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Control Number: SLEU-1808006

# Lithium-ion Battery UN38.3 Test Report

## Recommendations on the TRANSPORT OF DANGEROUS GOODS

(Manual of Tests and Criteria, Sixth revised edition)

**Customer: Lenovo**

**Model: L18M3P73**

**Rating: 11.52V , Typical Capacity 4345mAh / 51Wh**

**Rated Capacity 4213mAh / 48Wh**

**Issue date: 2018/08/03**

Approved By	Checked By	Prepared By

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Form No. : W11-002-B04

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### 1. Purpose of the Test :

To test each cell/battery is of the type proved to meet the requirements in United Nations Recommendations on the TRANSPORT OF DANGEROUS GOODS, Manual of Tests and Criteria, Sixth revised edition, Section 38.3.

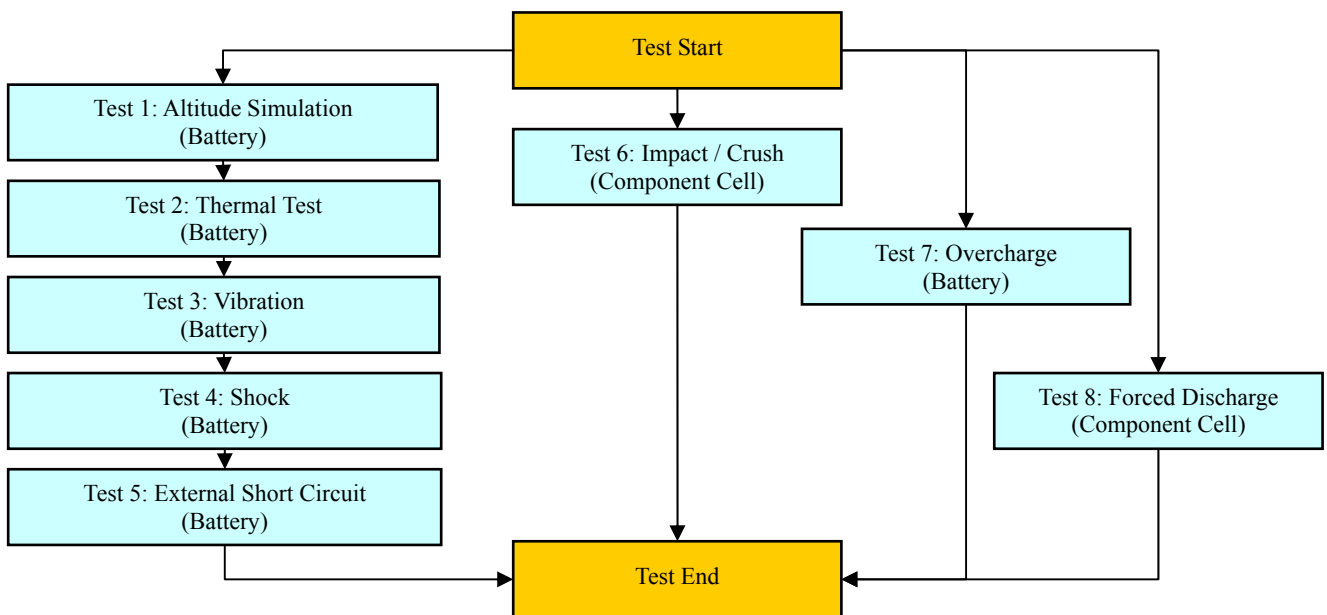
### 2. Test Quantity :

- 2.1 Four batteries, at first cycle, in fully charged states. (For T.1~T.5)
- 2.2 Four batteries, after 50 cycles ending in fully charged states. (For T.1~T.5)
- 2.3 Five component cells, at first cycle at 50% of the design rated capacity. (For T.6)
- 2.4 Four batteries, at first cycle, in fully charged states. (For T.7)
- 2.5 Four batteries, after 50 cycles ending in fully charged states. (For T.7)
- 2.6 Ten component cells, at first cycle in fully discharge states. (For T.8)
- 2.7 Ten component cells, after 50 cycles ending in fully discharged states. (For T.8)

### 3. Test Procedure :

3.1 All detailed test procedures must be based on United Nations Recommendations on the TRANSPORT OF DANGEROUS GOODS, Manual of Tests and Criteria, Sixth revised edition, Section 38.3.

