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Control Number: SLEU-1901001

# 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: L18M6P90**

**Rating: 11.25V , Typical Capacity 8000mAh / 90Wh**

**Rated Capacity 7800mAh / 87.5Wh**

**Issue date: 2019/01/03**

Approved By	Checked By	Prepared By
<i>stiny sin</i>	<i>[Signature]</i>	<b>Kenny</b>

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Form No. : W11-002-B04

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### 1. Purpose of the Test :

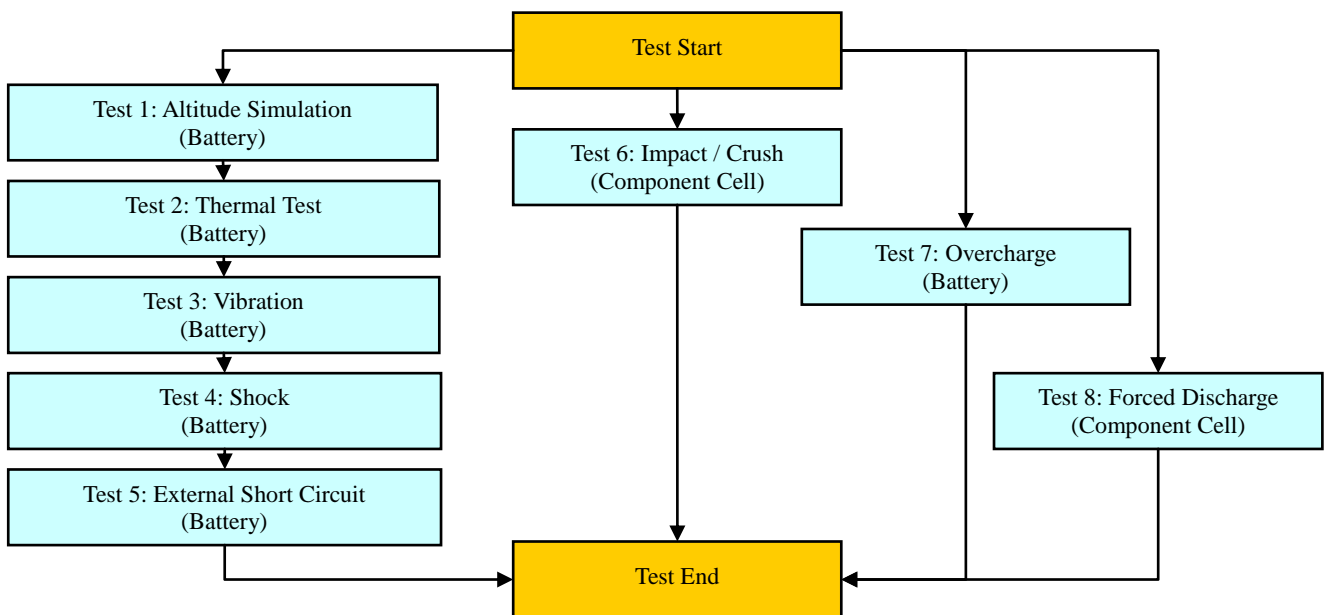
To test each cell/battery is of the type proved to meet the requirements in United Nations Recommendations on the TRANSPORT OF DANGEROUS GOODS, Manual of Tests and Criteria, Sixth revised edition, Section 38.3.

### 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-1901001

## 5. Test Equipment :

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Revised Date: 2019-01-03

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	
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	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	1-1220 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	
	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	
	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	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	2018/9/12	2019/9/12	

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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	2018/9/18	2019/9/18	
	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2018/9/12	2019/9/12	
	ML-460	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	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 ℃; 30~80 %RH	CENTER	2018/9/18	2019/9/18	
	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2018/9/12	2019/9/12	
	ML-460	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	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-1901001

