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: L18M3PF8
Rating: 11.4V, Typical Capacity 4610mAh/ 52.5Wh
Rated Capacity 4480mAh/ 51Wh
Issue date: 2018/09/25

Approved By	Checked By	Prepared By

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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.

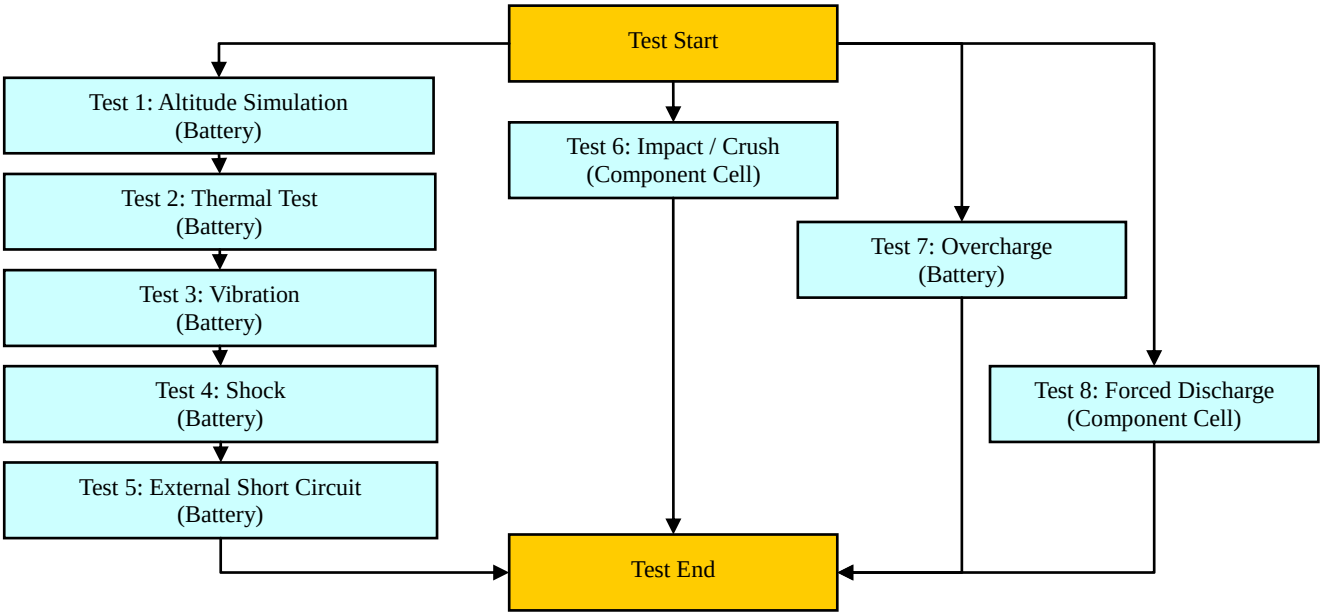
2. Test Quantity：

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≦M≦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℃.

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℃.

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.

5. Test Equipment：

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Revised Date: 2018-09-25

Test Instruments Reference List

Used	Instrument ID	Instrument Name	Type	Range of use	Manufacturer	Calibration Date_Last	Calibration Date_Next	Remarks
	Pretest							
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	
	T.1 Altitude Simulation							
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	
	T.2 Thermal Test							
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	
	T.3 Vibration							
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	
	T.4 Shock							
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	
	T.5 External Short Circuit							
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	
	T.6 Impact / Crush							
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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Revised Date: 2018-09-25

Test Instruments Reference List

Used	Instrument ID	Instrument Name	Type	Range of use	Manufacturer	Calibration Date_Last	Calibration Date_Next	Remarks
	T.7 Overcharge							
	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	
	T.8 Forced Discharge							
	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.