3.2 Test flow shall be followed as below.





#### 4. Test Result :

##### 4.1 T.1 ~T.4 Test result: **Passed**

4.1.1 All batteries could meet the requirement of Table 38.3.1 Mass loss limit ( $M < 1g$ : 0.5% ;  $1g \leq M \leq 75g$ : 0.2% ;  $M > 75g$ : 0.1%) and residual OCV not less than 90% after the test.

4.1.2 No leakage, no venting, no disassembly, no rupture and no fire.

##### 4.2 T.5 Test result: **Passed**

4.2.1 All batteries could meet the requirement, external temperature did not exceed 170°C.

4.2.2 All batteries were no disassembly, no rupture and no fire during the test and within six hours after the test.

##### 4.3 T.6 Test result: **Passed**

4.3.1 All component cells could meet the requirement, external temperature did not exceed 170°C.

4.3.2 All component cells were no disassembly and no fire during the test and within six hours after the test.

##### 4.4 T.7 Test result: **Passed**

4.4.1 All batteries could meet no disassembly and no fire during the test and within seven days after the test.

##### 4.5 T.8 Test result: **Passed**

4.5.1 All component cells could meet the requirement, no disassembly and no fire during the test and within seven days after the test.

#### **Conclusion: The samples had passed the test items of UN38.3.**



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Control Number: SLEU-1808006

## 5. Test Equipment :

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Revised Date: 2018-08-03

Test Instruments Reference List								
Used	Instrument ID	Instrument Name	Type	Range of use	Manufacturer	Calibration Date_Last	Calibration Date_Next	Remarks
<b>Pretest</b>								
V	ML-761	Learning	715C	0~18V 0~8A	SMP	2018/2/26	2019/2/26	
V	ML-762	Learning	715C	0~18V 0~8A	SMP	2018/1/3	2019/1/3	
V	ML-763	Learning	715C	0~18V 0~8A	SMP	2018/2/26	2019/2/26	
V	ML-764	Learning	715C	0~18V 0~8A	SMP	2018/1/3	2019/1/3	
	ML-925	Learning	750C8	0~60V 0~30A	SMP	2018/1/3	2019/1/3	
<b>T.1 Altitude Simulation</b>								
V	ML-522	Altitude	SVT-120	Kpa:30~90	HSIN JIANG	2018/7/18	2019/7/18	
V	ML-257	Multimeter	HP 34401A	Note 1	Agilent	2018/3/1	2019/3/1	
	ML-494	Electronic Balance	XS1220M-SCS	1-1200 gf	CHUANHUA	2018/7/18	2019/7/18	
V	TD-166	Electronic Balance	PG603-S	1-610 gf	METTLER TOLEDO	2017/9/13	2018/9/13	
	ML-523	Electronic Balance	MTW-30K	30*0.005Kg		2017/9/13	2018/9/13	
V	ML-550	Data Logger	313	15~35 ℃; 30~80 %RH	CENTER	2017/9/18	2018/9/18	
<b>T.2 Thermal Test</b>								
V	ML-789	Thermal Shock	GTST-080-65-AW	T:-40 to 120℃	GF	2018/1/3	2019/1/3	
V	ML-257	Multimeter	HP 34401A	note 1	Agilent	2018/3/1	2019/3/1	
	ML-494	Electronic Balance	XS1220M-SCS	1-1000 gf	CHUANHUA	2018/7/18	2019/7/18	
V	TD-166	Electronic Balance	PG603-S	1-610 gf	METTLER TOLEDO	2017/9/13	2018/9/13	
	ML-523	Electronic Balance	MTW-30K	30*0.005Kg		2017/9/13	2018/9/13	
V	ML-551	Data Logger	313	15~35 ℃; 30~80 %RH	CENTER	2017/9/18	2018/9/18	
<b>T.3 Vibration</b>								
V	ML-233	Vibration	KD-9636-EM-300F2K-30N80	F:5~2000Hz G:0.2~20G	King Design	2017/8/29	2018/8/29	
V	ML-257	Multimeter	HP 34401A	note 1	Agilent	2018/3/1	2019/3/1	
	ML-494	Electronic Balance	XS1220M-SCS	1-1000 gf	CHUANHUA	2018/7/18	2019/7/18	
V	TD-166	Electronic Balance	PG603-S	1-610 gf	METTLER TOLEDO	2017/9/13	2018/9/13	
	ML-523	Electronic Balance	MTW-30K	30*0.005Kg		2017/9/13	2018/9/13	
V	ML-552	Data Logger	313	15~35 ℃; 30~80 %RH	CENTER	2017/9/18	2018/9/18	
<b>T.4 Shock</b>								
V	ML-056	Shock	DP-1200-25	G:10~600G	King Design	2017/8/29	2018/8/29	
V	ML-257	Multimeter	HP 34401A	note 1	Agilent	2018/3/1	2019/3/1	
	ML-494	Electronic Balance	XS1220M-SCS	1-1000 gf	CHUANHUA	2018/7/18	2019/7/18	
V	TD-166	Electronic Balance	PG603-S	1-610 gf	METTLER TOLEDO	2017/9/13	2018/9/13	
	ML-523	Electronic Balance	MTW-30K	30*0.005Kg		2017/9/13	2018/9/13	
V	ML-551	Data Logger	313	15~35 ℃; 30~80 %RH	CENTER	2017/9/18	2018/9/18	
<b>T.5 External Short Circuit</b>								
V	ML-534	mΩ Hitester	3540	1mΩ ~ 30kΩ	HIOKI	2017/9/18	2018/9/18	
V	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2017/9/13	2018/9/13	
V	ML-460	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2017/9/13	2018/9/13	
V	ML-521	Oven	9031	30~80 ℃	YEOW LONG	2017/9/13	2018/9/13	
V	ML-549	Data Logger	313	15~35 ℃; 30~80 %RH	CENTER	2017/9/18	2018/9/18	
<b>T.6 Impact / Crush</b>								
V	ML-339	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2018/5/17	2019/5/17	
	ML-076	Impact Tester			JYI SHENG	2018/1/3	2019/1/3	
	ML-553	Crush Tester	BCT-01		Simplo	2018/5/16	2019/5/16	
V	ML-866	Crush Tester	M0654		JYI SHENG	2018/4/9	2019/4/9	
	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2017/9/13	2018/9/13	

