

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

Customer: Lenovo

Pack Model: L13C6Y01

Nominal voltage: 10.8V dc

Nominal capacity: 48Wh/4400mAh

Configuration: 3S2P

Customer P/N: 121500266

Celxpert P/N: 921300046

Cell Type: SDI 22FM

Jan.27 2018

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

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

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

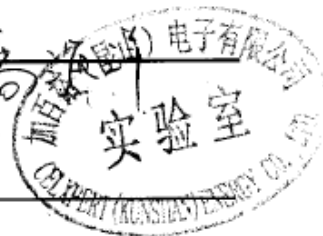


Figure photo of the pack.



# 1. UN38.3 Test Report

Test Period	2014/1/21~2014/2/15		Test Spec.	ST/SG/AC.10/11/Rev.5 Amend.1	
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	SDI 22FM 2200mAh	38.3.6
2	Sample No:2/16	38.3.1~5	2	SDI 22FM 2200mAh	38.3.6
3	Sample No:3/16	38.3.1~5	3	SDI 22FM 2200mAh	38.3.6
4	Sample No:4/16	38.3.1~5	4	SDI 22FM 2200mAh	38.3.6
5	Sample No:5/16	38.3.1~5	5	SDI 22FM 2200mAh	38.3.6
6	Sample No:6/16	38.3.1~5	6	SDI 22FM 2200mAh	38.3.8
7	Sample No:7/16	38.3.1~5	7	SDI 22FM 2200mAh	38.3.8
8	Sample No:8/16	38.3.1~5	8	SDI 22FM 2200mAh	38.3.8
9	Sample No:9/16	38.3.7	9	SDI 22FM 2200mAh	38.3.8
10	Sample No:10/16	38.3.7	10	SDI 22FM 2200mAh	38.3.8
11	Sample No:11/16	38.3.7	11	SDI 22FM 2200mAh	38.3.8
12	Sample No:12/16	38.3.7	12	SDI 22FM 2200mAh	38.3.8
13	Sample No:13/16	38.3.7	13	SDI 22FM 2200mAh	38.3.8
14	Sample No:14/16	38.3.7	14	SDI 22FM 2200mAh	38.3.8
15	Sample No:15/16	38.3.7	15	SDI 22FM 2200mAh	38.3.8
16	Sample No:16/16	38.3.7	16	SDI 22FM 2200mAh	38.3.8
			17	SDI 22FM 2200mAh	38.3.8
			18	SDI 22FM 2200mAh	38.3.8
			19	SDI 22FM 2200mAh	38.3.8
			20	SDI 22FM 2200mAh	38.3.8
			21	SDI 22FM 2200mAh	38.3.8
			22	SDI 22FM 2200mAh	38.3.8
			23	SDI 22FM 2200mAh	38.3.8
			24	SDI 22FM 2200mAh	38.3.8
			25	SDI 22FM 2200mAh	38.3.8

**1.3 Test result**

Item	Test Item	Test specification	Judge criteria	Sample(s)							
T1	Altitude Simulation (UN38.3-1)	<p>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.</p> <p>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.</p> <p>1-3. Vacuum is released. All cells weight is measured. The charged cell voltage are measured and recorded.</p>	<p>No mass loss (&lt;0.1%), no leakage, no venting, no disassembly, no rupture and no fire. Battery voltage drop &lt; 10%. Battery resistance change &lt; ±10%.</p>	<p>4 packs are standard charged (Pack#1~4) 4 packs 50 cycled ending in fully charged states (Pack#5~8)</p>							
Test Period	Start: 2014/01/21                      End:2014/01/21										
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			Difference			Result
		OCV (V)	Resistance(mΩ)	Weight (g)	OCV (V)	Resistance(mΩ)	Weight (g)	Volt (%)	Resistance(%)	Weight (%)	
	1	12.498	122.25	288.42	12.498	122.55	288.41	0.00%	0.25%	0.00%	Pass
	2	12.511	121.24	288.36	12.510	121.54	288.35	-0.01%	0.25%	0.00%	Pass
	3	12.552	121.78	288.71	12.533	121.58	288.70	-0.15%	-0.16%	0.00%	Pass
	4	12.534	123.46	288.64	12.549	123.96	288.63	0.12%	0.40%	0.00%	Pass
	5	12.547	122.37	288.53	12.545	122.77	288.52	-0.02%	0.33%	0.00%	Pass
	6	12.516	121.94	288.59	12.513	122.44	288.58	-0.02%	0.41%	0.00%	Pass
	7	12.528	122.08	288.45	12.527	122.48	288.44	-0.01%	0.33%	0.00%	Pass
8	12.544	121.66	288.61	12.544	121.96	288.60	0.00%	0.25%	0.00%	Pass	

