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Control Number: SLEU-1902004

# 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: L18M4PE0**

**Rating: 7.72V, Typical Capacity 6610mAh/ 51Wh**

**Rated Capacity 6390mAh/ 49.3Wh**

**Issue date: 2019/02/26**

Approved By	Checked By	Prepared By
<i>stiny sin</i>	<i>gsmh</i>	<i>Mia deng</i>

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Form No. : W11-002-B04

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### 1. Purpose of the Test :

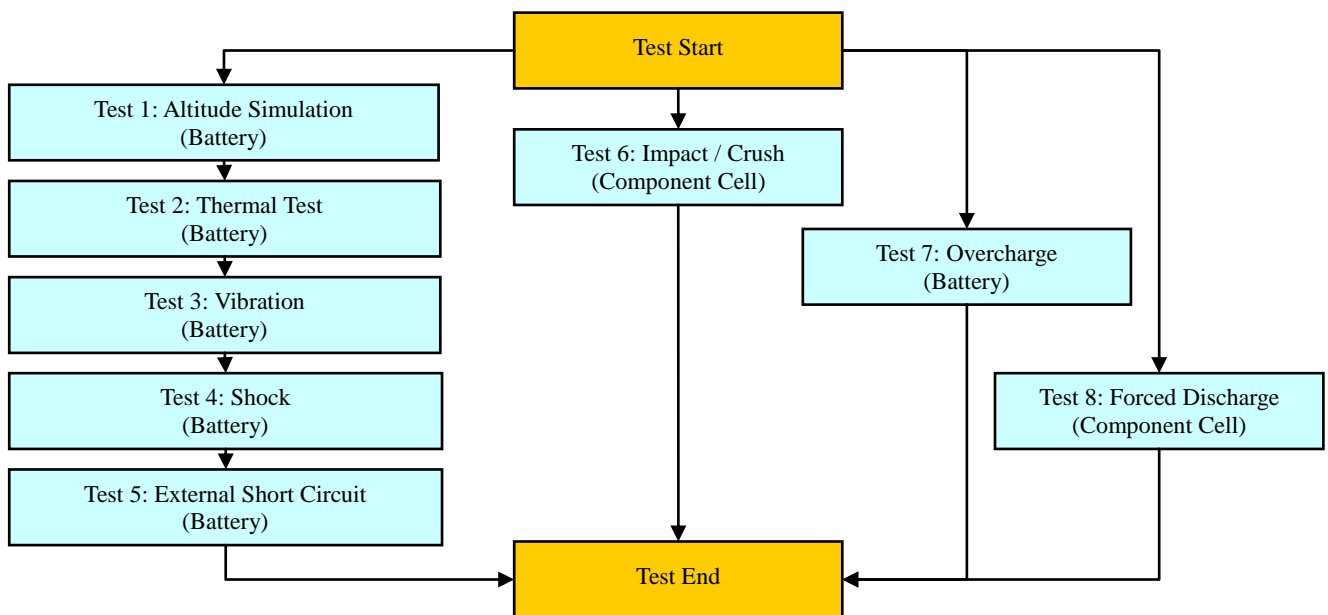
To test each cell/battery is of the type proved to meet the requirements in United Nations Recommendations on the TRANSPORT OF DANGEROUS GOODS, Manual of Tests and Criteria, Sixth revised edition, Section 38.3.

### 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  $170^{\circ}\text{C}$ .
- 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  $170^{\circ}\text{C}$ .
- 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-1902004