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Revised Date: 2018-08-03

Test Instruments Reference List								
Used	Instrument ID	Instrument Name	Type	Range of use	Manufacturer	Calibration Date_Last	Calibration Date_Next	Remarks
	<b>T.7 Overcharge</b>							
	ML-482	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2018/5/17	2019/5/17	
	ML-483	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2018/5/17	2019/5/17	
	ML-484	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2018/5/17	2019/5/17	
	ML-486	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2018/5/17	2019/5/17	
	ML-487	Programmable DC Source	DS6024	1-60 Vdc, 0.3-24A	MOTECH	2018/5/17	2019/5/17	
V	ML-549	Data Logger	313	15~35 ℃; 30~80 %RH	CENTER	2017/9/18	2018/9/18	
	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2017/9/13	2018/9/13	
	ML-460	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2017/9/13	2018/9/13	
V	ML-918	Overcharge & Forced discharge tester	T901	3~30 Vdc, Charge: 0.05~20A Discharge: 0.02~10A	SMP	2018/5/17	2019/5/17	
	<b>T.8 Forced Discharge</b>							
	ML-132	Electronic Load	3311C	60V,55A, 300W	Prodigit	2018/3/1	2019/3/1	
	ML-133	Electronic Load	3311C	60V,55A, 300W	Prodigit	2018/3/1	2019/3/1	
	ML-136	Electronic Load	3311C	60V,55A, 300W	Prodigit	2018/3/1	2019/3/1	
	ML-192	Electronic Load	3311C	60V,55A, 300W	Prodigit	2018/3/1	2019/3/1	
	ML-269	Electronic Load	3311C	60V,55A, 300W	Prodigit	2018/3/1	2019/3/1	
	ML-532	DC Electronic Load	33511-01	120V, 240A, 3600W	Prodigit	2018/7/18	2019/7/18	
	ML-482	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2018/5/17	2019/5/17	
	ML-483	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2018/5/17	2019/5/17	
	ML-484	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2018/5/17	2019/5/17	
	ML-486	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2018/5/17	2019/5/17	
	ML-487	Programmable DC Source	DS6024	1-60 Vdc, 0.3-24A	MOTECH	2018/5/17	2019/5/17	
V	ML-549	Data Logger	313	15~35 ℃; 30~80 %RH	CENTER	2017/9/18	2018/9/18	
	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2017/9/13	2018/9/13	
	ML-460	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2017/9/13	2018/9/13	
V	ML-918	Overcharge & Forced discharge tester	T901	3~30 Vdc, Charge: 0.05~20A Discharge: 0.02~10A	SMP	2018/5/17	2019/5/17	
Note 1: DC Voltage: 0.1-1000V; AC Voltage: 0.5-700V at 60Hz, 1kHz; Resistance: 10Ω-10MΩ; DC Current: 0.1mA-3A; AC Current: 0.01-3A at 60Hz, 0.01-1A, at 1kHz.								