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

### UN 38.3 Test Datasheet

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

Control Number: SLEU-1901001	Customer: Lenovo	Model Name: L18M6P90	SMP Project Name: P53
Pack P/N: 931QA125H (A)(B)	Configuration: 3S2P	Test Duration: 2018/12/03~2019/01/02	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: 2018/12/18 09:00	Ambient temp.: 21.8 °C								Operator: Kenny
Finish time: 2018/12/18 16:00	Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08	
OCV (V)	Before	12.531	12.518	12.522	12.519	12.527	12.530	12.524	12.520
	After	12.512	12.504	12.507	12.506	12.511	12.513	12.509	12.502
	Residual OCV %	99.85%	99.89%	99.88%	99.90%	99.87%	99.86%	99.88%	99.86%
Mass (g)	Before	393.904	394.943	394.628	393.951	394.276	394.829	393.988	394.182
	After	393.902	394.937	394.624	393.951	394.275	394.826	393.988	394.179
	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: 2018/12/18 16:20	Ambient temp.: 21.6 °C								Operator: Kenny
Finish time: 2018/12/25 08:50	Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08	
OCV (V)	Before	12.512	12.504	12.507	12.506	12.511	12.513	12.509	12.502
	After	12.369	12.366	12.372	12.375	12.377	12.377	12.378	12.368
	Residual OCV %	98.86%	98.90%	98.92%	98.95%	98.93%	98.91%	98.95%	98.93%
Mass (g)	Before	393.902	394.937	394.624	393.951	394.275	394.826	393.988	394.179
	After	393.878	394.915	394.601	393.927	394.252	394.805	393.963	394.156
	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: 2018/12/25 09:10	Ambient temp.: 22.0 °C								Operator: Kenny
Finish time: 2018/12/26 09:00	Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08.	
OCV (V)	Before	12.369	12.366	12.372	12.375	12.377	12.377	12.378	12.368
	After	12.356	12.353	12.353	12.358	12.361	12.359	12.359	12.353
	Residual OCV %	99.89%	99.89%	99.85%	99.86%	99.87%	99.85%	99.85%	99.88%
Mass (g)	Before	393.878	394.915	394.601	393.927	394.252	394.805	393.963	394.156
	After	393.873	394.909	394.601	393.925	394.251	394.802	393.960	394.154
	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: 2018/12/26 09:20	Ambient temp.: 22.1 °C								Operator: Kenny
Finish time: 2018/12/26 13:20	Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08	
OCV (V)	Before	12.356	12.353	12.353	12.358	12.361	12.359	12.359	12.353
	After	12.344	12.339	12.344	12.342	12.347	12.342	12.344	12.341
	Residual OCV %	99.90%	99.89%	99.93%	99.87%	99.88%	99.86%	99.88%	99.90%
Mass (g)	Before	393.873	394.909	394.601	393.925	394.251	394.802	393.960	394.154
	After	393.873	394.907	394.600	393.921	394.250	394.799	393.956	394.152
	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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**T.5 External Short Circuit**

Start time: 2018/12/26 13:40		Ambient temp.: 21.9 °C						Operator: Kenny	
Finish time: 2018/12/27 09:00		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	12.344	12.339	12.344	12.342	12.347	12.342	12.344	12.341
	After	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Resistance (<100mΩ)		58.1	56.4	59.5	56.9	57.3	58.7	60.4	59.8
Max Temp. (< 170°C)		57.6	57.6	57.3	57.8	57.4	57.2	57.9	57.7
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: 2018/12/22 09:00		Ambient temp.: 22.3 °C				Operator: Kenny	
Finish time: 2018/12/22 17:00		Sample 01C	Sample 02C	Sample 03C	Sample 04C	Sample 05C	
Initial OCV (V)		3.718	3.705	3.712	3.711	3.709	
Max Temp. (< 170°C)		23.7	24.1	23.8	24.0	24.2	
Results		P	P	P	P	P	

**T.7 Overcharge**

Start time: 2018/12/25 10:00		Ambient temp.: 21.9 °C						Operator: Kenny	
Finish time: 2019/01/02 13:00		Sample 09	Sample 10	Sample 11	Sample 12	Sample 13	Sample 14	Sample 15	Sample 16
Initial OCV (V)		12.528	12.523	12.520	12.520	12.523	12.527	12.526	12.523
Results		P	P	P	P	P	P	P	P

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

Start time: 2018/12/24 09:00		Ambient temp.: 22.0 °C								Operator: Kenny	
Finish time: 2019/01/02 08:50		Sample 06C	Sample 07C	Sample 08C	Sample 09C	Sample 10C	Sample 11C	Sample 12C	Sample 13C	Sample 14C	Sample 15C
Initial OCV (V)		3.473	3.434	3.446	3.437	3.461	3.477	3.450	3.431	Sample 16C	Sample 17C
Results		P	P	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	Sample 22C	Sample 23C
Initial OCV (V)		3.468	3.457	3.455	3.475	3.440	3.472	3.439	3.444	Sample 24C	Sample 25C
Results		P	P	P	P	P	P	P	P	P	P
Sample No.		Sample 22C	Sample 23C	Sample 24C	Sample 25C						
Initial OCV (V)		3.463	3.435	3.453	3.448						
Results		P	P	P	P						

**7. Test Sample:**



Form No. : W11-002-B04

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