## 5. Test Equipment :

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Revised Date: 2019-02-26

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	2019/1/3	2020/1/3	
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	2019/1/3	2020/1/3	
	ML-925	Learning	750C8	0~60V 0~30A	SMP	2019/1/3	2020/1/3	
<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	
V	ML-494	Electronic Balance	XS1220M-SCS	1-1220 gf	CHUANHUA	2018/7/18	2019/7/18	
	ML-523	Electronic Balance	MTW-30K	30*0.005Kg		2018/9/12	2019/9/12	
V	ML-550	Data Logger	313	15~35 ℃; 30~80 %RH	CENTER	2018/9/18	2019/9/18	
<b>T.2 Thermal Test</b>								
V	ML-789	Thermal Shock	GTST-080-65-AW	T:40 to 120℃	GF	2019/1/3	2020/1/3	
V	ML-257	Multimeter	HP 34401A	note 1	Agilent	2018/3/1	2019/3/1	
V	ML-494	Electronic Balance	XS1220M-SCS	1-1220 gf	CHUANHUA	2018/7/18	2019/7/18	
	ML-523	Electronic Balance	MTW-30K	30*0.005Kg		2018/9/12	2019/9/12	
V	ML-551	Data Logger	313	15~35 ℃; 30~80 %RH	CENTER	2018/9/18	2019/9/18	
<b>T.3 Vibration</b>								
V	ML-233	Vibration	KD-9636-EM-300F2K-30N80	F:5~2000Hz G:0.2~20G	King Design	2018/8/24	2019/8/24	
V	ML-257	Multimeter	HP 34401A	note 1	Agilent	2018/3/1	2019/3/1	
V	ML-494	Electronic Balance	XS1220M-SCS	1-1220 gf	CHUANHUA	2018/7/18	2019/7/18	
	ML-523	Electronic Balance	MTW-30K	30*0.005Kg		2018/9/12	2019/9/12	
V	ML-552	Data Logger	313	15~35 ℃; 30~80 %RH	CENTER	2018/9/18	2019/9/18	
<b>T.4 Shock</b>								
V	ML-056	Shock	DP-1200-25	G:10~600G	King Design	2018/8/24	2019/8/24	
V	ML-257	Multimeter	HP 34401A	note 1	Agilent	2018/3/1	2019/3/1	
V	ML-494	Electronic Balance	XS1220M-SCS	1-1220 gf	CHUANHUA	2018/7/18	2019/7/18	
	ML-523	Electronic Balance	MTW-30K	30*0.005Kg		2018/9/12	2019/9/12	
V	ML-551	Data Logger	313	15~35 ℃; 30~80 %RH	CENTER	2018/9/18	2019/9/18	
<b>T.5 External Short Circuit</b>								
V	ML-534	mΩ Hitester	3540	1mΩ ~ 30kΩ	HIOKI	2018/9/18	2019/9/18	
V	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2018/9/12	2019/9/12	
V	ML-460	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2018/9/12	2019/9/12	
V	ML-521	Oven	9031	30~80 ℃	YEOW LONG	2018/9/12	2019/9/12	
V	ML-549	Data Logger	313	15~35 ℃; 30~80 %RH	CENTER	2018/9/18	2019/9/18	
<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	2019/1/3	2020/1/3	
	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	2018/9/12	2019/9/12	

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Revised Date: 2019-02-26

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 °C; 30~80 %RH	CENTER	2018/9/18	2019/9/18	
	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150°C	Yokogawa	2018/9/12	2019/9/12	
	ML-460	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150°C	Yokogawa	2018/9/12	2019/9/12	
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 °C; 30~80 %RH	CENTER	2018/9/18	2019/9/18	
	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150°C	Yokogawa	2018/9/12	2019/9/12	
	ML-460	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150°C	Yokogawa	2018/9/12	2019/9/12	
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-1902004

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

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

Control Number: SLEU-1902004	Customer: Lenovo	Model Name: L18M4PE0	SMP Project Name: YogaC740-14
Pack P/N: 928QA281H (A)(B)	Configuration: 2S2P	Test Duration: 2019/01/28~2019/02/26	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: 2019/02/12 09:10	Ambient temp.: 21.9 °C								Operator: Mia	
Finish time: 2019/02/12 16:00	Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08		
OCV (V)	Before	8.463	8.504	8.497	8.501	8.473	8.482	8.469	8.494	
	After	8.453	8.499	8.490	8.492	8.461	8.477	8.460	8.488	
	Residual OCV %	99.88%	99.94%	99.92%	99.89%	99.86%	99.94%	99.89%	99.93%	
Mass (g)	Before	191.277	191.473	191.428	191.325	191.377	191.293	191.364	191.407	
	After	191.272	191.470	191.424	191.325	191.377	191.290	191.364	191.404	
	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	P	