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%. Battery resistance change < ±10%.	4 packs are standard charged (Pack#1~4) 4 packs 50 cycled ending in fully charged states (Pack#5~8)								
Test Period		Start: 2014/01/22                      End:2014/01/28										
Test Equipment		數位電表 Q153, 電子天平 Q090, 冷熱衝擊機 Q155										
Major Problem		-										
Warning Point		-										
Recommendation		The packs pass the test.										
Raw Data		<b>Thermal Test on Charged Packs</b>										
		No.	Before			After			Difference			Result
			OCV (V)	Resistance(mΩ)	Weight (g)	OCV (V)	Resistance(mΩ)	Weight (g)	Volt (%)	Resistance(%)	Weight (%)	
		1	12.498	122.55	288.41	12.429	123.05	288.31	-0.55%	0.41%	0.04%	Pass
		2	12.510	121.54	288.35	12.434	122.04	288.24	-0.61%	0.41%	0.04%	Pass
		3	12.533	121.58	288.70	12.458	121.98	288.59	-0.60%	0.33%	0.04%	Pass
		4	12.549	123.96	288.63	12.475	124.36	288.53	-0.59%	0.32%	0.04%	Pass
		5	12.545	122.77	288.52	12.474	123.37	288.42	-0.57%	0.49%	0.03%	Pass
		6	12.513	122.44	288.58	12.438	122.84	288.49	-0.60%	0.33%	0.03%	Pass
		7	12.527	122.48	288.44	12.459	123.08	288.35	-0.54%	0.49%	0.03%	Pass
8	12.544	121.96	288.60	12.469	122.46	288.51	-0.60%	0.41%	0.03%	Pass		

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%. Battery resistance change < ±10%	4 packs are standard charged (Pack#1~4) 4 packs 50 cycled ending in fully charged states (Pack#5~8)							
Test Period	Start: 2014/02/05      End:2014/02/06										
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	<b>Vibration Test on Charged Packs</b>										
	No.	Before			After			Difference			Result
		OCV (V)	Resistance(mΩ)	Weight (g)	OCV (V)	Resistance(mΩ)	Weight (g)	Volt (%)	Resistance(%)	Weight (%)	
	1	12.429	123.05	288.31	12.422	123.65	288.28	-0.06%	0.49%	0.01%	Pass
	2	12.434	122.04	288.24	12.427	122.64	288.22	-0.06%	0.49%	0.01%	Pass
	3	12.458	121.98	288.59	12.450	122.48	288.57	-0.06%	0.41%	0.01%	Pass
	4	12.475	124.36	288.53	12.467	125.06	288.51	-0.06%	0.56%	0.01%	Pass
	5	12.474	123.37	288.42	12.466	124.07	288.40	-0.06%	0.57%	0.01%	Pass
	6	12.438	122.84	288.49	12.432	123.34	288.46	-0.05%	0.41%	0.01%	Pass
	7	12.459	123.08	288.35	12.450	123.48	288.32	-0.07%	0.32%	0.01%	Pass
8	12.469	122.46	288.51	12.462	123.06	288.48	-0.06%	0.49%	0.01%	Pass	

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%. Battery resistance change < ±10%.	4 packs are standard charged (Pack#1~4) 4 packs 50 cycled ending in fully charged states (Pack#5~8)							
Test Period	Start: 2014/02/07                      End:2014/02/07										
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>										
		Before			After			Difference			
	No.	OCV (V)	Resistance(mΩ)	Weight (g)	OCV (V)	Resistance(mΩ)	Weight (g)	Volt (%)	Resistance(%)	Weight (%)	Result
	1	12.422	123.65	288.28	12.416	124.15	288.27	-0.05%	0.40%	0.00%	Pass
	2	12.427	122.64	288.22	12.422	123.14	288.21	-0.04%	0.41%	0.00%	Pass
	3	12.450	122.48	288.57	12.445	122.88	288.56	-0.04%	0.33%	0.00%	Pass
	4	12.467	125.06	288.51	12.461	125.36	288.50	-0.05%	0.24%	0.00%	Pass
	5	12.466	124.07	288.40	12.462	124.57	288.39	-0.03%	0.40%	0.00%	Pass
	6	12.432	123.34	288.46	12.425	123.74	288.46	-0.06%	0.32%	0.00%	Pass
	7	12.450	123.48	288.32	12.444	124.08	288.31	-0.05%	0.49%	0.00%	Pass
	8	12.462	123.06	288.48	12.457	123.56	288.48	-0.04%	0.41%	0.00%	Pass



