/12/11 End: 2015/12/11			
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

Impact Test on 50% Charged Cells

No.	Max. Temp.(℃)	Other event
1	45.56	O
2	50.23	O
3	63.17	O
4	59.94	O
5	40.28	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: 2015/12/25 End: 2015/12/28
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

Overcharge Test on Charged Packs

No.	Charge Voltage(V)	Charge Current(A)	Max. Temp.(°C)	Other event
9	22.0 V	2.70	19.83	O
10			20.36	O
11			21.14	O
12			20.87	O
13			20.54	O
14			19.63	O
15			21.22	O
16			20.11	O

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: 2015/12/14 End:2015/12/17			
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.(℃)	Other event	No.	Max. Temp.(℃)	Other event
6	42.56	O	16	47.15	O
7	45.63	O	17	48.62	O
8	56.78	O	18	53.46	O
9	62.74	O	19	59.84	O
10	58.31	O	20	64.62	O
11	58.69	O	21	57.48	O
12	47.12	O	22	41.51	O
13	46.34	O	23	51.39	O
14	67.14	O	24	56.82	O
15	55.49	O	25	61.75	O
Note:D-Disassembly ; F-Fire / O-No Disassembly , No Fire					