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Control Number: SLEU-1808006

## 6. T.1~T.8 Detail Reports:

### UN 38.3 Test Datasheet UN38.3/ST/SG/AC.10/11/Rev.6

Control Number: SLEU-1808006	Customer: Lenovo	Model Name: L18M3P73	SMP Project Name: Drift
Pack P/N: 931QA110H (A)(B)	Configuration: 3S1P	Test Duration: 2018/07/04~2018/08/02	Reviewer: Esmond

Test Sample Identification:  Large Battery  Small Battery  Single-cell Battery

Battery Pack					Component Cell			
Used	Sample No.	Sample State	Used	Sample No.	Sample State	Used	Sample No.	Sample State
V	01~04	1 Cycle, Fully charged	V	05~08	50 Cycles, Fully charged	V	01C~05C	1 Cycle, 50% SOC
V	09~12	1 Cycle, Fully charged	V	13~16	50 Cycles, Fully charged	V	06C~15C	1 Cycle, Fully discharged (0% SOC)
		25Cycles, Fully charged			25 Cycles, Fully charged	V	16C~25C	50 Cycles, Fully discharged (0% SOC)

#### T.1 Altitude Simulation

Start time: 2018/07/19 09:20		Ambient temp.: 23.6 °C						Operator: Martin	
Finish time: 2018/07/19 15:40		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	13.069	13.062	13.060	13.063	13.066	13.069	13.061	13.066
	After	13.062	13.054	13.052	13.055	13.059	13.061	13.053	13.058
	Residual OCV %	99.95%	99.94%	99.94%	99.94%	99.95%	99.94%	99.94%	99.94%
Mass (g)	Before	196.859	197.212	196.965	196.723	196.814	197.036	196.869	196.142
	After	196.859	197.212	196.965	196.720	196.814	197.034	196.869	196.140
	Mass loss %	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Results		P	P	P	P	P	P	P	P

#### T.2 Thermal Test

Start time: 2018/07/19 16:00		Ambient temp.: 24.8 °C						Operator: Martin	
Finish time: 2018/07/26 08:50		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	13.062	13.054	13.052	13.055	13.059	13.061	13.053	13.058
	After	12.907	12.888	12.884	12.891	12.899	12.904	12.891	12.892
	Residual OCV %	98.81%	98.73%	98.71%	98.74%	98.77%	98.80%	98.76%	98.73%
Mass (g)	Before	196.859	197.212	196.965	196.720	196.814	197.034	196.869	196.140
	After	196.837	197.188	196.947	196.697	196.794	197.010	196.854	196.119
	Mass loss %	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
Results		P	P	P	P	P	P	P	P

#### T.3 Vibration

Start time: 2018/07/26 09:10		Ambient temp.: 23.3 °C						Operator: Martin	
Finish time: 2018/07/27 08:50		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	12.907	12.888	12.884	12.891	12.899	12.904	12.891	12.892
	After	12.897	12.876	12.872	12.879	12.887	12.892	12.880	12.880
	Residual OCV %	99.92%	99.91%	99.91%	99.91%	99.91%	99.91%	99.91%	99.91%
Mass (g)	Before	196.837	197.188	196.947	196.697	196.794	197.010	196.854	196.119
	After	196.836	197.183	196.947	196.694	196.790	197.010	196.853	196.115
	Mass loss %	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Results		P	P	P	P	P	P	P	P