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		S Start: 2014/02/10 End:2014/02/11																																										
Test Equipment		數位電表 Q153, 資料收集器 Q075, 烘箱 Q171																																										
Recommendation		The packs pass the test.																																										
Raw Data		<table border="1"> <thead> <tr> <th colspan="4">Short Circuit Test on Charged Packs</th> </tr> <tr> <th>No.</th> <th>Max. Temp.(°C)</th> <th>Visual</th> <th>Result</th> </tr> </thead> <tbody> <tr><td>1</td><td>55.3</td><td>OK</td><td>Pass</td></tr> <tr><td>2</td><td>54.9</td><td>OK</td><td>Pass</td></tr> <tr><td>3</td><td>54.5</td><td>OK</td><td>Pass</td></tr> <tr><td>4</td><td>55.2</td><td>OK</td><td>Pass</td></tr> <tr><td>5</td><td>55.0</td><td>OK</td><td>Pass</td></tr> <tr><td>6</td><td>55.7</td><td>OK</td><td>Pass</td></tr> <tr><td>7</td><td>55.4</td><td>OK</td><td>Pass</td></tr> <tr><td>8</td><td>54.3</td><td>OK</td><td>Pass</td></tr> </tbody> </table>			Short Circuit Test on Charged Packs				No.	Max. Temp.(°C)	Visual	Result	1	55.3	OK	Pass	2	54.9	OK	Pass	3	54.5	OK	Pass	4	55.2	OK	Pass	5	55.0	OK	Pass	6	55.7	OK	Pass	7	55.4	OK	Pass	8	54.3	OK	Pass
Short Circuit Test on Charged Packs																																												
No.	Max. Temp.(°C)	Visual	Result																																									
1	55.3	OK	Pass																																									
2	54.9	OK	Pass																																									
3	54.5	OK	Pass																																									
4	55.2	OK	Pass																																									
5	55.0	OK	Pass																																									
6	55.7	OK	Pass																																									
7	55.4	OK	Pass																																									
8	54.3	OK	Pass																																									
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: 2014/02/10 End:2014/02/11																																										
Test Equipment		數位電表 Q153, 資料收集器 Q152, 擠壓試驗機 Q437																																										
Recommendation		The Cells pass the test.																																										
Raw Data		<table border="1"> <thead> <tr> <th colspan="4">Crush Test on 50% Charged Cells</th> </tr> <tr> <th>No.</th> <th>Max. Temp.(°C)</th> <th>Visual</th> <th>Result</th> </tr> </thead> <tbody> <tr><td>1</td><td>43.93</td><td>OK</td><td>Pass</td></tr> <tr><td>2</td><td>42.82</td><td>OK</td><td>Pass</td></tr> <tr><td>3</td><td>36.47</td><td>OK</td><td>Pass</td></tr> <tr><td>4</td><td>25.84</td><td>OK</td><td>Pass</td></tr> <tr><td>5</td><td>54.16</td><td>OK</td><td>Pass</td></tr> </tbody> </table>			Crush Test on 50% Charged Cells				No.	Max. Temp.(°C)	Visual	Result	1	43.93	OK	Pass	2	42.82	OK	Pass	3	36.47	OK	Pass	4	25.84	OK	Pass	5	54.16	OK	Pass												
Crush Test on 50% Charged Cells																																												
No.	Max. Temp.(°C)	Visual	Result																																									
1	43.93	OK	Pass																																									
2	42.82	OK	Pass																																									
3	36.47	OK	Pass																																									
4	25.84	OK	Pass																																									
5	54.16	OK	Pass																																									

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: 2014/02/12      End:2014/02/14				
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)	Visual	Result
	9	22.0 V	4.4	28.7	OK	Pass
	10			28.6	OK	Pass
	11			27.7	OK	Pass
	12			28.3	OK	Pass
	13			29.1	OK	Pass
	14			29.0	OK	Pass
	15			28.8	OK	Pass
	16			28.7	OK	Pass