#### T.2 Thermal Test

Start time: 2019/02/12 16:20	Ambient temp.: 22.1 °C								Operator: Mia	
Finish time: 2019/02/19 08:50	Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08		
OCV (V)	Before	8.453	8.499	8.490	8.492	8.461	8.477	8.460	8.488	
	After	8.363	8.404	8.403	8.403	8.370	8.384	8.371	8.393	
	Residual OCV %	98.94%	98.88%	98.98%	98.95%	98.92%	98.90%	98.95%	98.88%	
Mass (g)	Before	191.272	191.470	191.424	191.325	191.377	191.290	191.364	191.404	
	After	191.259	191.458	191.409	191.309	191.364	191.277	191.345	191.386	
	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	P	

#### T.3 Vibration

Start time: 2019/02/19 09:10	Ambient temp.: 22.3 °C								Operator: Mia	
Finish time: 2019/02/20 09:20	Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08		
OCV (V)	Before	8.363	8.404	8.403	8.403	8.370	8.384	8.371	8.393	
	After	8.348	8.391	8.386	8.391	8.355	8.371	8.354	8.377	
	Residual OCV %	99.82%	99.85%	99.80%	99.86%	99.82%	99.84%	99.80%	99.81%	
Mass (g)	Before	191.259	191.458	191.409	191.309	191.364	191.277	191.345	191.386	
	After	191.256	191.458	191.407	191.307	191.363	191.277	191.344	191.383	
	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	P	

#### T.4 Shock

Start time: 2019/02/20 09:40	Ambient temp.: 22.0 °C								Operator: Mia	
Finish time: 2019/02/20 13:30	Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08		
OCV (V)	Before	8.348	8.391	8.386	8.391	8.355	8.371	8.354	8.377	
	After	8.336	8.381	8.376	8.382	8.342	8.363	8.343	8.367	
	Residual OCV %	99.86%	99.88%	99.88%	99.89%	99.84%	99.90%	99.87%	99.88%	
Mass (g)	Before	191.256	191.458	191.407	191.307	191.363	191.277	191.344	191.383	
	After	191.256	191.454	191.406	191.305	191.363	191.274	191.343	191.381	
	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	P	

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**T.5 External Short Circuit**

Start time: 2019/02/20 13:50		Ambient temp.: 21.8 °C						Operator: Mia	
Finish time: 2019/02/21 09:30		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	8.336	8.381	8.376	8.382	8.342	8.363	8.343	8.367
	After	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Resistance (<100mΩ)		56.8	57.2	56.4	59.8	58.5	57.3	60.1	59.7
Max Temp. (< 170°C)		57.7	57.3	57.6	57.2	57.2	57.8	57.5	57.4
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: 2019/02/14 09:00		Ambient temp.: 22.0 °C				Operator: Mia	
Finish time: 2019/02/15 08:50		Sample 01C	Sample 02C	Sample 03C	Sample 04C	Sample 05C	
Initial OCV (V)		3.819	3.824	3.827	3.820	3.815	
Max Temp. (< 170°C)		24.5	24.1	23.9	23.7	24.2	
Results		P	P	P	P	P	

**T.7 Overcharge**

Start time: 2019/02/18 08:40		Ambient temp.: 22.2 °C						Operator: Mia	
Finish time: 2019/02/26 10:50		Sample 09	Sample 10	Sample 11	Sample 12	Sample 13	Sample 14	Sample 15	Sample 16
Initial OCV (V)		8.466	8.499	8.496	8.505	8.475	8.479	8.471	8.499
Results		P	P	P	P	P	P	P	P

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

Start time: 2019/02/15 09:10		Ambient temp.: 22.1 °C							Operator: Mia	
Finish time: 2019/02/23 10:50		Sample 06C	Sample 07C	Sample 08C	Sample 09C	Sample 10C	Sample 11C	Sample 12C	Sample 13C	
Initial OCV (V)		3.457	3.486	3.452	3.461	3.443	3.474	3.460	3.449	
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)		3.482	3.455	3.479	3.447	3.465	3.457	3.456	3.444	
Results		P	P	P	P	P	P	P	P	
Sample No.		Sample 22C	Sample 23C	Sample 24C	Sample 25C					
Initial OCV (V)		3.471	3.464	3.441	3.459					
Results		P	P	P	P					

**7. Test Sample:**



Form No. : W11-002-B04

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