#### T.4 Shock

Start time: 2018/07/27 09:10		Ambient temp.: 24.2 °C						Operator: Martin	
Finish time: 2018/07/27 11:20		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	12.897	12.876	12.872	12.879	12.887	12.892	12.880	12.880
	After	12.896	12.875	12.871	12.878	12.886	12.891	12.879	12.879
	Residual OCV %	99.99%	99.99%	99.99%	99.99%	99.99%	99.99%	99.99%	99.99%
Mass (g)	Before	196.836	197.183	196.947	196.694	196.790	197.010	196.853	196.115
	After	196.836	197.183	196.943	196.694	196.790	197.008	196.853	196.115
	Mass loss %	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Results		P	P	P	P	P	P	P	P

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Control Number: SLEU-1808006

**T.5 External Short Circuit**

Start time: 2018/07/27 11:40		Ambient temp.: 23.6 °C							Operator: Martin	
Finish time: 2018/07/30 09:10		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08	
OCV (V)	Before	12.896	12.875	12.871	12.878	12.886	12.891	12.879	12.879	
	After	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Resistance (<100mΩ)		56.8	61.2	55.3	59.4	59.7	55.8	57.1	60.3	
Max Temp. (< 170°C)		57.8	57.8	58.1	58.1	57.9	57.8	58.0	58.1	
Results		P	P	P	P	P	P	P	P	

**T.6 Impact / Crush (Component Cell)**

UN38.3/ST/SG/AC.10/11/Rev.6

- Impact - Cylindrical cells not less than 18.0 mm in diameter
- Crush - Prismatic, pouch, coin/button cells and cylindrical cells less than 18.0 mm in diameter

Start time: 2018/07/23 09:40		Ambient temp.: 23.6 °C				Operator: Martin	
Finish time: 2018/07/23 17:30		Sample 01C	Sample 02C	Sample 03C	Sample 04C	Sample 05C	
Initial OCV (V)		3.788	3.792	3.795	3.791	3.786	
Max Temp. (< 170°C)		23.6	23.8	23.6	23.6	23.6	
Results		P	P	P	P	P	

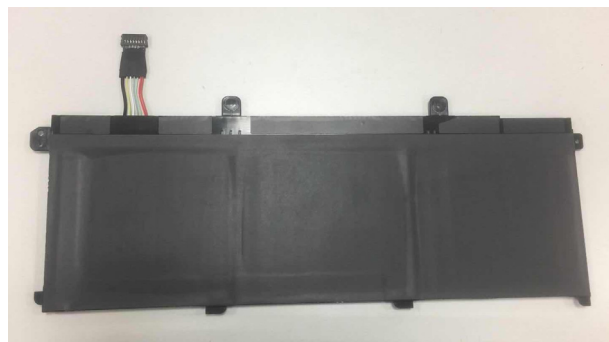
**T.7 Overcharge**

Start time: 2018/07/25 09:30		Ambient temp.: 23.8 °C								Operator: Martin	
Finish time: 2018/08/02 10:20		Sample 09	Sample 10	Sample 11	Sample 12	Sample 13	Sample 14	Sample 15	Sample 16		
Initial OCV (V)		13.067	13.065	13.064	13.065	13.064	13.065	13.063	13.070		
Results		P	P	P	P	P	P	P	P		

**T.8 Forced Discharge (Component Cell)**

Start time: 2018/07/24 09:30		Ambient temp.: 23.7 °C								Operator: Martin	
Finish time: 2018/08/01 09:10		Sample 06C	Sample 07C	Sample 08C	Sample 09C	Sample 10C	Sample 11C	Sample 12C	Sample 13C		
Initial OCV (V)		3.429	3.431	3.418	3.427	3.433	3.421	3.429	3.430		
Results		P	P	P	P	P	P	P	P		
Sample No.		Sample 14C	Sample 15C	Sample 16C	Sample 17C	Sample 18C	Sample 19C	Sample 20C	Sample 21C		
Initial OCV (V)		3.432	3.416	3.433	3.424	3.417	3.416	3.426	3.418		
Results		P	P	P	P	P	P	P	P		
Sample No.		Sample 22C	Sample 23C	Sample 24C	Sample 25C						
Initial OCV (V)		3.415	3.419	3.427	3.413						
Results		P	P	P	P						

**7. Test Sample:**



Form No. : W11-002-B04

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