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: 2014/02/12                      End:2014/02/15																																																																																																			
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	<table border="1"> <thead> <tr> <th colspan="4">Forced discharge are first cycle in fully discharged</th> <th colspan="4">Forced discharge are after 50 cycles ending in fully discharged</th> </tr> <tr> <th>No.</th> <th>Max. Temp.(°C)</th> <th>Visual</th> <th>Result</th> <th>No.</th> <th>Max. Temp.(°C)</th> <th>Visual</th> <th>Result</th> </tr> </thead> <tbody> <tr> <td>6</td> <td>54.32</td> <td>OK</td> <td>Pass</td> <td>16</td> <td>41.62</td> <td>OK</td> <td>Pass</td> </tr> <tr> <td>7</td> <td>42.56</td> <td>OK</td> <td>Pass</td> <td>17</td> <td>42.27</td> <td>OK</td> <td>Pass</td> </tr> <tr> <td>8</td> <td>40.38</td> <td>OK</td> <td>Pass</td> <td>18</td> <td>51.32</td> <td>OK</td> <td>Pass</td> </tr> <tr> <td>9</td> <td>32.44</td> <td>OK</td> <td>Pass</td> <td>19</td> <td>57.45</td> <td>OK</td> <td>Pass</td> </tr> <tr> <td>10</td> <td>28.96</td> <td>OK</td> <td>Pass</td> <td>20</td> <td>39.87</td> <td>OK</td> <td>Pass</td> </tr> <tr> <td>11</td> <td>30.77</td> <td>OK</td> <td>Pass</td> <td>21</td> <td>40.45</td> <td>OK</td> <td>Pass</td> </tr> <tr> <td>12</td> <td>36.84</td> <td>OK</td> <td>Pass</td> <td>22</td> <td>45.56</td> <td>OK</td> <td>Pass</td> </tr> <tr> <td>13</td> <td>41.18</td> <td>OK</td> <td>Pass</td> <td>23</td> <td>43.94</td> <td>OK</td> <td>Pass</td> </tr> <tr> <td>14</td> <td>25.24</td> <td>OK</td> <td>Pass</td> <td>24</td> <td>38.49</td> <td>OK</td> <td>Pass</td> </tr> <tr> <td>15</td> <td>22.31</td> <td>OK</td> <td>Pass</td> <td>25</td> <td>40.08</td> <td>OK</td> <td>Pass</td> </tr> </tbody> </table>				Forced discharge are first cycle in fully discharged				Forced discharge are after 50 cycles ending in fully discharged				No.	Max. Temp.(°C)	Visual	Result	No.	Max. Temp.(°C)	Visual	Result	6	54.32	OK	Pass	16	41.62	OK	Pass	7	42.56	OK	Pass	17	42.27	OK	Pass	8	40.38	OK	Pass	18	51.32	OK	Pass	9	32.44	OK	Pass	19	57.45	OK	Pass	10	28.96	OK	Pass	20	39.87	OK	Pass	11	30.77	OK	Pass	21	40.45	OK	Pass	12	36.84	OK	Pass	22	45.56	OK	Pass	13	41.18	OK	Pass	23	43.94	OK	Pass	14	25.24	OK	Pass	24	38.49	OK	Pass	15	22.31	OK	Pass	25	40.08	OK	Pass
	Forced discharge are first cycle in fully discharged				Forced discharge are after 50 cycles ending in fully discharged																																																																																															
	No.	Max. Temp.(°C)	Visual	Result	No.	Max. Temp.(°C)	Visual	Result																																																																																												
	6	54.32	OK	Pass	16	41.62	OK	Pass																																																																																												
	7	42.56	OK	Pass	17	42.27	OK	Pass																																																																																												
	8	40.38	OK	Pass	18	51.32	OK	Pass																																																																																												
	9	32.44	OK	Pass	19	57.45	OK	Pass																																																																																												
	10	28.96	OK	Pass	20	39.87	OK	Pass																																																																																												
	11	30.77	OK	Pass	21	40.45	OK	Pass																																																																																												
	12	36.84	OK	Pass	22	45.56	OK	Pass																																																																																												
	13	41.18	OK	Pass	23	43.94	OK	Pass																																																																																												
	14	25.24	OK	Pass	24	38.49	OK	Pass																																																																																												
	15	22.31	OK	Pass	25	40.08	OK	Pass																																																																																												