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

UN 38.3 Test Datasheet

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

Control Number: SLEU-1809008	Customer: Lenovo	Model Name: L18M3PF8	SMP Project Name: S540-3T
Pack P/N: 928QA262H (A)(B)	Configuration: 3S1P	Test Duration: 2018/08/23~2018/09/21	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: 2018/09/07 08:40						Ambient temp.: 23.8 ℃		Operator: Mia	
Finish time: 2018/09/07 16:00		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	12.583	12.579	12.573	12.575	12.587	12.585	12.576	12.591
	After	12.579	12.576	12.567	12.573	12.581	12.581	12.573	12.585
	Residual OCV %	99.97%	99.98%	99.95%	99.98%	99.95%	99.97%	99.98%	99.95%
Mass (g)	Before	218.325	218.610	218.462	218.382	218.605	218.574	218.592	218.433
	After	218.322	218.610	218.462	218.379	218.602	218.573	218.590	218.432
	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: 2018/09/10 09:10						Ambient temp.: 23.8 ℃		Operator: Mia	
Finish time: 2018/09/17 09:10		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	12.556	12.554	12.539	12.549	12.556	12.559	12.549	12.562
	After	12.422	12.426	12.407	12.406	12.414	12.423	12.402	12.429
	Residual OCV %	98.93%	98.98%	98.95%	98.86%	98.87%	98.92%	98.83%	98.94%
Mass (g)	Before	218.322	218.610	218.462	218.379	218.602	218.573	218.590	218.432
	After	218.302	218.601	218.437	218.358	218.584	218.557	218.562	218.416
	Mass loss %	0.01%	0.00%	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: 2018/09/17 09:30						Ambient temp.: 24.0 ℃		Operator: Mia	
Finish time: 2018/09/18 07:50		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08.
OCV (V)	Before	12.422	12.426	12.407	12.406	12.414	12.423	12.402	12.429
	After	12.407	12.418	12.393	12.400	12.401	12.406	12.384	12.413
	Residual OCV %	99.88%	99.94%	99.89%	99.95%	99.90%	99.86%	99.85%	99.87%
Mass (g)	Before	218.302	218.601	218.437	218.358	218.584	218.557	218.562	218.416
	After	218.302	218.601	218.434	218.357	218.583	218.557	218.562	218.412
	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: 2018/09/18 08:10						Ambient temp.: 23.7 ℃		Operator: Mia	
Finish time: 2018/09/18 13:00		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	12.407	12.418	12.393	12.400	12.401	12.406	12.384	12.413
	After	12.406	12.416	12.388	12.396	12.396	12.403	12.378	12.409
	Residual OCV %	99.99%	99.98%	99.96%	99.97%	99.96%	99.98%	99.95%	99.97%
Mass (g)	Before	218.302	218.601	218.434	218.357	218.583	218.557	218.562	218.412
	After	218.302	218.601	218.430	218.354	218.581	218.553	218.561	218.412
	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.5 External Short Circuit

Start time: 2018/09/18 13:20						Ambient temp.: 23.8 ℃		Operator: Mia	
Finish time: 2018/09/19 09:20		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	12.406	12.416	12.388	12.396	12.396	12.403	12.378	12.409
	After	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Resistance (<100mΩ)		58.4	58.6	57.2	59.7	60.5	59.3	57.8	56.8
Max Temp. (< 170℃)		57.9	57.6	57.7	57.8	57.3	57.5	57.6	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: 2018/09/10 09:30			Ambient temp.: 23.7 ℃		Operator: Mia
Finish time: 2018/09/11 10:00	Sample 01C	Sample 02C	Sample 03C	Sample 04C	Sample 05C
Initial OCV (V)	3.755	3.741	3.743	3.757	3.748
Max Temp. (< 170℃)	24.1	23.6	23.9	24.0	23.8
Results	P	P	P	P	P

T.7 Overcharge

Start time: 2018/09/11 10:20					Ambient temp.: 23.9 ℃		Operator: Mia	
Finish time: 2018/09/19 09:10	Sample 09	Sample 10	Sample 11	Sample 12	Sample 13	Sample 14	Sample 15	Sample 16
Initial OCV (V)	12.586	12.578	12.574	12.572	12.591	12.582	12.574	12.593
Results	P	P	P	P	P	P	P	P

T.8 Forced Discharge (Component Cell)

Start time: 2018/09/13 09:10					Ambient temp.: 23.8 ℃		Operator: Mia	
Finish time: 2018/09/21 14:30	Sample 06C	Sample 07C	Sample 08C	Sample 09C	Sample 10C	Sample 11C	Sample 12C	Sample 13C
Initial OCV (V)	3.483	3.457	3.453	3.468	3.470	3.436	3.425	3.473
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)	3.477	3.489	3.492	3.464	3.451	3.445	3.466	3.475
Results	P	P	P	P	P	P	P	P
Sample No.	Sample 22C	Sample 23C	Sample 24C	Sample 25C				
Initial OCV (V)	3.485	3.462	3.493	3.441				
Results	P	P	P	P				

7. Test Sample: